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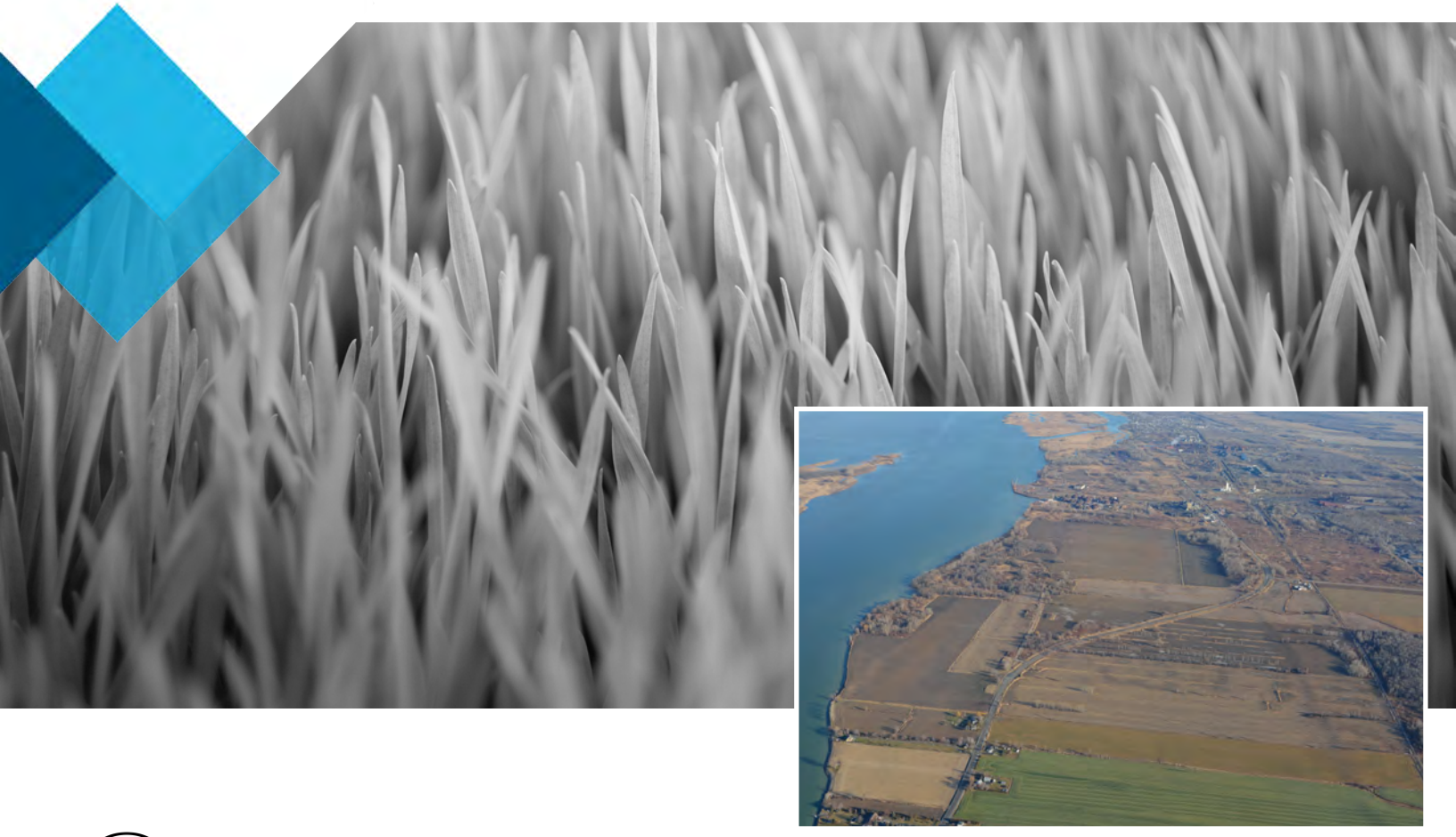
SNC·LAVALIN

Agrandissement du terminal portuaire de Contrecœur

Étude d'impact environnemental

Volume 3 - Études sectorielles - TOME 4

Administration portuaire de Montréal



Environnement et géosciences

Septembre | 2017

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Agrandissement du terminal portuaire de Contrecœur

Étude d'impact environnemental

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Administration portuaire de Montréal
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Étude sectorielle No. 25

Identification d’options pour le dragage et la disposition des sédiments
dans le cadre du projet de développement d’un terminal à conteneurs à Contrecœur



Port de Montréal Port of Montreal

IDENTIFICATION D'OPTIONS POUR LE DRAGAGE ET LA DISPOSITION DES SÉDIMENTS DANS LE CADRE DU PROJET DE DÉVELOPPEMENT D'UN TERMINAL À CONTENEURS À CONTRECOEUR



Présenté à
L'Administration portuaire de Montréal
Projet : 11527

Rapport final

Octobre 2012

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Note au lecteur :

Le présent document constitue le rapport préliminaire des travaux d'élaboration des options de dragage et de mise en dépôt dans le cadre du projet de développement d'un terminal à conteneurs à Contrecoeur. Il permet au lecteur de prendre connaissance des orientations prises et des voies de solution explorées.

Plusieurs détails techniques ou d'ordre financier sont fournis à titre privilégié. Les organismes et entrepreneurs qui ont bien voulu fournir ces informations s'attendent à ce que celles-ci demeurent confidentielles. Par ailleurs, les coûts présentés dans le présent document le sont à titre informel et n'ont aucune valeur en termes d'obligation de la part des compagnies. Ils sont uniquement fournis pour donner un ordre de grandeur.

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1 Introduction

L'Administration portuaire de Montréal (APM) désire aménager des terminaux à conteneurs sur sa propriété de Contrecœur située à environ 40 km en aval des installations actuelles sur l'île de Montréal. Cette réserve foncière a une superficie d'un peu plus de 468 hectares (Figure 1).

Un plan directeur a été préparé en 2010 par l'APM et l'emplacement de la future ligne de quai a été déterminé dans le cadre de ce plan. Ultimement, l'aire de manutention des conteneurs pourra accueillir plus de 3,6 millions de conteneurs par année. À cet effet, il est prévu de construire environ 2 600 mètres linéaires de nouveaux quais comprenant 6 postes à quai dédiés aux porte-conteneurs. Les autres composantes du projet sont : l'aménagement d'une cour ferroviaire, l'aménagement d'un portail d'entrée et de sortie des camions, l'aménagement de la structure de chaussée (fondation et pavage), la mise en place des infrastructures pour un système d'éclairage, de drainage, d'aqueduc, de protection incendie, d'une sous-station électrique, d'un réseau de sécurité de même que les bâtiments nécessaires à l'opération d'un terminal à conteneurs. Le projet est inscrit sur le Registre canadien d'évaluation environnementale sous le numéro de référence : 11-01-63731 (http://www.ceaa.gc.ca/050/details-fra.cfm?evaluation=63731).

La première phase des travaux sera limitée à la construction de 2 postes à quai dédiés aux porte-conteneur. Ces aménagements permettront d'accueillir 1,1 millions de conteneurs par année (Figure 2).

Suite à la réalisation d'une étude géotechnique complémentaire et d'une caractérisation environnementale des sédiments en place devant être dragués, au cours de la phase I, l'APM souhaite maintenant amorcer une réflexion concernant les différentes options qui peuvent être envisagées pour le dragage et la disposition de ces sédiments. Cette activité constitue une première étape menant à la préparation d'une étude d'impact environnementale pour le projet.

La sélection des modes d'intervention tiendra compte des potentiels et des contraintes liés au site et à son environnement immédiat. De plus, le dragage et la disposition des sédiments seront évalués selon une gestion efficace et conforme, de façon à minimiser les risques environnementaux et à inscrire ces actions dans la perspective d'un développement durable.

2 Contexte

2.1 Objectifs et plans des travaux prévus

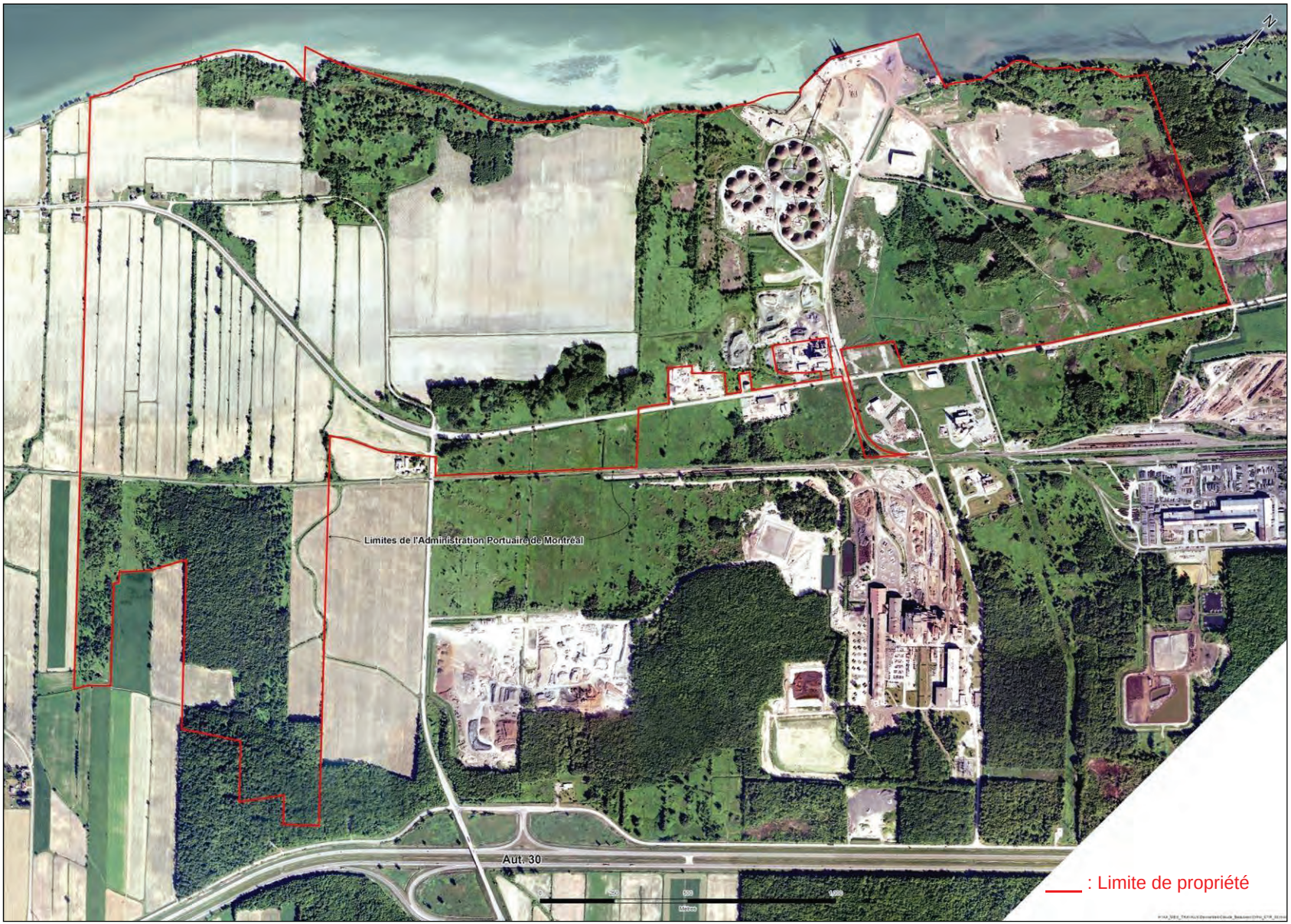
L'aménagement de la phase I comprend la construction 2 postes à quai dédiés aux porte-conteneurs. Ces travaux représentent 675 m de ligne de quai à construire et permettront d'accueillir 1,1 millions de conteneurs par année.

Tel qu'illustré à la Figure 3, la construction de ces postes à quai implique le remblayage dans le fleuve d'une superficie de 212 512 m² ainsi qu'une zone de dragage évaluée à 324 627 m².

Cette dernière superficie représente un volume de 873 000 m³[1] de sédiments à draguer qui a été déterminé selon les relevés bathymétriques et la profondeur de dragage visée afin de permettre l'accessibilité à la voie navigable et une zone de manœuvre sécuritaire devant les installations portuaires.

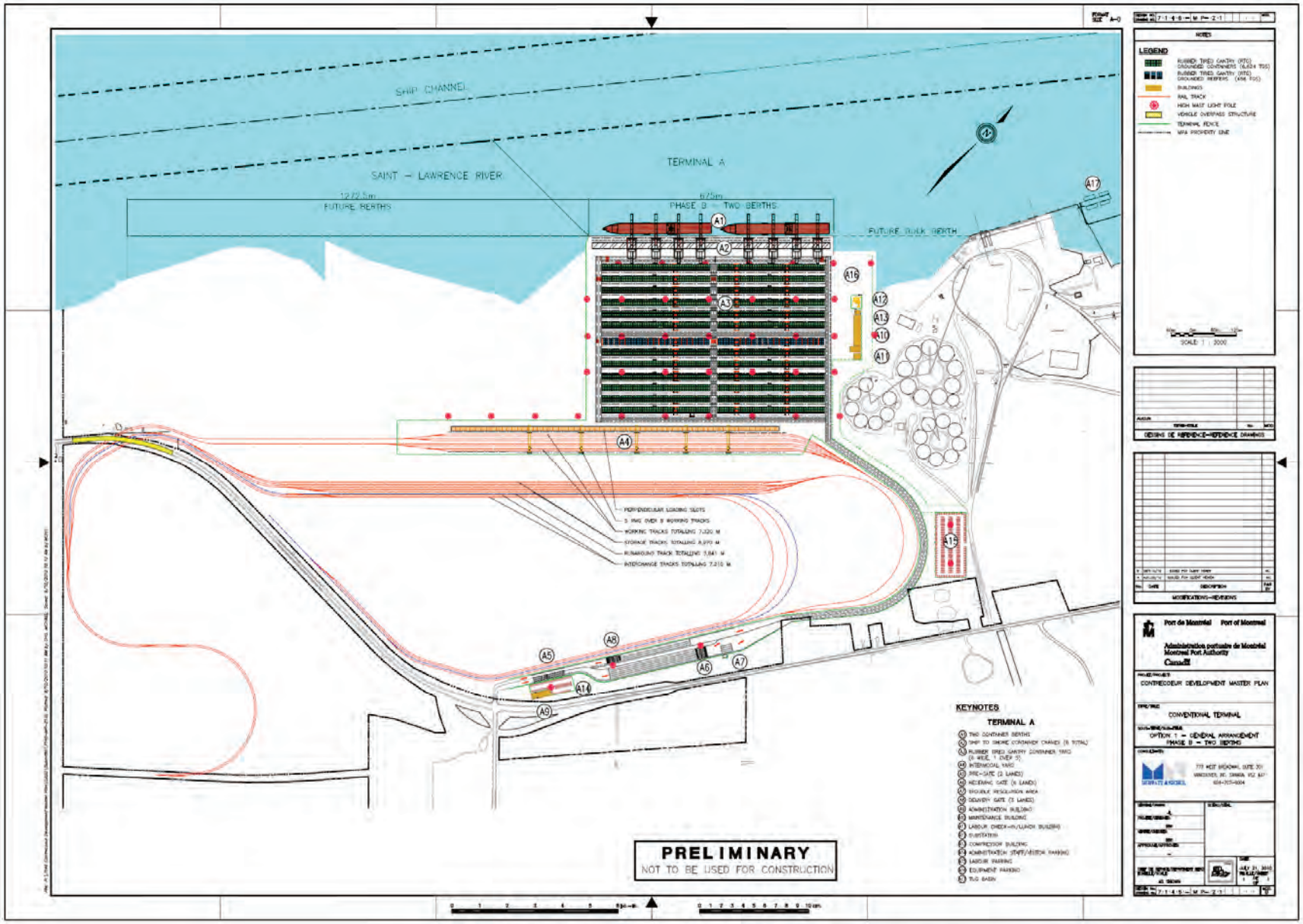
Dans le cadre des travaux de construction, l'APM devra gérer la disposition des matériaux de dragage.

[1] Bien que le volume de sédiments à draguer soit estimé à 873 000 m³, pour les fins de calcul de la présente étude, un volume de 1 000 000 m³ a été considéré.



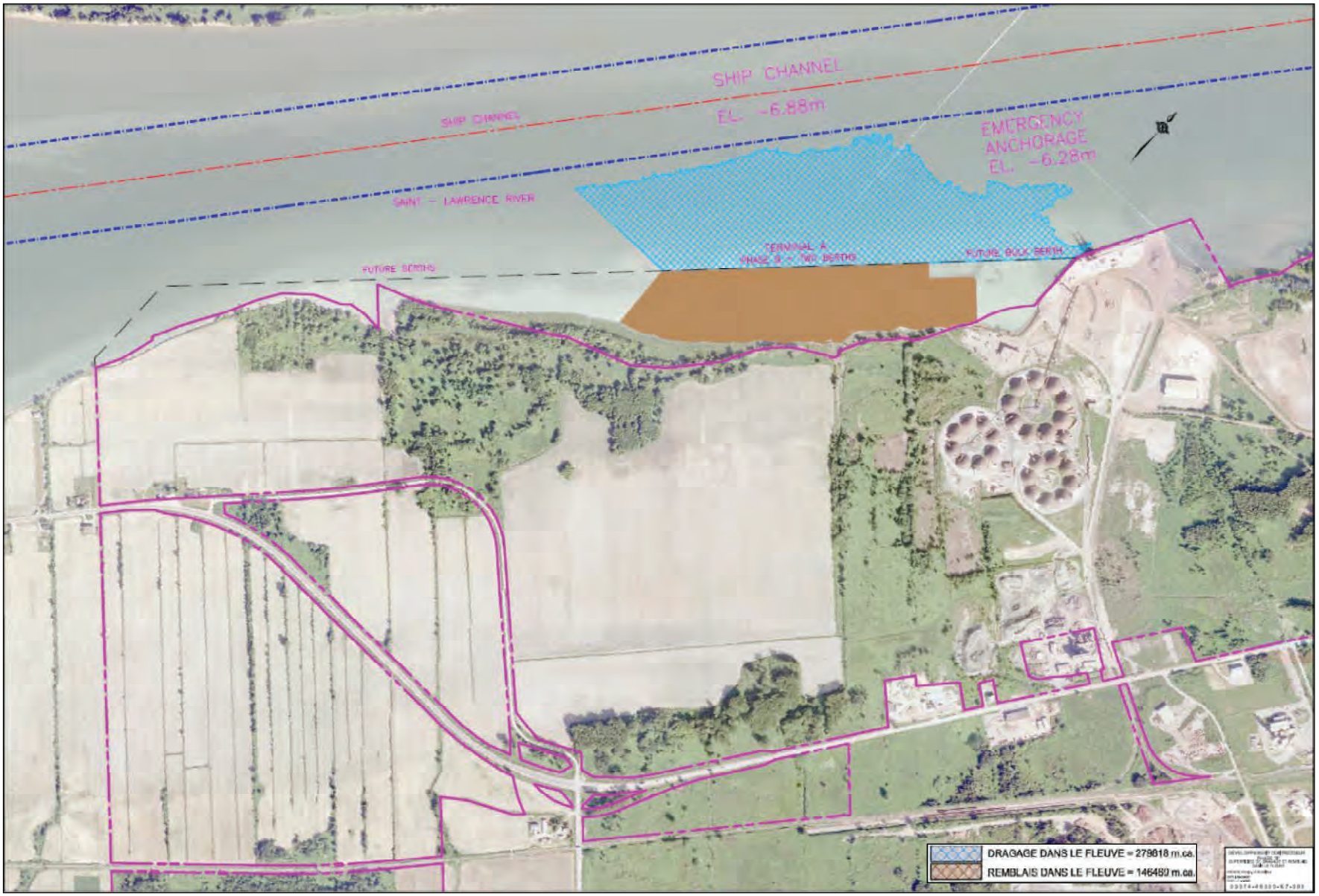
Source : APM, 2011.

Figure 1 Limites de la propriété de l'Administration Portuaire de Montréal à Contrecoeur



Source, APM, 2011.

Figure 2 Aménagement de la première phase



Source, APM, 2011.

Figure 3 Superficies couvertes par les travaux de dragage et de remblayage

2.2 Caractéristiques du matériel à gérer

L'approfondissement des nouveaux postes à quai et des aires de manœuvre entre le chenal de navigation et les postes à quai occasionnera le dragage d'environ 1 000 000 m³ de matériaux. Afin d'évaluer les options de dragage et de gestion de ces matériaux, il est important de prendre en compte leur nature physique ainsi que leur qualité chimique.

La ligne des futurs quais se trouve à la limite nord d'une aire à pente douce recouverte d'un horizon alluvionnaire composé de sable et de silt. Cet horizon, d'une épaisseur de 0,9 m à 3,5 m, repose sur une couche d'argile silteuse raide atteignant une profondeur d'environ 16 m sous le niveau de l'eau (Inspec-Sol, 2012). Le dragage garantira une profondeur d'eau de 11,3 m : il n'atteindra pas le till ni le roc retrouvé sous cette argile.

Juste au nord de la ligne de quai proposée, en direction du chenal, la pente du fond fluvial s'accentue et le fond est plus affecté par les processus d'érosion. À ce niveau, à une profondeur d'eau de 1 m à 9 m par rapport au zéro des cartes, le fond est recouvert d'une fine couche de sable avec un peu de gravier en surface (CJB Environnement, 2011). De plus, les carottes prélevées en 2011 (Inspec-Sol, 2012) ont permis d'observer que le premier mètre était constitué d'argile silteuse mélangée avec des couches de gravier et de sable. Sous cette couche, se retrouve l'argile silteuse raide. À partir d'une profondeur d'eau de 9 m, la pente du fond s'adoucit jusqu'à la limite du chenal de navigation. Le fond, fortement érodé par les courants à ces profondeurs, est constitué d'une petite couche de gravier et de sable directement sur l'argile silteuse raide (CJB Environnement, 2011; Inspec-Sol, 2012).

La description du fond donnée dans les deux paragraphes précédents est valable pour les secteurs n'ayant jamais été remaniés. Cependant, la partie la plus à l'est de l'aire qui devra être draguée se trouve à l'intérieur d'une zone ayant déjà été approfondie pour créer l'accès au terminal actuellement présent sur le site de Contrecœur. Dans cette zone, du silt argileux lâche recouvre le fond à proximité des quais actuels et du sable est retrouvé à des distances plus grandes de la rive.

Pour les fins de l'analyse des options de dragage et de gestion des déblais de dragage, il est considéré que quatre grands types de matériaux seront dragués :

1. Les sables et sables silteux retrouvés à la surface près de la ligne du futur quai et près des aires de manœuvres du terminal existant;
2. Les argiles silteuses raides retrouvées sous les autres matériaux;
3. La couche d'argile silteuse mélangée avec des couches de gravier et de sable retrouvée dans le premier mètre dans la pente plus abrupte juste au large de la future ligne de quai;
4. Les silts argileux lâches retrouvés en surface, à l'est, près du quai existant.

2.2.1 Volumes des différents types de matériaux à draguer

La détermination de la proportion de chacun des quatre types de matériaux à draguer a été réalisée en élaborant des coupes transversales perpendiculaires à la rive à 4 endroits, soit vis-à-vis chacun des trois forages réalisés en 2011 (Inspec-Sol, 2012) de même qu'à un point un plus à l'est, près du point d'échantillonnage SED-13 (Figure 4).

Pour chacune de ces coupes, il a été considéré que les sédiments en surface sont constitués de sables silteux (matériel de type 1) jusqu'à la profondeur indiquée par le forage le plus rapproché. Pour la partie de la coupe où la surface du fond se trouve sous le niveau inférieur du sable, il a été considéré que le premier mètre était constitué d'un mélange d'argile silteuse, de gravier et de sable (matériel de type 3) jusqu'à une profondeur de 9 m par rapport au zéro des cartes. Il a ensuite été considéré que le restant du matériel est constitué d'argile silteuse raide (matériel de type 2). Les proportions ont été déterminées en supposant que le dragage serait effectué jusqu'à une profondeur de 11,6 m, afin de garantir une profondeur de 11,3 m aux navires (Figure 5).

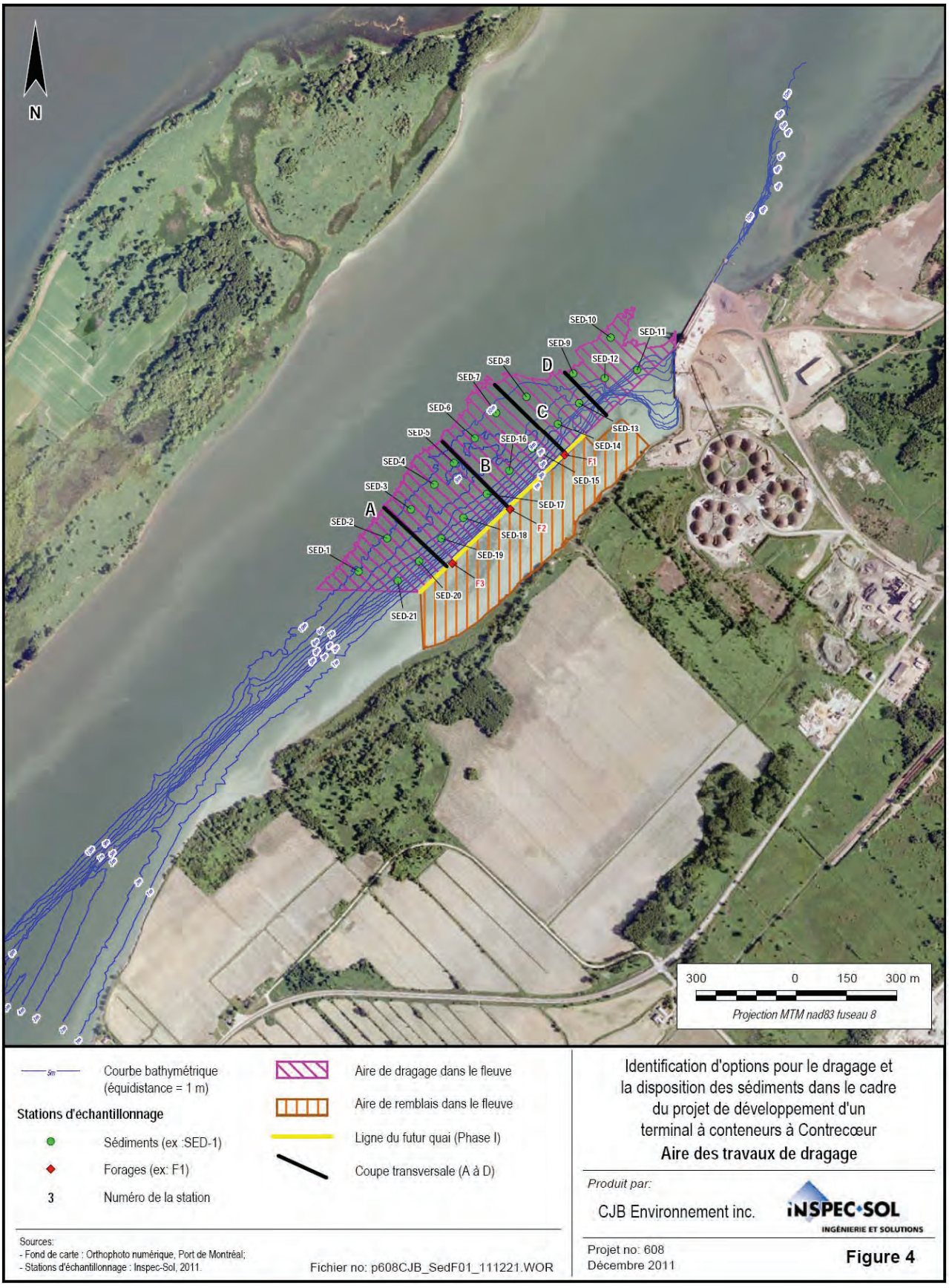


Figure 4 Aire des travaux de dragage

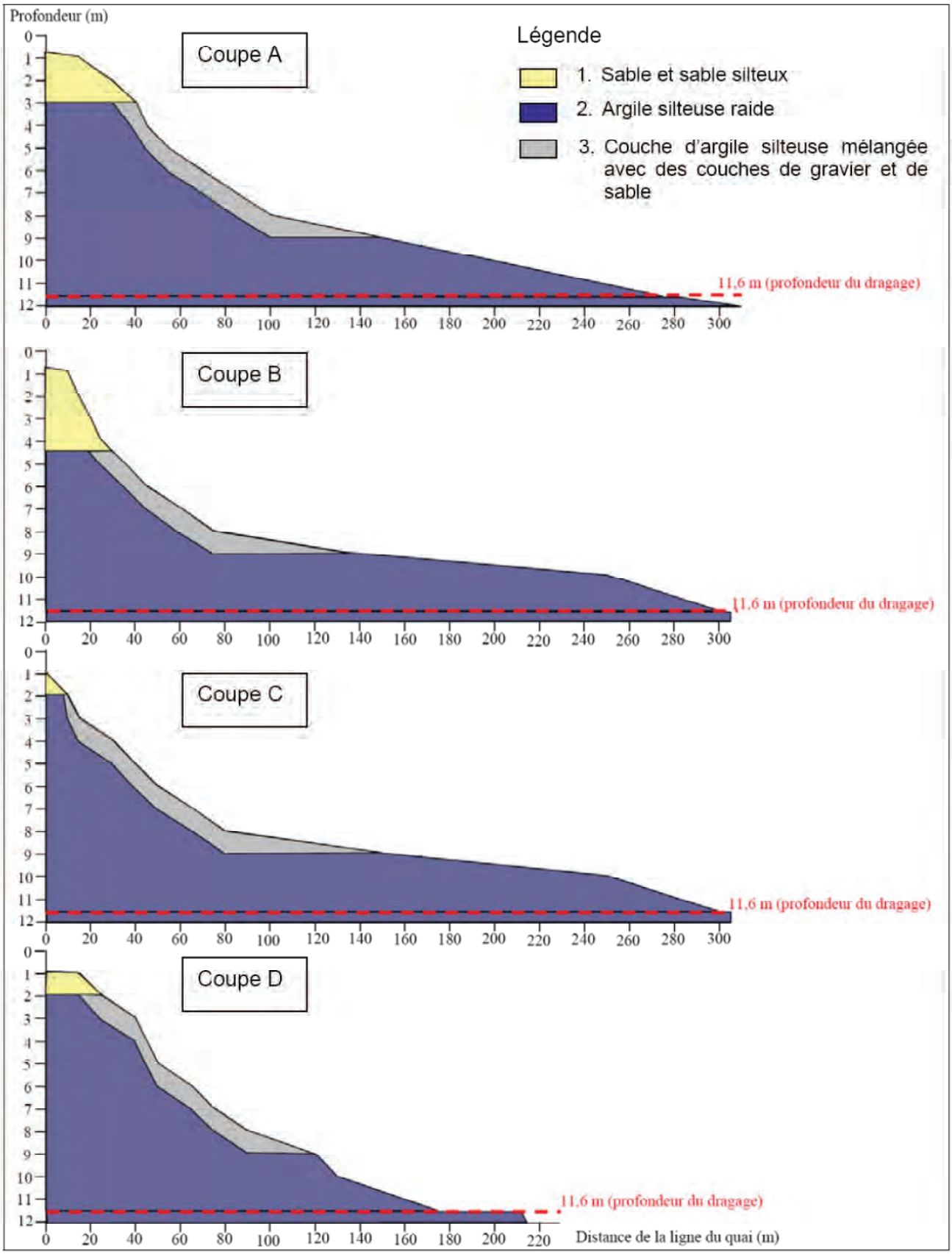


Figure 5 Coupes transversales perpendiculaires à la rive

En ce qui concerne le secteur le plus à l'est, soit le premier 150 m de la zone de dragage à partir du quai actuel, il a été considéré que la première partie de 50 m à partir de la ligne du quai vers le large est recouverte de 1 m de silt argileux (matériel de type 4), que la zone située de 50 à 200 m plus au large est recouverte de 0,5 m de sable (matériel de type 1) et que, sous ces couches, se retrouve l'argile silteuse raide (matériel de type 2).

À partir de ces estimations, les proportions des différents types de matériaux ont été établies ainsi : 5 % de sable ou sable silteux (type 1), 85 % d'argile silteuse raide (type 2), 9 % d'argile silteuse mélangée avec des couches de gravier et de sable (type 3) et 1 % de silt argileux lâche (type 4). En supposant un volume total de 1 000 000 m³, ceci correspond respectivement à 50 000 m³, 850 000 m³, 90 000 m³ et 10 000 m³.

2.2.2 Caractéristiques physiques des différents types de matériaux à draguer

Les sables à draguer (matériel de type 1) viennent de deux secteurs ayant des caractéristiques un peu différentes. Environ trois quart du volume provient du secteur près de la ligne du futur quai et est constitué à part égale de sable fin et de silt (voir échantillons F1-TM1, F2-TM1, F2-TM4 et F3-TM1, Annexe 1). Le sable provenant de l'aire de manœuvre du terminal existant (échantillons SED-9 et SED-10, Annexe 1) est plus grossier, comprenant peu de silt et incluant une petite quantité de gravier.

L'argile silteuse raide (matériel de type 2), retrouvée en profondeur dans les forages, est constituée de 78 % à 85 % d'argile avec 15 % à 22 % de silt. Dans les échantillons de surface (0 m à 0,15 m), prélevés à plus grande profondeur d'eau (SED-1 à SED-7, Annexe 1), l'argile silteuse est accompagnée de 1 % à 17 % de sable et jusqu'à 7 % de gravier. Ces particules plus grossières proviennent probablement de matériaux retrouvés en surface et correspondent donc à une proportion encore plus faible du matériel qui sera dragué dans les secteurs échantillonnés, puisque la profondeur draguée, même lors d'une première passe de la drague, sera plus grande que la profondeur échantillonnée.

Le matériel de type 3 est constitué d'un mélange variable de gravier, de sable et de sédiments fins (silt et argile). De façon générale, le gravier, le sable et les sédiments fins sont présents en parts relativement égales. Les proportions de ces trois composantes dans les carottes prélevées en 2011 (voir Annexe 1) varient de 1 % à 40 % pour le gravier, de 9 % à 70 % pour les sables et de 16 % à 91 % pour les sédiments fins.

En ce qui concerne le 4^{e} type de matériel, il consiste en un silt argileux ayant une consistance molle. Cependant, l'échantillon SED-12 comporte une grande proportion de sable, et peut être vu comme une transition entre les sédiments fins retrouvés dans l'échantillon SED-11 et les sables retrouvés à SED-9 et SED-10 (Annexe 1).

2.2.3 Qualité chimique des différents types de matériaux à draguer

Les matériaux à draguer pour créer le nouveau terminal à Contrecœur présentent très peu de signes de contamination. Les seuls indices de contamination sont la présence très ponctuelle de petites quantités de certains contaminants organiques. Cependant, la majorité des sédiments à draguer est constituée d'argiles ayant des teneurs naturelles en certains métaux plus élevées que ce qui est retrouvé dans les autres sols naturels de la région (tel que défini comme teneurs de fond (critère A), pour les métaux et les métalloïdes, selon la *Politique de protection des sols et de réhabilitation des terrains contaminés* (MEF, 1998)).

Les sédiments sableux (matériel de type 1) échantillonnés en 2011 (Inspec-Sol, 2012) ne présentent aucune contamination ni dépassement de la concentration d'effets occasionnels (CEO) selon les critères en vigueur pour l'évaluation de la qualité des sédiments d'eau douce au Québec (EC & MDDEP, 2007) ou du critère A de la *Politique de protection des sols et de réhabilitation des terrains contaminés* (MEF, 1998).

La majorité des échantillons d'argile silteuse raide (matériel de type 2) dépassent le critère A pour le cuivre. De plus, quatre des cinq échantillons prélevés en profondeur (Inspec-Sol, 2012) dépassent le critère A et la CEO pour le chrome et le nickel (Annexe 1). Cependant, il faut noter que les teneurs en chrome, en cuivre et en nickel sont naturellement plus élevées dans les argiles postglaciaires (EC & MDDEP, 2007) et que les teneurs mesurées en profondeur ne peuvent pas être associées à une contamination anthropique. Ces mesures doivent donc être considérées comme représentatives des teneurs naturelles du site. Les teneurs plus faibles observées dans les échantillons de surface sont probablement liées à des apports d'autres types de sédiments, moins enrichis en métaux, se déposant à la surface des argiles. Des hydrocarbures aromatiques polycycliques (HAP) ont été détectés dans deux échantillons et le méthyl-2 naphtalène dépassait légèrement le critère A dans un de ceux-ci (avec 0,11 mg/kg alors que le critère « A » des sols du MDDEP est de 0,1 mg/kg, Annexe 1).

La majorité des échantillons prélevés par Inspec-Sol (2012) dans le matériel de type 3 (mélange d'argile silteuse, de sable et de gravier) ne présente aucun dépassement du critère A ou de la CEO. Les échantillons prélevés au point d'échantillonnage SED-14 dépassent légèrement le critère A pour le cuivre. Cette teneur plus élevée en cuivre provient sûrement des argiles postglaciaires, qui doivent être moins altérées par d'autres types de sédiments en surface à cet endroit, tel qu'indiqué par la granulométrie (Annexe 1).

Le seul dépassement des critères applicables observés dans les silts argileux près des installations portuaires actuelles (matériel de type 4) est un dépassement du critère A pour le zinc. La teneur en question étant inférieure au 90^{e} centile pour le zinc dans les argiles postglaciaires (EC & MDDEP, 2007), il est permis de croire qu'elle soit d'origine naturelle.

3 Identification des méthodes de dragage

3.1 Dragues mécaniques

Les dragues mécaniques sont utilisées aussi bien pour les matériaux durs que pour les matériaux meubles. Elles retirent les sédiments par application directe d'une force mécanique sur le fond. Un des grands avantages de ce type de drague réside dans le fait que les sédiments dragués conservent pratiquement la densité qu'ils avaient alors qu'ils étaient en place, ce qui réduit la quantité d'eau recueillie au moment de l'excavation. Elles peuvent également être opérées et manœuvrées dans des zones restreintes et confinées. Elles sont généralement bien adaptées pour des travaux qui impliquent des volumes relativement réduits.

Il existe plusieurs types de dragues mécaniques, dont la drague à benne preneuse, la drague à cuiller et la drague rétrocaveuse. Un bref descriptif de ces dragues est présenté dans les sections qui suivent. Toutes ces dragues sont aptes à excaver les matériaux visés par les travaux, selon les profondeurs et les conditions de navigation qui seront rencontrées. Elles sont donc toutes retenues comme option potentielle de dragage. De plus, elles produisent toutes des déblais de dragage ayant des caractéristiques semblables. Le choix du type précis de drague mécanique n'aura donc pas d'incidence sur le choix de l'option de gestion des sédiments dragués. Aucune tentative de choisir entre ces types de dragues mécaniques n'est donc faite ici. En effet, étant donné la grande quantité de sédiments à draguer, le choix final d'une drague mécanique risquerait d'être fait davantage sur la base de la capacité et du rendement des dragues disponibles que sur le type de mécanisme utilisé pour creuser.

3.1.1 Drague à benne preneuse

Ce sont des engins flottants qui peuvent être automoteurs ou manœuvrés par des remorqueurs. L'engin mouillé sur ses ancres ou sur des points d'amarrage travaille sur point fixe. Il peut être équipé de puits à clapets dans lesquels sont déversés les déblais mais le plus souvent, il est utilisé en tandem avec des chalands ou des barges. Ces dragues sont montées sur une grue et sont utilisées pour extraire des sédiments fins consolidés, des sables et des graviers. La benne descend jusqu'au fond en position ouverte et pénètre dans les matériaux à draguer sous l'effet de son poids et de l'action du mécanisme de fermeture. Après la remontée, les déblais de dragage sont déchargés en relâchant le filin fermant la benne. Le rendement moyen de la drague à benne preneuse est d'environ 30 mètres cubes/heure (m^3/h) et peut atteindre le triple et même plus selon que la couche de matériau à enlever est épaisse, que le dragage n'exige pas de repositionnements fréquents, que le matériau se prête bien à l'excavation ou qu'il s'agisse d'une drague ayant une benne de haute capacité. Le rendement dépend aussi de la profondeur de dragage qui reste limitée à environ 20 m. Au-delà de cette profondeur, la durée de descente et de remontée de la benne fait rechuter le rendement.

Les dragues à benne preneuse sont des engins peu encombrants et relativement précis qui s'adaptent bien aux opérations en eau agitée, car ils n'ont pas de liaison rigide avec le fond. Elles sont toutefois limitées par des conditions de vagues et de houle plus sévères. En raison de leur précision, elles sont plus particulièrement intéressantes pour les travaux à proximité des quais, dans les bassins étroits ou les darses.

Lors d'un dragage à l'aide d'une benne preneuse, une mise en suspension dans la colonne d'eau peut être attribuée au niveau de la benne et occasionnée par la surverse des chalands. Il est aussi possible de diminuer la remise en suspension lors de l'opération d'une drague à benne preneuse en utilisant une benne étanche et par l'application de certaines bonnes pratiques d'opération telles qu'en réduisant les vitesses de descente et de remontée de la benne et en évitant la surcharge des barges (Robert Hamelin et Associés inc., 1997). Il est permis de croire que les pertes de matériel sont relativement beaucoup plus faibles lorsque la drague opère dans un matériau cohésif comme

les argiles raides qui forment la grande partie des matériaux à draguer dans le cadre du présent projet.

Le rendement de ce type de drague varie selon le type de matériel dragué. Lorsqu'elle travaille dans des argiles, tel que sera le cas pour la majorité des matériaux à draguer à Contrecœur, la drague à benne preneuse peut minimiser la perturbation et la dilution des argiles en comparaison avec les dragues hydrauliques (PIANC, 2009). Cependant, elle peut causer des turbidités élevées lors du dragage de silts lâches (PIANC, 2009).

3.1.2 Drague à cuiller

La drague à cuiller est essentiellement une pelle mécanique montée sur un ponton. Elle est souvent utilisée pour l'extraction de roches tendres brisées et pour l'excavation de dépôts sédimentaires denses immergés. Elle est également utilisée pour des travaux en eaux peu profondes ou encore pour des travaux lourds tels que l'élimination d'anciennes structures. Dans les matériaux où d'autres types de drague peuvent opérer assez facilement, le rendement de la drague à cuiller est comparativement faible. Le dragage avec ce type d'équipement est difficile par mauvais temps et les pertes de matériaux fins sont importantes lors de la remontée du godet. En raison de sa construction, la profondeur de dragage maximale ne dépassera généralement pas 12 m. La capacité des godets est variable et le rythme de travail est de l'ordre de 30 à 60 cycles par heure (Centre Saint-Laurent, 1992).

3.1.3 Drague rétrocaveuse

La drague rétrocaveuse étant à l'origine un excavateur opérant sur terre, elle peut être installée sur le pont renforcé d'un chaland. Le godet de la drague est fixé à un bras de manœuvre articulé sur la flèche et les matériaux sont extraits en ramenant le godet vers la drague. Les produits de dragage sont déposés sur les rives ou dans des chalands. La drague rétrocaveuse peut normalement opérer jusqu'à une profondeur d'environ 12 m dans une large gamme de sédiments : petits cailloux, gravier, sable grossier, sable cohésif et argile compacte. Elle est habituellement équipée de godets dont la capacité varie de 1 à 3 m^3 (Centre Saint-Laurent, 1992).

Cette drague peut être opérée avec beaucoup de précision. Toutefois, elle peut occasionner des pertes importantes de matériaux et, pour cette raison, elle est rarement utilisée pour l'excavation de sédiments très fins et peu cohésifs.

3.1.4 Équipements mécaniques terrestres

Dans le cas de dragage à proximité des rives, il peut être possible de réaliser le dragage à partir d'équipements terrestres placés sur les berges, sur un quai ou s'avançant dans l'eau peu profonde, tout comme les travaux réalisés avec les jetées pour les baies 103. Des équipements qui peuvent être utilisées de cette façon incluent les pelles rétrocaveuses et les grues munies de benne preneuse. Ces équipements ont les mêmes capacités et caractéristiques que des dragues rétrocaveuses ou à benne preneuse ; ils sont toutefois limités à draguer des zones atteignables de la rive ou à partir de chemins-digues temporaires.

Dans le cadre du présent projet, des niveaux d'eau très bas, comme en 2012, permettraient l'utilisation d'équipements terrestres à partir de la rive. De plus, l'utilisation d'équipements terrestres serait possible dans la mesure où le nouveau quai serait construit avant le début des travaux de dragage. Malgré le fait que ces équipements ne pourraient pas atteindre la plus grande partie de l'aire à draguer, ils pourraient draguer directement une portion non négligeable des matériaux se trouvant le long de la ligne du futur quai. Ils pourraient e1nsuite continuer d'être utilisés pour vider les chalands remplis par des équipements flottants.

Dans un scénario un peu différent, des équipements terrestres pourraient aussi être utilisés à partir de chemins-digues temporaires mis en place avant la construction du quai et les matériaux

pourraient être réutilisés comme remblais lors de la construction du quai. Les chemins-digues temporaires pourraient également être aménagés devant la ligne de quai, une fois construit, pour atteindre une plus large portion de la zone à excaver.

3.2 Dragues hydrauliques

En aspirant de l'eau à une vitesse élevée, les dragues hydrauliques déplacent les matériaux du fond vers les aires de dépôt. Ces dragues sont généralement montées sur des barges équipées de pompes centrifuges commandées par un moteur diesel ou électrique et raccordées à des pipelines de refoulement de 15 à 122 cm de diamètre montés sur flotteurs. L'extrémité du bras qui est en contact avec le fond est généralement équipée d'un désagrégateur qui permet de prendre en charge les matériaux pour les intégrer à l'eau aspirée. Elles aspirent les sédiments lâches sous forme de boues liquides, alors qu'elles transportent les matériaux cohésifs arrachés par le désagrégateur sous forme de morceaux solides plus ou moins grossiers qui s'incorporent à l'eau aspirée. Les sédiments sont refoulés vers les zones de dépôt à l'aide de canalisations, par déchargement latéral, ou par chargement d'un puits de déblai installé à bord.

Les dragues hydrauliques sont généralement plus rapides que les dragues mécaniques, leur rendement peut atteindre 20 000 m³/j. Cependant, un rendement de 5 000 m^3/jour à 10 000 m^3/jour semble plus réaliste. Leur performance sur le plan de la remise en suspension des sédiments au site de l'excavation est généralement meilleure que celle des dragues mécaniques. Elles facilitent aussi le transport du matériel dragué sur de longues distances (Centre Saint-Laurent, 1992). En contrepartie, l'évacuation du mélange eau-déblais implique généralement des mesures particulières au site de dépôt, comme la mise en place de vastes bassins de sédimentation et d'équipement de déshydratation, ce qui d'une part engendre des coûts supplémentaires et qui, d'autre part, nécessite un espace relativement grand pour la mise en place des bassins. Par ailleurs, l'évacuation par pipeline des matériaux excavés peut être entravée en présence de débris qui occasionnent le colmatage des conduites. Les systèmes d'ancrage, les conduites de refoulement et les manœuvres des navires auxiliaires peuvent constituer des obstacles à la navigation. Enfin, les coûts importants de mobilisation/démobilisation ainsi que les coûts de traitement des eaux avant leur rejet à l'environnement font en sorte que la majorité des dragues hydrauliques ne sont pas adéquates pour le dragage de volumes faibles.

Il existe trois principaux types de dragues hydrauliques à savoir : la drague suceuse simple, la drague suceuse à désagrégateur et la drague autoporteuse. En plus de celles-ci, il existe également des dragues hydrauliques de conception spéciale qui ont été développées pour aspirer les sédiments en maintenant une teneur élevée en solides ou en réduisant la remise en suspension occasionnée par l'excavation.

3.2.1 Drague suceuse simple

Les sédiments sont retirés par succion et déposés sur des barges ou transportés par canalisation. Ces dragues sont de performance moyenne variant selon les caractéristiques précises de la drague. Leur utilisation est restreinte aux matériaux fins et au petit gravier sans cohésion. Puisque les matériaux solides ne totalisent que 10 à 20 % du matériel refoulé par ces dragues, elles ont le désavantage de nécessiter de vastes terrains de décantation et un drainage important lors de la mise en dépôt en milieu terrestre. De plus, la présence d'un tuyau flottant pour refouler les sédiments provenant de la drague vers les bassins peut interférer avec les activités maritimes et portuaires. Ces dragues sont très sensibles à la houle et aux vagues (Centre Saint-Laurent, 1992).

Étant donné qu'une proportion importante des matériaux à draguer est constituée d'argile compacte, une drague suceuse simple serait incapable d'effectuer les travaux. Pour cette raison, ce type d'équipement n'est pas retenu dans le cadre du présent projet.

3.2.2 Drague suceuse à désagrégateur

La drague suceuse à désagrégateur est une drague suceuse munie d'un appareil rotatif de désagrégation mécanique monté à l'embouchure d'une élinde. En présence de matériaux lâches, le désagrégateur met en suspension les matériaux qui sont immédiatement aspirés et transportés sous forme d'une boue liquide (80 à 90% d'eau). En présence de matériaux fortement cohésifs, le désagrégateur arrache des morceaux à la matrice cohésive et ceux-ci sont pris en charge par le courant d'eau aspiré. Suivant le degré de cohésion et la distance à parcourir en conduites, la résultante qui est rejetée sera constituée d'une proportion variable de morceaux solides incorporés dans une boue plus ou moins liquide.

Le produit du dragage est donc remonté en surface et refoulé à l'aide de tuyaux de canalisation vers un site de dépôt. Retenue en place par des béquilles qui lui servent de pivot, la drague hydraulique opère par un mouvement latéral en utilisant successivement ses câbles d'amarrage de bâbord et de tribord. L'efficacité du dragage, la concentration de la boue et la taille des morceaux cohésifs dépend de l'équilibre entre l'action mécanique du désagrégateur, la vitesse du mouvement latéral et la force de la succion hydraulique. Le rendement varie aussi en fonction de la granulométrie du matériel, de la profondeur d'excavation et de la taille de la drague (Centre Saint-Laurent, 1992). Elle a l'avantage de draguer tous les types de matériaux, mais le désavantage d'être nuisible à la navigation et d'opérer difficilement dans une houle supérieure à 0,90 m.

Puisque le dragage des postes à quai et aires de manœuvre du nouveau terminal de Contrecœur nécessitera le dragage d'une grande quantité de matériel très cohésif et que les aires à draguer ne sont pas utilisées pour la navigation commerciale, la drague suceuse à désagrégateur pourrait être bien adaptée aux travaux.

3.2.3 Drague autoporteuse

Cette drague est aussi appelée suceuse-porteuse ou porteuse. Montée sur des navires océaniques autopropulsés, cette drague aspire les matériaux à l'aide d'élindes suspendues par des bossoirs de chaque côté de la coque. En position de dragage, l'extrémité des élindes prend appui sur le fond et les matériaux sont pompés alors que le navire se déplace à faible vitesse. Le mélange eau-sédiments est stocké à bord dans des puits à déblais, où il décante. Les matériaux décantés sont transportés par la drague elle-même vers l'aire de dépôt où ils sont déchargés suite à l'ouverture du fond des puits à déblais. Le surplus d'eau (pouvant contenir des matières fines qui n'ont pas décanté) est soit rejeté directement à la mer par surverse, soit dirigé dans une conduite qui descend sous la coque du navire (surverse immergée). Cette dernière configuration aide à diminuer les impacts sur la qualité de l'eau liés à la mise en suspension de particules fines, et confère aux dragues équipées d'une surverse immergée un rendement environnemental potentiellement plus élevé.

Ces dragues, qui nécessitent des tirants d'eau de 3,0 à 8,5 m, ont des rendements qui sont variables, pouvant être très élevées, selon les dragues individuelles. Elles ont l'avantage d'opérer en pleine circulation maritime et sous de mauvaises conditions météorologiques et de courants, mais elles ne peuvent excaver des sédiments trop cohésifs.

Une grande portion des matériaux à draguer est constituée d'argiles compactes très cohésives qui ne peuvent être draguées à l'aide d'une drague autoporteuse à élinde trainante. De plus, une bonne portion des sédiments à draguer les plus meubles se trouve dans des aires ayant une faible profondeur et ne pourrait pas être retirée avec ce type de drague. Les dragues suceuses autoporteuses ne sont donc pas retenues comme option de dragage pour le projet à l'étude.

3.2.4 Dragues spéciales

Plusieurs systèmes de dragage hydraulique de conception spéciale ont été développés pour aspirer les sédiments en maintenant une teneur élevée en solides ou en réduisant la remise en suspension occasionnée par l'excavation. La plupart des dragues de conception spéciale sont destinées à des travaux de petite et de moyenne envergures et elles sont surtout utilisées pour des projets de restauration, de nettoyage ou encore pour des interventions très particulières mettant le plus souvent en cause des sédiments très pollués. Cependant, elles ne sont pas conçues pour avoir un rendement élevé. Deux types de dragues de conception spéciale ayant opéré au Québec sont présentés ci-dessous.

« La drague à tarière horizontale (Mudcat) est une drague hydraulique portative montée sur un ponton et munie d'un désagrégateur en forme de tarière qui achemine la boue liquide par une pompe centrifuge. Cette drague a été conçue pour extraire les sédiments fins. Elle se déplace le long d'un câble d'ancrage; les déblais de dragage sont évacués par une canalisation montée sur flotteurs. Ce genre d'équipement est utilisé pour des travaux de petite et moyenne envergures, à profondeur réduite. Son principal avantage est sa petite taille qui facilite le transport par camion pour des travaux dans des endroits confinés et peu accessibles. Elle peut excaver à des profondeurs aussi faibles que 0,5 m mais elle est limitée à une profondeur maximale de 6,1 m. Son rendement est de l'ordre de 90 m³/h. Elle laisse un fond uniforme » (Centre Saint-Laurent, 1992).

« La drague Amphibex est une pelle rétrocaveuse montée sur un ponton et équipée de stabilisateurs ainsi que d'une hélice. Elle peut donc opérer de façon autonome aussi bien sur terre que dans l'eau ou dans les zones marécageuses. En plus d'un godet excavateur conventionnel, cette drague peut également être munie d'un godet-pompe : deux pompes à déblais situées dans le godet permettent de pomper en continu les matières délogées. Pour éviter l'obstruction des conduites, des lames coupantes sont logées à l'entrée de la pompe afin d'assurer le déchiquetage des racines ou de la végétation (Centre Saint-Laurent, 1992b). Le mélange pompé est refoulé dans un pipeline pouvant mesurer jusqu'à 1 km sans pompe intermédiaire de surpresseur. En présence d'un surpresseur, une distance de 3 km peut être envisagée. La drague Amphibex a un rendement relativement modeste et elle ne convient que dans les endroits où la profondeur ne dépasse pas 6,5 m ».

Puisque le dragage des nouveaux postes à quai nécessiterait un dragage d'une très grande quantité de matériel et devra atteindre une profondeur supérieure au maximum atteignable avec la drague à tarière horizontale ou la drague Amphibex, ces dragues ne sont pas retenues comme options potentielles.

3.3 Synthèse des méthodes de dragage

Dans le cadre du projet à l'étude, tel que mentionné à la section 3.1, tous les principaux types de dragues mécaniques pourraient être utilisés.

Bien qu'avec une drague hydraulique, la présence d'obstacles puisse occasionner l'enrayage ou le blocage de la drague ou de la ligne de succion, les travaux pourraient également être réalisés par ce type d'équipement puisque l'aire à draguer n'est pas connue pour présenter une densité de gros obstacles sur le lit du fleuve, tels que des troncs d'arbres, des souches, des blocs de pierre et des débris divers tels que ceux issus de la construction ou la consommation domestique. En contrepartie, la drague à désagrégateur est la seule drague hydraulique retenue, car les autres dragues hydrauliques ne sont pas adaptées aux types de matériaux ou aux conditions de dragage du projet (section 3.2).

Le Tableau 1 résume les principaux avantages et inconvénients des équipements de dragage lié au présent projet.

Tableau 1 Synthèse des méthodes de dragage

	AVANTAGES	INCONVÉNIENTS
Équipements mécaniques	• Conservation maximale de l'intégrité des matériaux excavés : teneur en solides élevée. • Envergure minimale des installations pour le transport, le traitement et le dépôt des matériaux. • Opération possible dans les matériaux meubles et durs, en présence d'obstacles et de débris. • Bonne précision en eau peu profonde.	• Taux de production relativement faible et décroissant avec la profondeur (30 à 500 m³/h). • Taux de remise en suspension des sédiments relativement élevé dans la colonne d'eau, particulièrement durant le travail dans un matériau très fin et non cohésif. • Peut constituer un encombrement pour la navigation. • Manipulations additionnelles requises lorsque le rejet en eau libre est impossible.
Drague à benne preneuse	• Manœuvrabilité. • Teneur en eau peu modifiée par rapport à celle du matériau en place. • Profondeur de dragage presque illimitée.	• Mélange des couches sédimentaires. • Remise en suspension moyenne à importante, notamment dans les matériaux très fins et non cohésifs.
Drague à cuiller	• Stabilité du ponton. • Utile dans le cas des excavations de roc ou de matériaux très cohésifs. • Capacité des godets variable. • 30 à 60 cycles/h • Profondeur de dragage maximale 12 m.	• Opération difficile par mauvais temps. • Rendement faible. • Remise en suspension importante dans les matériaux fins et non cohésifs.
Drague rétrocaveuse	• Stabilité du ponton. • Ne mélange pas les couches sédimentaires. • Sédiments dragués à leur propre densité. • Possibilité d'une grande précision. • Profondeur de dragage maximale 12 m.	• Opération difficile par mauvais temps. • Rendement faible. • Remise en suspension moyenne à importante notamment dans les matériaux fins et non cohésifs.
Équipements hydrauliques	• Taux de production élevé (jusqu'à plusieurs centaines de m³ à l'heure) (peut atteindre 20 000 m³/j, mais 5 000 à 10 000 m³/jour est plus réaliste). • Taux de remise en suspension des sédiments dans la colonne d'eau plus faible qu'avec les dragues mécaniques, à l'endroit du dragage. • Utilisation non limitée par les vitesses de courant. • Pour l'excavation de grands volumes, spécialement dans le cas de travaux de capitalisation importants, les coûts unitaires sont généralement moins élevés que ceux des dragues mécaniques.	• Haute teneur en eau des matériaux excavés (80- 90 %). • Grandes surfaces nécessaires pour le dépôt des matériaux dragués et le traitement des eaux. • Impossibilité d'enlever la plupart des débris de façon hydraulique. L'évacuation par pipeline des matériaux excavés peut être entravée en présence de débris qui occasionnent le colmatage des conduites. • La drague elle-même et la présence du pipeline peuvent constituer un obstacle à la navigation. • Le rejet en eau libre par pipeline génère plus de turbidité que le rejet par barge des dragues mécaniques. • Le transport sur de grandes distances (plus de quelques kilomètres) est impossible. • Nuisance sonore parfois importante.
Drague suceuse simple	• Rendement important dans les sédiments fins et lâches.	• Possibilité de mélange des couches sédimentaires
Drague suceuse à désagrégateur	• Compatible avec une vaste gamme de matériaux. • Précision et uniformité de l'excavation.	• Possibilité de resuspension importante au site de dragage si la puissance de pompage n'est pas en adéquation avec le pouvoir de découpe du désagrégateur.
Drague suceuse porteuse	• Peu sensible à la houle et aux vagues. • Entrave à la navigation nulle.	• Ce type de drague est limité au dragage des sables non-contaminés qui peuvent être

	AVANTAGES	INCONVÉNIENTS
	• Transport sur de longues distances facilité et aucune manipulation additionnelle lorsque le rejet en eau libre est possible. • Utilisation maximale des compartiments grâce à la surverse.	rejetés en eau libre (généralement réservée à l'excavation de volumes importants dans le chenal de navigation du Saint-Laurent). • Profondeur de dragage limitée par le tirant d'eau du bateau et des élindes (3,0 à 8,5 m). • Nécessité de surdraguer (plusieurs passages pour obtenir une surface draguée régulière). • Utilisation restreinte dans les zones de rejet en eau libre peu profondes à cause des forts tirants d'eau requis.
Équipements spéciaux		
Drague à tarière horizontale (Mudcat)	• Petite taille : transport facile par camion ou par avion et permet de travailler dans des endroits confinés et peu accessibles. • Laisse un fond régulier.	• Rendement modeste. • Occasionne une certaine remise en suspension notamment aux extrémités de la tarière. • Profondeur maximale de dragage limitée à 6,1 m. • Sa sensibilité aux vents et aux courants nécessite des repositionnements fréquents.
Drague amphibie à godet-pompe (Amphibex)	• Faible perte des matériaux lors du dragage et du transport. • Petite taille, transport facile par camion ou par avion et permet de travailler dans des endroits peu accessibles. Encombrement faible. Coûts de mobilisation/démobilisation réduits et utilisation d'un personnel restreint. • Bon nivellement de la surface draguée. • Grande variété d'utilisations envisagées. • Capacité de récupérer efficacement les matériaux contaminés : contrôle précis du volume à draguer évitant le sur-dragage. • Utilise des huiles biodégradables pour son fonctionnement hydraulique. • Le pourcentage des sédiments dragués est beaucoup plus élevé que les autres dragues hydrauliques traditionnelles car les pompes sont conçues pour pousser les sédiments plutôt que pour travailler en succion, ce qui comporte des avantages concernant la taille des bassins nécessaires pour la sédimentation des matériaux dragués et la productivité. • L'Amphibex a fait l'objet de démonstrations technologiques convaincantes auprès du ministère de l'environnement et des groupes environnementaux.	• Rendement modeste. • Profondeur maximum de dragage à 6,5 m. • Besoin de mettre en place des bassins de sédimentation (comparativement à une drague mécanique).

3.4 Drague mécanique versus drague hydraulique à désagrégateur

Dans les paragraphes qui suivent, les dragues mécaniques sont comparées aux dragues hydrauliques à désagrégateur afin de faire ressortir les avantages et désavantages de ces équipements et de souligner les impacts du choix de l'un ou de l'autre sur la gestion des sédiments dragués.

3.4.1 Nature et traitement des déblais de dragage selon le type de drague

Un des principaux avantages du dragage mécanique réside dans le fait que la densité et la teneur en eau des sédiments sont peu affectées. En effet, lors de dragage de l'argile silteuse raide, une drague mécanique peut remonter à la surface des grands blocs cohésifs de ce matériel. Les photos ci-dessous démontrent bien la situation.



Dragage dans des argiles Champlainiennes lors de l'approfondissement de la marina de Berthier





Dragage mécanique dans les argiles dans le chenal de navigation du Saint-Laurent lors de l'approfondissement du chenal

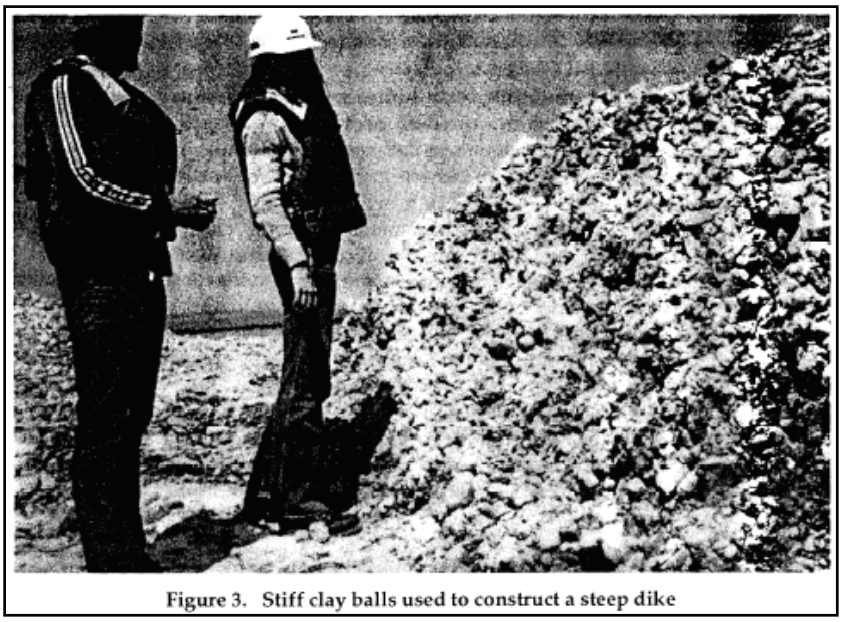


Figure 3. Stiff clay balls used to construct a steep dike

Boules d'argile raide obtenues par dragage hydraulique et utilisées pour construire une digue à pente raide

Tiré de : Degradation of Hydraulically Transported Clay Balls. Dredging Reserach Technical Notes DRP-2-09, August 1994. USA Corps of Engineers.

Même lors du dragage de matériel plus lâche, les teneurs en eau des sédiments demeurent faibles. Selon le type de matériel dragué, ceci peut éviter le recours à des bassins de sédimentation pour la consolidation des sédiments. Dans tous les cas, les quantités d'eau à gérer et le temps d'assèchement des sédiments sont beaucoup moins importants que lors de l'utilisation de dragues hydrauliques.

En contrepartie, les dragues hydrauliques à désagrégateur mélangent les sédiments dragués à des quantités importantes d'eau afin de les pomper. La nature exacte des déblais de dragage à la sortie de la conduite de refoulement dépend du type de sédiment dragué, de la longueur de la conduite et de l'efficacité de l'opérateur. Les sédiments lâches, tels que les matériaux de type 1 et de type 4 décrits à la section 2.2, sont très susceptibles d'être homogénéisé avec l'eau et de former une boue liquide. Si les particules sont plutôt grossières (sable et gravier), le mélange se décantera rapidement. Si les particules sont plus fines, la boue demeurera liquide pendant un certain temps et nécessitera des espaces de décantation de grande superficie avant que le surnageant n'atteigne une qualité d'eau satisfaisante pour un rejet vers l'environnement. Lors du dragage d'argiles très cohésives, telles que les argiles silteuses raides qui constitueront la majorité des matériaux dragués à Contrecœur, une bonne proportion des argiles draguées se maintiendra en morceaux denses dont la taille variera selon différents facteurs : le type de désagrégateur utilisé, la longueur et la taille de la conduite, l'opération de la drague, etc. Même dans ce cas, les eaux de pompage accompagnant les morceaux d'argile seront chargées de particules très fines en suspension (argile et silt) et exigeront des bassins de sédimentation importants de même que, très vraisemblablement, l'utilisation d'un agent floculant (alun, polymère, floculant de grade alimentaire, etc.) afin d'atteindre une qualité d'eau acceptable à l'effluent. L'agent floculant sera injecté dans la conduite, avant le point de rejet dans le bassin de décantation, afin de favoriser la floculation des MES et/ou à l'entrée du bassin de polissage.

3.4.2 Transport et manutention des déblais de dragage

Les dragues mécaniques n'ont généralement aucun mécanisme pour transporter d'elles-mêmes les sédiments. Elles opèrent donc habituellement en remplissant des barges ou des chalands et les déblais ne sont généralement pas traités. Lorsque le matériel est immergé en eau libre, des chalands munis d'un fond ouvrant sont utilisés et le matériel est déposé directement sur le fond.

Par contre, lors d'une gestion terrestre, une deuxième manipulation des déblais est nécessaire pour les amener sur terre. Ceci nécessite un quai ou un débarcadère temporaire où les chalands peuvent être accostés et où un équipement terrestre, souvent une grue munie d'une benne, peut être installé pour les décharger et pour déposer leur contenu dans des camions. Dans certains cas, lorsque la zone à draguer est très rapprochée de la rive, l'équipement de dragage, flottant ou terrestre, peut déposer les déblais directement dans des camions. Lorsque les matériaux nécessitent une période de décantation à proximité immédiate du lieu de dragage, une troisième manipulation est également nécessaire pour remettre les matériaux à bord des camions qui les transporteront au site de mise en dépôt.

En contrepartie, le système de pompage des dragues hydrauliques à désagrégateur peut refouler les déblais de dragage sur de grandes distances à l'aide de conduites. Lors du dépôt en milieu aquatique, les déblais ne sont généralement pas traités. Ils sont déposés directement à partir des chalands ou à partir des tuyaux de refoulement, selon le type de drague utilisé. Pour limiter les impacts importants de remise en suspension des sédiments lors du pompage hydraulique vers le milieu aquatique, les sédiments peuvent être rejetés près du fond, à vitesse réduite, à l'aide d'un diffuseur (PIANC, 2009).

Lors d'un dépôt en milieu terrestre, les sédiments pompés sont refoulés jusqu'en rive dans une conduite de succion flottante, puis acheminés au bassin de décantation ou au site de dépôt à l'intérieur d'un pipeline.

3.4.3 Rendement environnemental

Les impacts les plus importants du dragage sur le milieu naturel sont ceux liés aux effets sur la qualité de l'eau. Ces impacts peuvent varier considérablement selon les caractéristiques de la drague utilisée et du type de matériel dragué. Les études qui ont évalué les effets du dragage sur la qualité de l'eau ont généralement établi ces impacts soit en termes de la quantité de matières solides perdues dans la colonne d'eau par volume de sédiments dragués ou en termes d'impacts sur la qualité de l'eau à différentes distances de la drague. Les données de qualité de l'eau sont généralement exprimées soit en UTN (unités de turbidité néphélométriques) ou en mg/L de matières en suspension (MES). De ces deux types de données, la concentration des MES est celle qui représente le mieux la remise en suspension car la turbidité (mesurée en UTN) peut être affectée par des facteurs autres que la concentration des particules en suspension (comme la couleur de l'eau par exemple). Ceci étant dit, les mesures en UTN sont très utilisées car elles peuvent être enregistrées rapidement et facilement sur le terrain.

Un résumé des résultats de différentes études portant spécifiquement sur la perte de matériel lors du dragage est présenté au Tableau 2. Les données de Hayes et Wu (2001) présentées au Tableau 2 constituent des moyennes pour chacune des cinq dragues hydrauliques à désagrégateur dont il est question. En fait, si on considère l'ensemble des données présentées par ces auteurs, la distribution des taux de perte varie entre 0,0005 % et 0,51 %. Dans le cas de Calumet Harbor, où le taux était le plus faible, les conditions de dragage étaient presque idéales (Hayes et Wu, 2001). Dans le cas des dragues utilisées à James River et Back River, elles étaient très imposantes et équipées de pompes puissantes capables de draguer de quelques centaines à quelques milliers de m^3/h. Selon les auteurs, de tels types d'équipements ne sont pas susceptibles d'avoir des taux de perte élevés; en effet, on observe généralement les pourcentages de perte plus élevés avec des dragues plus petites (Hayes et Wu, 2001).

McLellan *et al*. (1989) à Calumet Harbor ont mesuré des concentrations de 9,6 mg/L à moins de 1 m de la tête désagrégatrice et de 5 à 10 mg/L dans le panache de 30 à 500 m de la drague. Toutefois, il est important de prendre en compte que les concentrations mesurées à Calumet Harbor sont les plus faibles de la littérature et qu'elles sont représentatives de conditions de dragage idéales (Hayes et Wu, 2001). Il est beaucoup plus typique d'avoir des concentrations de plus de 100 mg/L à des distances de quelques dizaines de mètres de la drague, diminuant graduellement pour atteindre des valeurs se confondant au bruit de fond à une distance de quelques centaines de mètres (Tableau 3). Ces impacts plus grands peuvent être associés à des problèmes techniques qui surviennent occasionnellement au cours des travaux, tels que des blocages de la conduite ou du désagrégateur, des répercussions reliées à une opération qui n'est pas toujours optimale en terme de vitesse de rotation du désagrégateur et de patron de balayage de la tête, aux arrêts nécessités par le repositionnement de la drague et par la recherche des sites précis à draguer, etc.

Tableau 2 Résultats d'études sur la perte de matériel lors de projets de dragage

Site	Type de drague	Perte (%)	Taux de remise en suspension (kg/m³)	Référence
MIL Davie inc., Lauzon	suceuse-refouleuse à désagrégateur	2	8*	Robert Hamelin et Associés inc., 1989
James River	suceuse-refouleuse à désagrégateur	0,023	0,092*	Hayes et Wu, 2001
Back River	suceuse-refouleuse à désagrégateur	0,041	0,164*	Hayes et Wu, 2001
Calumet Harbour	suceuse-refouleuse à désagrégateur	0,003	0,012*	Hayes et Wu, 2001
Acushnet River	suceuse-refouleuse à désagrégateur	0,082	0,328*	Hayes et Wu, 2001
Lavaca Bay	suceuse-refouleuse à désagrégateur	0,13	0,52*	Hayes et Wu, 2001
MIL Davie inc., Lauzon	benne preneuse	6	24*	Robert Hamelin et Associés inc., 1989
New York Bight	benne preneuse	2	8*	Tavolaro, 1984
St. Johns River	benne preneuse	0,16	0,64*	Hayes et Wu, 2001
Black Rock Harbour	benne preneuse	0,28	1,12*	Hayes et Wu, 2001
Calumet River	benne preneuse	0,25	1*	Hayes et Wu, 2001
Boston Harbour	benne preneuse	0,66	2,64*	Hayes et Wu, 2001
Rotterdam	benne preneuse	0,75*	3	Pennekamp *et al.*1996
IJssel	benne preneuse + écran	2,25*	9	Pennekamp *et al.*1996
IJssel	benne étanche	4,75*	19	Pennekamp *et al.*1996
Zierikzee	benne étanche	2,75*	11	Pennekamp *et al.*1996
Rotterdam	benne étanche	3,25*	13	Pennekamp *et al.*1996
IJssel	benne étanche + écran	0,75*	3	Pennekamp *et al.*1996
Zierikzee	benne étanche + écran	2,75*	11	Pennekamp *et al.*1996

* Calculé en assumant une concentration typique de 400 g/L de matières solides dans les sédiments (Barnard, 1978).

Tableau 3 Mesure des MES lors de dragages effectués avec des dragues hydrauliques à désagrégateur (McLellan *et al.*, 1989)

Site	Type de sédiment	Vitesse du courant (m/s)	Distance de la drague (m)	Concentration des MES[1] (mg/L)	
				Moyenne	Min. - Max.
Calumet Harbour[2]	Argile-Silt	0 - 0,06	0,61	9,6	6,6 - 14,1
Calumet Harbour[3]	Argile-Silt	0 - 0,06	30 - 490		5 - 10
Savannah River[2]	Argile silteuse	0,06 - 0,49	6,1	292	8,2 - 1964,5
Savannah River[3]	Argile silteuse	0,06 - 0,49	30 - 490		20 - 120
James River[2]	Argile silteuse	0,15 - 0,7	3	63	0 - 166
James River[3]	Argile silteuse	0,15 - 0,7	30 - 490		40 - 200

[1] Mesure de la concentration au-dessus du bruit de fond.
[2] Mesures de la concentration à proximité immédiate de la tête désagrégatrice.
[3] Mesures dans le panache de turbidité autour de la drague.

Les pertes de matériel sont généralement plus importantes lors du dragage mécanique. Selon Palermo *et al.* (1990), 20 à 30 % du contenu d'une benne preneuse peut être « perdu » entre le moment où le godet quitte le fond avec sa charge et celui où il se déverse dans la barge. Par contre, la grande majorité de ce matériel est perdue au moment précis où le godet s'arrache du fond et ces matériaux « perdus » demeurent relativement cohésifs et se redéposent rapidement au site même de l'aire de dragage (Bowen *et al.,* 1992). Selon Tavolaro (1984, cité dans Environnement Canada, 1994), il n'y aurait en général qu'une très faible proportion (2 %) de la masse de matériel dragué qui serait effectivement mise en suspension dans la colonne d'eau et perdue lors d'un dragage à l'aide d'une benne preneuse, en incluant les pertes au niveau de la benne et celles occasionnées par la surverse des chalands. Des estimés encore plus faibles, de l'ordre de 0,25 %, ont été calculés par Hayes et Wu (2001). Dans ce dernier cas, il faut noter que les dragues utilisées étaient beaucoup plus grandes et avaient des productions mesurées en centaines de m³/h (Hayes et Wu, 2001).

Une grande quantité de données est disponible concernant la qualité de l'eau en aval de travaux de dragage. La concentration de MES à proximité immédiate de la tête désagrégatrice d'une drague hydraulique suceuse-refouleuse peut être aussi élevée que 1100 mg/L, mais des concentrations de quelques dizaines de mg/L sont typiques à une distance d'environ 50 m de la drague (Kirby et Land, 1991 cité dans Environnement Canada, 1994). Il faut aussi noter que les conditions environnementales, les paramètres techniques des travaux (épaisseur de la couche à draguer, expérience de l'opérateur, continuité des travaux, présence de débris, etc.) et la nature des sédiments peuvent causer de grandes variations dans les concentrations de MES. Ainsi, McLellan *et al*. (1989) ont mesuré des concentrations moyennes de 9,6 mg/L au-dessus du bruit de fond à moins de 1 m de la tête désagrégatrice à Calumet Harbour et une moyenne de 292 mg/L au-dessus du bruit de fond à 6,1 m de la tête désagrégatrice à Savannah River. Un résumé des mesures de MES relevées autour de dragues hydrauliques à désagrégateur par McLellan *et al*. (1989) est présenté au Tableau 3. L'impact de la drague hydraulique est surtout limité aux parties plus profondes de la colonne d'eau (McLellan *et al*., 1989). Cette observation est aussi notée par Raymond (1984) qui indique que la mise en suspension liée à une drague hydraulique serait de 134 mg/L au fond et de 35 mg/L dans la partie supérieure de la colonne d'eau à une distance de 244 m de la drague.

Lors du dragage des chantiers de MIL Davie inc. à Lauzon en 1988, une drague hydraulique à été utilisée pour effectuer le dragage de matériaux sableux contenant des proportions variables de particules fines (Robert Hamelin et Associés inc., 1987). Durant la première phase de ces travaux, la concentration de MES a varié de 3,2 à 113,6 mg/L dans la zone des travaux, comparé à des valeurs « bruit de fond » de 4,0 à 39,2 mg/L dans la période précédant les travaux (Robert Hamelin et Associés inc., 1988a). Durant la deuxième phase de ces travaux, la concentration en MES dans la zone des travaux a varié de 0,8 à 758 mg/L, mais 95,6 % des résultats étaient inférieurs à

50 mg/L. Durant toute la durée de la période d'opération de la drague, la concentration moyenne a été de 17 mg/L, ce qui correspond à une légère augmentation par rapport aux périodes d'arrêt d'opération durant lesquelles la concentration moyenne était de 12 mg/L (Robert Hamelin et Associés inc., 1988b). Au cours de la troisième phase de ces travaux, les concentrations moyennes mesurées aux différentes stations variaient entre 9,5 et 111,7 mg/L. Les concentrations les plus élevées (de 58,6 et 111,7 mg/L) se retrouvaient dans la darse du port et elles diminuaient pour atteindre des valeurs se rapprochant du bruit de fond de 12,8 mg/L à une distance d'environ 300 m en aval de la darse (Robert Hamelin et Associés inc., 1988c).

Dans le cas de l'utilisation d'une drague hydraulique à désagrégateur au port de Bécancour en 1983 et 1984, aucun suivi de la mise en suspension dans l'aire de dragage n'a été réalisé. Par contre, la qualité de l'eau à la prise d'eau de la centrale Gentilly II a fait l'objet d'un suivi. Les solides en suspension à la prise d'eau se sont maintenus à moins de 50 mg/L plus de 80% du temps lors de la première période de dragage, avec un seul dépassement du seuil de 100 mg/L (La firme A.G.I.R. ltée. et André Masson & Associés inc., 1984). Ce dépassement était vraisemblablement lié à une diminution de l'efficacité du bassin de sédimentation et non à l'activité de la drague. Durant les deux périodes de dragage subséquentes, les concentrations se sont maintenues à moins de 20 mg/L avec des maximums avoisinant les 40 mg/L (La firme A.G.I.R. ltée. et André Masson & Associés inc., 1984).

Lors des travaux d'entretien du port de Gros-Cacouna, en juin 2008, une drague hydraulique suceuse à tête rotative désagrégatrice a également été utilisée pour draguer un peu plus de 60 000 m³. Les matériaux dragués, constitués de sable limoneux avec un peu d'argile, ont été déversés dans trois bassins de décantation préalablement aménagés à cet effet. Au cours du suivi de la qualité de l'eau, via l'évaluation de la turbidité et des teneurs en MES, la turbidité naturelle du milieu récepteur a été mesurée aux stations de référence afin de tenir compte des variations naturelles. Celles-ci ont varié entre 2,80 et 138,0 NTU, soit 4,38 et 215,8 mg/L. Les concentrations mesurées variaient selon le régime des vents, mais surtout, des marées. En effet, à marée montante, les valeurs « bruits de fond » relevées aux différents points d'échantillonnage a varié entre 2,80 et 37,7 NTU (4,38 à 58,94 mg/L), alors qu'à marée descendante, les teneurs ont varié alors entre 4,83 et 138,0 NTU (7,55 à 215,74 mg/L) (CJB Environnement inc., 2008).

Dans la zone d'influence des travaux, soit à partir du quai, près de la drague et à l'intérieur du havre, les teneurs en MES étaient comprises entre 6 et 79 mg/L dans l'ensemble de la colonne d'eau, alors que la valeur moyenne était de 16 mg/L. Les concentrations moyennes obtenues dans la zone d'influence des travaux et dans les secteurs adjacents (stations de référence) étaient à toutes fins pratiques comparables (16 ± 18 mg/L vs 22 ± 39 mg/L), tout comme les concentrations minimales (3,82 vs 4,38 mg/L). On remarque que les moyennes et les minimums enregistrés sont du même ordre de grandeur que ceux obtenus dans les zones périphériques. Par contre, les valeurs maximales sont inférieures dans la zone d'influence par rapport aux stations de référence (78,63 vs 215,74 mg/L). Ces résultats indiquent que la drague ne crée pas de hausses de MES de façon significative.

Il existe plusieurs études ayant porté sur la qualité de l'eau autour et en aval d'opérations de dragues mécaniques à benne preneuse. Les résultats de ces études sont variables selon le type d'équipement utilisé, la nature du sédiment à draguer et les conditions hydrologiques. Le Tableau 4 présente un résumé des résultats provenant de différents suivis de la qualité de l'eau à proximité de dragues mécaniques.

Tableau 4 Résumé des impacts de dragues à benne preneuse sur la turbidité de l'eau.

Conditions du site	Emplacement des mesures	Résultats	Référence
Dragage d'argiles dans le chenal navigable du fleuve Saint-Laurent. Bruit de fond de 3-9 UTN.	À proximité de la drague	Maximum de 30-40 UTN	CJB Environnement inc. et Procéan inc., 1999
	150 m en aval	Maximum de 12 UTN	
	200 m en aval	Moyennes de 5 à 9 UTN, maximum de 13 UTN	
Dragage d'argiles dans le chenal navigable du fleuve Saint-Laurent. Bruit de fond de 3,7 à 8,2 mg/L*.	200 m en aval	7,3 à 15,6 mg/L*	CJB Environnement inc. et Procéan inc., 2000
Dragage d'argiles dans le chenal navigable du fleuve Saint-Laurent. Bruit de fond de 1,5 à 7 mg/L*, moyenne de 3 mg/L*.	200 m en aval	1,8 à 6,2 (moyenne de 3) mg/L*. Dans le pire des cas, la mesure était le triple du bruit de fond.	CJB Environnement inc. et Procéan inc., 20
Dragage de sables dans le chenal navigable du lac Saint-Pierre.	200 à 400 m en aval	Aucune augmentation de la turbidité par rapport au bruit de fond.	Les Consultants Jacques Bérubé inc., 1997
Dragage de silts argileux dans un bassin du port de Trois-Rivières. Peu de courant dans le bassin. Taux de dragage d'environ 75 m³/h depuis environ 24 h avant la prise des mesures. Bruit de fond de 9,6 UTN.	Dans le bassin à 10 m de la drague	25 UTN	CJB Environnement inc., 2002
	À l'ouverture du bassin (toutes les mesures à moins de 100 m de la drague)	14 à 41 (moyenne de 26) UTN	
	15 m en aval du bassin	15 UTN	
	34 m en aval du bassin	9,9 UTN	
Dragage de particules fines dans le port de Bécancour. Bruit de fond de 7,95 à 8,65 (moyenne de 8,25) UTN	dans la surverse du chaland	35,5 ; 82,5 ; et 160 UTN	CJB Environnement inc., 2010
	< 15 m de la drague	entre 15,8 et 62,4 UTN	
	< 100-130 m de la drague	entre 8,29 et 19,1 UTN	
Dragage d'argile silteuse et d'argile compactée dans le havre de Boston.	À partir de la drague, de 5 à 20 m de la benne.	8 à 896 (moyenne de 210) mg/L	Hayes *et al*., 2000
Dragage de vases aux chantiers de MIL Davie inc. Bruit de fond de 4 à 46,6 (moyenne de 15,68) mg/L	En face des aires de dragage et à la prise d'eau de Lauzon.	3,2 à 116,4 (moyenne de 15,05) mg/L	Robert Hamelin et Associés inc., 1988a
Dragage de sables à l'aire d'accostage de QIT-Fer et Titane inc. à Tracy.	5 à 170 m en aval	Aucune augmentation de la turbidité par rapport au bruit de fond.	Roche ltée, 1987 cité dans Environnement Canada, 1994
Dragage d'argile et silt en milieu riverain à Calumet River. Courant de 0 à 0,06 m/s. Bruit de fond de 10 mg/L au fond et 12 mg/L à la surface.	15 à 200 m autour de la drague	Nuage de turbidité de 140 mg/L à 15 m et mesure de 20 mg/L à 150 m (concentrations au-dessus du bruit de fond)	McLellan *et al*., 1989

Conditions du site	Emplacement des mesures	Résultats	Référence
Dragage de sable et argile en milieu d'estuaire saumâtre à Black Rock Harbor. Courant de 0,06 à 0,24 m/s. Bruit de fond de 45 mg/L au fond et 69 mg/L à la surface.	15 à 200 m autour de la drague	Nuage de turbidité de 1100 mg/L à 15 m à 250 mg/L à 200 m (concentrations au-dessus du bruit de fond)	McLellan *et al*., 1989
Dragage de silt avec sable et argile en milieu d'estuaire saumâtre à Duwamish. Courant de 0,09 à 0,33 m/s. Bruit de fond de 11 mg/L au fond et 26 mg/L à la surface.	15 à 200 m autour de la drague	Nuage de turbidité de 20 à 160 mg/L (concentrations au-dessus du bruit de fond)	McLellan *et al*., 1989
Dragage de silt en milieu d'estuaire à St. John River. Courant de 0 à 0,06 m/s. Bruit de fond de 47 mg/L au fond et 72 mg/L à la surface.	15 à 200 m autour de la drague	Nuage de turbidité de 480 mg/L à 15 m à 100 mg/L à 150 m (concentrations au-dessus du bruit de fond)	McLellan *et al*., 1989
Dragage au Havre Merwe à Rotterdam. Bruit de fond de 20 mg/L.	50 m de la drague	Augmentation de 35 mg/L au-dessus du bruit de fond.	Pennekamp *et al.*, 1996
Dragage avec utilisation d'un écran dans une rivière à IJssel. Bruit de fond de 35 mg/L.	50 m de la drague	Augmentation de 35 mg/L au-dessus du bruit de fond.	Pennekamp *et al.*, 1996
Dragage de sédiments fins.	244 m de la drague.	105,9 mg/L dans la partie supérieure de la colonne d'eau et 134,3 mg/L en profondeur.	Raymond, 1984

* calculé à partir de données en UTN selon une droite de régression (1 mg/L = 1,0924 UTN, R^2 = 0,7258)

Contrairement à la drague hydraulique à désagrégateur, la drague mécanique à benne preneuse affecte la qualité de l'eau sur toute la colonne d'eau. A titre d'exemple, les concentrations des MES sont presque identiques en profondeur et dans la partie supérieure de la colonne d'eau selon Raymond (1984) (voir Tableau 4). Hayes *et al*. (2000) observent aussi que la turbidité était semblable aux quatre différentes profondeurs échantillonnées à proximité de la benne preneuse conventionnelle. Malgré ceci, certains auteurs indiquent que même si l'impact était réparti sur toute la colonne d'eau, les plus grandes concentrations se trouvaient en profondeur. Selon les données de Vellinga (1989, cité dans Environnement Canada, 1994) les concentrations étaient de 60 mg/L au fond, 35 mg/L en mi-profondeur et de 15 mg/L en surface. McLellan *et al.* (1989) rapportent que le nuage de turbidité était plus présent dans le quart le plus profond de la colonne d'eau à Calumet River et était davantage présent entre les trois quarts et la moitié de la profondeur à Black Rock Harbor.

La remise en suspension lors d'un dragage mécanique est associée en partie à l'étanchéité de la fermeture des bennes mais aussi à des manœuvres diverses qui accompagnent inévitablement les travaux de dragage. Les mauvaises manœuvres de l'opérateur, la recherche des hauts fonds par le passage de la benne sur le fond, la récupération de débris, le nivellement des surfaces draguées et le déplacement des béquilles de positionnement et des ancres de stabilisation constituent également des facteurs qui contribuent à augmenter la turbidité associée au dragage mécanique. De plus, les pertes dues à la surverse des chalands contribuent souvent le plus à la mise en

suspension des sédiments dragués. Comme l'indiquent les estimés présentés au Tableau 2, l'utilisation des bennes étanches ne signifie pas forcément des pertes moins importantes puisque les pertes calculées pour des travaux réalisés avec des bennes étanches (0,75 à 4,75%) diffèrent peu de celles qui sont associées à des travaux effectués avec des bennes conventionnelles (0,16 à 6 %).

Les bennes étanches du type « Cable Arm » sont des équipements qui visent la récupération de matériaux fortement contaminés, lorsque les conditions et la sensibilité du milieu justifient que des mesures extraordinaires soient mises en œuvre (pour protéger une prise d'eau potable par exemple). Généralement l'utilisation de ce type de benne s'accompagne de mesures de confinement des aires de travail (utilisation de rideaux ou confinement physique à l'aide de rideaux de palplanches par exemple) et de méthodes de transbordement sophistiquées (pompage des chalands par exemple). Les travaux de restauration ainsi menés sont généralement caractérisés par un rendement très faible et des coûts très élevés puisque plusieurs autres mesures et précautions accompagnent ce type d'intervention.

Lors des travaux de dragage au port de Bécancour, en 2010, une drague à benne preneuse a été utilisée dans des sédiments principalement composés de particules fines. Sur la base des observations et des mesures de la qualité de l'eau effectuées, le suivi environnemental a démontré que les travaux de dragage mécanique dans le bassin du port de Bécancour génèrent une augmentation mesurable de la turbidité et des MES. Toutefois, les augmentations en turbidité observées dans le bassin sont relativement peu importantes, locales et très ponctuelles. Tel que rapporté dans le Tableau 4, la plupart de ces dépassements surviennent dans un environnement assez rapproché de la drague (quelques dizaines de mètres et principalement dans la surverse du chaland) et à l'intérieur de la darse. Les résultats indiquent d'ailleurs une diminution de la turbidité et des MES en s'éloignant de la zone des travaux (CJB Environnement inc., 2010).

3.5 Rendement, productivité et coûts associés selon la méthode de dragage privilégiée

La présente section rassemble les renseignements fournis par les entrepreneurs en dragage consultés qui ont bien voulu faire part de leur évaluation du rendement de leurs équipements de dragage dans les matériaux retrouvés à Contrecoeur, ainsi que de la productivité anticipée et qui ont consenti à fournir un ordre de grandeur associé aux coûts des travaux selon la méthode favorisée (voir la note présentée en avant-propos).

Suite aux discussions, les différentes compagnies de dragage affirment avoir la meilleure méthode de dragage pour le type de matériaux rencontrés. Les principaux éléments soulevés par les entrepreneurs sont les suivants :

<u>Les dragues mécaniques</u> :

Rendement :

- *En raison de la nature du matériel à draguer, le dragage mécanique est la meilleure option*.
- *Il est difficile de séparer l'eau de ce type de matériel. Compte tenu du volume à draguer et des restrictions qui seront vraisemblablement émises concernant la qualité des eaux retournant au fleuve, ce projet nécessitera un gigantesque système de bassins de décantation qui sera difficile à construire sur le site et, en plus, sera très onéreux.*
- *Selon les entrepreneurs : i) le rendement peut varier entre 1000 m³/j à 6000 m³/j ; ii) le rendement peut varier entre 10 m³/cycle à 14 m³/cycle, soit de 14 400 m³/j à 20 160 m³/j, car 1 cycle prend 60 secondes.*

- **En considérant l'utilisation d'une drague mécanique de bonne capacité, le rendement peut varier entre 6 000 m³/j à 14 400 m³/j, allant même jusqu'à 20 160 m³/j.**

Productivité :

- *L'utilisation de grosses excavatrices diminuerait le temps de dragage par rapport aux dragues conventionnelles.*
- *Il serait préférable de draguer avec des godets, placer le matériel dans des chalands et transférer ce matériel dans les sites disponibles sur les terrains de l'APM. Les modalités de transbordement et de disposition sont détaillées respectivement aux sections 8.1.2 et 7.3*.
- *Deux dragues travaillant de concert prendraient une période de 5 mois, avec une bonne mise en place au lieu de transbordement, car l'efficacité globale des dragues mécaniques sera vraisemblablement limitée par l'opération du point de déchargement des chalands.*
- **Selon l'équipement, la durée des travaux peut s'étendre de 70 à 170 jours ou prendre aussi peu que 50 jours.**

Coûts :

- *En ce qui a trait à l'aspect économique, il est difficile de comparer les dragues mécaniques aux dragues hydrauliques à désagrégateur en raison de particularités et des variantes de chaque projet et du peu d'utilisation de la drague hydraulique au Québec.*
- *Le dragage mécanique des sédiments ne requiert aucune étape proprement dite de décantation et d'assèchement des sédiments avant leur entreposage. Ainsi, il n'y aurait pas de coûts faramineux liés au traitement des déblais de dragage et à la mise en place des cellules de sédimentation. Cependant, une petite quantité d'eau résiduelle associée au ruissellement et à l'essorage provenant des aires de disposition devront être gérées avant leur rejet au fleuve afin de respecter les normes de rejet.*
- *Les dragages d'entretien de la voie maritime réalisés en 2007 dans le fleuve Saint-Laurent, avec des dragues mécaniques à benne preneuse, ont été réalisés à un coût unitaire moyen variant entre 25 et 30 $ /m³ (M.-A. Baillargeon, comm. pers., cité dans Genivar, 2008). Il est à noter cependant que la disposition des matériaux s'est faite par un rejet en eau libre.*
- *Selon les entrepreneurs : i) l'emploi d'une drague à benne preneuse est moins dispendieux que l'emploi d'une drague hydraulique en raison du coût de mobilisation élevé de cette dernière ; ii) les coûts de mobilisation/démobilisation des équipements sont semblables, peu importe la méthode de dragage privilégiée. Ces coûts varient entre 1 000 000 $ à 1 500 000 $. Plus le volume à draguer est important, moins le coût unitaire sera élevé car les frais de mobilisation et démobilisation seront amortis sur un plus grand nombre de mètres cubes.*
- **Le coût unitaire pour le dragage de 1 000 000 m³ effectué avec une drague mécanique se situerait entre 10 $/m³ et 20 $/m³ (10 000 000 $ à 20 000 000 $), excluant le transbordement à quai qui est estimé à 10 $/m³ à 12 $ /m³, soit de 10 000 000 $ à 12 000 000 $.**

Les dragues hydrauliques à désagrégateur:

Rendement :

- *Elles sont rapides et efficaces particulièrement lorsque de grandes quantités sont à draguer sur une surface relativement petite.*
- *En théorie, elles peuvent travailler à des rythmes beaucoup plus élevés que les dragues mécaniques (voir Tableau 1). Cependant, il peut y avoir des écarts considérables entre le rendement de production théorique attendu versus le rendement réel.*
- *Elles possèdent de bonnes aptitudes pour le dragage dans un large éventail de sédiments et assurent une bonne précision lorsqu'un profil précis doit être dragué.*
- *Les matériaux seraient pompés directement dans les bassins de sédimentation évitant le transbordement et le transport par camions.*
- *Les déplacements minimes de la drague deviendront avantageux.*
- *À cette production, il faudra prévoir qu'une certaine quantité d'eau sera pompée avec le matériel en place. Un rapport « 3:1 » sera à considérer en ce qui a trait au volume des bassins de sédimentation par rapport au volume en place du matériel à draguer.*
- *La présence de multiples bassins de sédimentation permettrait de pomper le matériel d'un bassin à l'autre, laissant les premiers bassins remplis le temps de s'assécher tout en poursuivant les activités de dragage.*
- **Selon les compagnies de dragage : la capacité de dragage varie de 5 000 m³ de matériel par jour à 10 000 m³/jour. Certaines dragues peuvent être encore plus performantes (20 000 m³/j), cependant, la gestion de l'eau pourrait être problématique.**

Productivité :

- *L'utilisation d'une drague hydraulique à disque désagrégateur de plus grande capacité augmenterait certainement la production, mais le volume d'eau à gérer deviendrait vraisemblablement problématique. Avec ce type d'équipement, la durée des travaux est estimée à 50 jours. L'assèchement du matériel dans les bassins de sédimentation deviendrait un facteur important à considérer et pourrait commander l'ensemble des activités de dragage. Ce qui n'est pas souhaitable.*
- **Selon l'équipement, la durée des travaux peut s'étendre de 100 à 200 jours ou prendre aussi peu que 50 jours.**

Coûts :

- *Selon certains entrepreneurs, il est difficile pour le moment de statuer sur un budget étant donné qu'il faut tenir compte du coût de carburant, de la quantité de m³ à draguer, de l'emplacement retenu pour la disposition des sédiments, du transport, de la construction des bassins, de la période de l'année durant laquelle les travaux pourront être entrepris, etc.*
- *À titre d'exemple, le projet de dragage d'entretien au Québec qui utilise une drague hydraulique est celui du port de Gros-Cacouna, qui consiste à l'enlèvement de 75 000 m³ de matériaux et à la construction d'un bassin de sédimentation de 105 000 m³, pour un coût total de 2 377 500 $ (M.-A. Baillargeon, comm. pers., cité dans Genivar, 2008). Le coût unitaire est donc d'environ 31,70 $/m³, mais n'inclut pas le traitement des eaux de rejet, mis à part l'installation d'une barrière filtrante avant l'évacuation de l'eau dans le fleuve.*

- *Bien que les coûts de floculant ne soient pas déterminés, ils seront somme toute peu significatifs par rapport au coût total du projet. À titre comparatif, avec d'autres projets, un floculant cationique a été utilisé à une dose de l'ordre de 1,5 kg par tonne de matière sèche. Considérant l'échantillon de sédiments recueilli, il y aura environ 1 TMS pour chaque 2,25 tonnes de sédiments in situ. De façon théorique, il est prévu que la quantité de polymère soit de 1,5 kg dans 2 250 kg de sédiments.*
- **Les coûts de mobilisation/démobilisation des équipements varient entre 1 000 000 $ et 1 500 000 $.**
- **Les coûts du dragage hydraulique proprement dits varient entre 6 $/m³ et 18 $/m³, soit 6 000 000 $ à 18 000 000 $.**
- **À ce montant, il faut, entre autres, ajouter les frais reliés à la construction de bassins de traitement pour la gestion des sédiments, l'ajout de pompes de surpression en fonction de la distance et le niveau de dénivellation séparant le lieu de dragage et les bassins de traitement de même que le traitement des eaux résiduelles avant leur rejet au fleuve afin de respecter les normes de rejet, incluant l'addition de floculant en fonction des volumes dragués et des quantités d'eau produites et/ou l'installation d'une barrière filtrante avant l'évacuation de l'eau dans le fleuve.**
- **De plus, il faudra prévoir la gestion à long terme des sédiments dans le bassin ou l'élimination des sédiments asséchés à l'extérieur du bassin de décantation.**

En résumé, bien que théoriquement les dragues hydrauliques puissent travailler à des rythmes beaucoup plus élevés que les dragues mécaniques (voir Tableau 1), les entrepreneurs semblent très optimistes avec l'utilisation de dragues mécaniques (
Tableau 5). Avec de tels rendements, les deux types de dragues ne devraient donc pas être limités par des contraintes techniques ou par le calendrier environnemental.

En considérant un rythme de travail de 24 heures par jour avec certains arrêts pour des conditions météorologiques défavorables ou l'entretien des équipements, la durée des travaux de dragage est évaluée entre 3 à 7 mois, plus vraisemblablement autour de 6 mois.

Les dragues hydrauliques n'ont pas de contraintes dans le cas d'apport des matériaux vers la terre ferme. Les matériaux seraient pompés directement dans les bassins de sédimentation, évitant le transbordement et le transport par camions. Par contre, le dragage hydraulique des sédiments nécessite l'entraînement d'une quantité élevée d'eau afin de permettre le transport des sédiments par pipeline (refoulement) jusqu'au bassin de décantation. La construction de bassins de décantation est obligatoire. Le bassin de décantation retiendra la majorité de la fraction solide et l'eau devra être traitée suite à la décantation en bassin.

Malgré l'existence de dragues mécaniques à haut rendement, notamment de grandes dragues à benne preneuse, le fait que plusieurs dragues pourraient draguer simultanément et compte tenu de la concentration des matériaux et des déplacements somme toute limités, l'efficacité globale des dragues mécaniques sera vraisemblablement limitée par l'opération du point de déchargement des chalands. Une solution consisterait à décharger à partir les nouveaux quais, en supposant que l'aire d'arrière quai serait utilisable avant de procéder au dragage. Dans une telle situation, la mobilisation des équipements de déchargement et de transport des déblais pourrait alors être équivalente à celle d'un dragage hydraulique.

Finalement, les coûts de mobilisation/démobilisation sont considérés comparables pour les deux variantes (1 000 000 $ à 1 500 000 $). Par contre, les coûts de dragage proprement dits sont plus élevés avec un équipement mécanique, incluant la première manipulation (20 $/m³ à 32 $/m³), par rapport à un équipement hydraulique (6 $/m³ à 18 $/m³).

Cependant, le dragage hydraulique nécessitera la construction du système de bassins de décantation (1 000 000 $), l'ajout de floculant, le suivi de la qualité des eaux et, si nécessaire, une seconde manipulation (10 $/m³ à 12 $/m³).

Comme les coûts associés au traitement des déblais de dragage et des eaux associées à ceux-ci sont beaucoup plus importants dans le cas d'une drague hydraulique que dans le cas d'une drague mécanique, les coûts totaux des deux alternatives de dragage peuvent être considérés, a priori, comme comparables.

Tableau 5 Rendement, productivité et coûts associés, selon les informations obtenues, en fonction des dragues utilisées

4 Équipement utilisé		**5 Drague mécanique**	**6 Drague hydraulique à disque désagrégateur**
Rendement/drague		6000 m³/j à 14 400 m³/j (+ réaliste), allant même jusqu'à 20 160 m³/j	5000 m³/j à 10 000 m³/j (+ réaliste), allant même jusqu'à 20 000 m³/j
Productivité (durée des travaux)		Entre 70 et 170 jours (avec 2 dragues) (+ réaliste) et même aussi peu que 50 jours	Entre 100 et 200 jours (+ réaliste) et même aussi peu que 50 jours
Coûts	**Mobilisation/ démobilisation**	1 000 000 $ à 1 5000 000 $	1 000 000 $ à 1 5000 000 $
	Dragage de 1 000 000 m³ d'argile	10 $/m³ à 20 $/m³ (10 000 000 $ à 20 000 000 $)	6 $/m³ à 18 $/m³ (6 000 000 $ à 18 000 000 $)
	Suivi de la qualité de l'eau lors du dragage	Suivi de la qualité des eaux : 1000 $/j	Suivi de la qualité des eaux : 1000 $/j
	Première manipulation : c'est-à-dire, déchargement et placement sur le site avoisinant de l'APM	10 $/m³ à 12 $/m³ (10 000 000 $ à 12 000 000 $)	0 $
	Construction du système de bassins de décantation, etc.	Nécessite des aménagements mineurs qui sont inclus dans les coûts du traitement des déblais de dragage 0 $	Nécessite 50 000 m³ de matériaux (excavés, placés et compactés) pour la construction des digues = 1 000 000 $
	Traitement des déblais de dragage et des eaux associées - **ajout de floculant** - **suivi de la qualité des eaux**	Gestion des eaux de ruissellement et d'essorage - Suivi de la qualité des eaux : 1000 $/j	Ajout de floculant = 100 000 $ Suivi de la qualité des eaux : 2000 $/j
	Si nécessaire, deuxième manipulation : c'est-à-dire, exportation des matériaux asséchés vers l'extérieur à partir du bassin et/ou gestion sur le site avoisinant de l'APM	0 $	10 $/m³ à 12 $/m³ (10 000 000 $ à 12 000 000 $)
Coûts totaux approximatifs évalués en 2011-2012, sans taxes		21 000 000 $ à 33 500 000 $ + suivi de la qualité des eaux : 2000 $/j	8 000 000 $ à 20 500 000 $ + si nécessaire, 2e manipulation portant les coûts à 18 000 000 $ à 32 500 000 $ + suivi de la qualité des eaux : 3000 $/j

6.1 Scénarios de dragage envisageables

Différents scénarios de dragage peuvent être envisagés pour les travaux. À cet égard, seule l'APM pourra décider lequel ou lesquels elle veut privilégier. Ci-dessous, les combinaisons possibles sont reprises en considérant les équipements flottants et les équipements terrestres.

Dragage avec uniquement des équipements flottants

Dragage mécanique

Il existe plusieurs types de dragues mécaniques, dont la drague à benne preneuse, la drague à cuiller et la drague rétrocaveuse (section 3.1). Toutes ces dragues sont aptes à excaver les matériaux visés par les travaux, selon les profondeurs et les conditions de navigation qui seront rencontrées. Elles sont donc toutes retenues comme option potentielle de dragage.

Drague hydraulique à disque désagrégateur

La drague à désagrégateur est la seule drague hydraulique retenue, car les autres dragues hydrauliques ne sont pas adaptées aux types de matériaux ou aux conditions de dragage du projet (section 3.2).

Dragage avec une combinaison des équipements flottants et des équipements terrestres

Équipements flottants et équipements terrestres disposés sur le nouveau quai

L'utilisation d'équipements terrestres pourra être conjointe avec l'utilisation d'équipements flottants (drague mécanique et/ou drague hydraulique à disque désagrégateur). Cette combinaison serait possible dans la mesure où le nouveau quai serait construit avant le début des travaux de dragage. Malgré le fait que ces équipements ne pourraient pas atteindre la plus grande partie de l'aire à draguer, ils pourraient excaver directement une portion non négligeable des matériaux se trouvant devant la ligne du futur quai, où les profondeurs sont faibles. Les équipements terrestres pourraient ensuite continuer d'être utilisés pour vider les chalands remplis par des équipements flottants. Les équipements qui peuvent être utilisées de cette façon incluent les pelles rétrocaveuses et les grues munies de benne preneuse. Ces équipements ont les mêmes capacités et caractéristiques que des dragues rétrocaveuses ou à benne preneuse.

Équipements flottants et équipements terrestres disposés sur un chemin-digue temporaire

Dans un scénario un peu différent, des équipements terrestres pourraient aussi être utilisés à partir de chemins-digues temporaires, soit avant la construction du quai.

La mise en place de chemins-digues temporaires en front des futures installations portuaires permettrait d'atteindre une plus large portion de la zone à draguer avec des équipements terrestres. Plusieurs pelles pourraient prendre place sur le chemin-digue temporaire. Ce scénario écarterait une deuxième manipulation de sédiments, car ils seraient déposés directement dans les camions, évitant ainsi le transbordement « chaland-camion ». Les camions circuleraient en boucle sur le chemin-digue temporaire et transiteraient entre le site de dragage et le site de disposition terrestre.

Une fois le secteur dragué en front du chemin-digue temporaire, ce dernier serait déplacé vers la rive et le dragage d'une nouvelle zone pourrait débuter. Lorsque le dragage serait rendu au niveau des futures installations portuaires, les chemins seraient progressivement retirés et les matériaux pourraient être réutilisés comme remblais lors de la construction du quai. Les travaux restant à réaliser seraient complétés après la construction des installations portuaires, là encore avec des équipements terrestres.

La zone non atteignable, par des équipements terrestres sur le chemin-digue temporaire, serait alors draguée par des équipements flottants.

Les chemins-digues temporaires pourraient également être aménagés devant la ligne de quai, une fois la structure construite, pour atteindre une plus large portion de la zone à excaver. Toutefois, la mise en place de digue temporaire devant la ligne de quai une fois construite engendre des travaux d'excavation à la fin des travaux.

7 Identification des options et sites potentiels pour la disposition terrestre ou aquatique des sédiments dragués

Les sédiments dragués peuvent être gérés de plusieurs façons. Le choix des options est influencé par la nature et la qualité des matériaux dragués. À la section 7.1, les différents modes de gestion sont présentés et évalués en fonction des matériaux à draguer pour le projet de construction d'un terminal à conteneur à Contrecœur. Ensuite, aux sections 7.2 et 7.3, les modes de gestion jugés potentiels sont repris et des sites précis, qui pourraient être utilisés pour la disposition des sédiments dragués, sont identifiés et évalués. Finalement, la section 7.5 synthétise l'information obtenue.

7.1 Variantes pour la disposition terrestre ou aquatiques des sédiments dragués

7.1.1 Rejet en eau libre

Le rejet en eau libre peut être retenu comme mode de gestion pour des matériaux de tous les types de granulométrie dans la mesure où ils présentent des teneurs en contaminants relativement faibles et dans la mesure où leur mise en dépôt ne contribue pas à dégrader la qualité des matériaux en place ou à détériorer des habitats aquatiques. Les critères de qualité des sédiments applicables à la gestion des déblais de dragage en eau libre pour le projet de dragage à Contrecœur sont les Critères pour l'évaluation de la qualité des sédiments au Québec pour eau douce d'EC & MDDEP (2007). Selon le cadre d'application de ces critères pour les sédiments résultant de travaux de dragage, les sédiments ayant des teneurs inférieurs au CEO peuvent être rejetés en eau libre ou être utilisés à d'autres fins dans la mesure où le dépôt ne contribue pas à détériorer le milieu récepteur, tandis que le rejet en eau libre est proscrit pour les sédiments ayant des dépassements du CEF. Pour les sédiments avec des teneurs entre le CEO et le CEF, le rejet en eau libre ne peut être considéré comme une option valable que si l'innocuité des sédiments pour le milieu récepteur est démontrée par des tests de toxicité et que le dépôt ne contribue pas à détériorer le milieu récepteur.

Les sédiments à draguer ne présentent aucune contamination qui pourrait empêcher leur rejet en eau libre. Les seuls autres dépassements du CEO sont liés à des teneurs de métaux retrouvés naturellement dans les argiles postglaciaires (matériel de type 2). Il n'y aurait donc pas de contrainte du point de vue de la qualité des sédiments à l'utilisation d'un site de rejet en eau libre ayant un fond constitué de ces mêmes argiles. Dans le cas des sédiments sableux à draguer (matériel de type 1), il y encore moins de contrainte à leur utilisation étant donné leur faible teneur en métaux et en substances organiques.

7.1.2 Utilisation des matériaux à des fins d'aménagement faunique

Comme plusieurs études l'ont démontré au cours des dernières années, le dépôt des matériaux de dragage en eau libre peut aller de pair avec une politique de mise en valeur et de bonification du milieu lorsque les déblais sont utilisés à des fins de restauration, de stabilisation ou de création d'aménagements à caractère faunique. Ce type d'aménagement, qui nécessite des volumes de matériaux très importants, a été évalué.

7.1.3 Confinement en milieu aquatique

Le confinement en milieu aquatique est une technique efficace et souvent utilisée pour gérer des matériaux contaminés qui présentent un potentiel de toxicité (PIANC, 2002). Les sédiments sont déposés dans une dépression naturelle ou artificielle ou encore rejetés dans une zone calme et bien abritée et sont recouverts d'une couche de matériaux propres (Centre Saint-Laurent, 1992). Le

confinement en milieu aquatique vise à couper tous les contacts directs entre les sédiments et le milieu aquatique et les organismes qui y vivent. Ses objectifs sont donc, d'une part, de limiter la migration des polluants vers des secteurs non contaminés ou vers des éléments sensibles du milieu et, d'autre part, d'empêcher la biomobilisation des polluants par la faune ou la flore benthique au site même du dépôt.

En général, la couche de recouvrement doit avoir une épaisseur minimum de 0,5 mètre. La granulométrie des matériaux formant cette couche doit être suffisamment grossière pour résister à long terme aux conditions d'érosion du milieu tout en étant suffisamment fine pour assurer le confinement adéquat des matériaux contaminés. De façon générale, les matériaux qui rencontrent le mieux ces exigences sont les sables fins à moyens. Un recouvrement en couches successives (fin à grossier) peut également être envisagé. Ce mode de dépôt nécessite l'utilisation de quantités relativement importantes de matériaux grossiers non contaminés pour pouvoir confiner de façon sécuritaire les volumes de sédiments contaminés.

Selon PIANC (2002), les avantages des installations de confinement en milieu aquatique sont :

- Le site sera toujours en condition anoxique, donc les métaux lourds resteront immobiles.
- Pas visible aux communautés environnantes, donc sa présence est plus acceptable d'un point de vue esthétique que celle d'un dépôt terrestre.
- Relativement facile à réaliser.
- Les coûts d'entretien sont relativement faibles.

Selon PIANC (2002), les désavantages des installations de confinement en milieu aquatique sont :

- L'excavation d'un site aquatique (si nécessaire) est plus coûteuse que l'excavation d'une installation de confinement près des berges. L'excavation d'un site aquatique permet d'aller chercher 1 m³ d'espace de confinement pour chaque m³ excavé. Pour une installation de confinement près des berges dont les digues sont construites avec le matériel excavé (sable), on peut augmenter de 3 m³ le volume de confinement pour chaque m³ excavé.
- Non visible, donc non apparent à long terme et donc plus de risque d'une perturbation accidentelle du site.
- Plus grande probabilité de dispersion du matériel dragué contaminé dans les eaux de surface à cause du contact direct avec le plan d'eau.
- Des mesures additionnelles sont nécessaires lors du remplissage pour éviter la dispersion du matériel dragué contaminé.
- Impossible de contrôler la quantité de surnageant en contrôlant le niveau de l'eau dans l'installation de confinement, comme le confinement en berge le permet.

Puisque la qualité des sédiments à draguer dans le cadre du projet à l'étude permettrait leur rejet en eau libre sans confinement (voir section 7.1.1), cette option n'est pas retenue.

7.1.4 Dépôt en berge

Le dépôt en berge sans restriction peut être retenu pour des sédiments non contaminés lorsque les conditions d'érosion du milieu le permettent. La recharge des plages et des battures sont des exemples de ce type de mise en dépôt. Il faut toutefois souligner que les conditions de courant, de vagues ou de glaces qui prévalent généralement dans le Saint-Laurent, et tout particulièrement dans toute sa partie fluviale, sont rarement favorables à ce genre d'intervention.

Étant donné qu'ils ne présentent pas de contamination préoccupante (voir section 7.1.1), les matériaux dragués à Contrecœur dans le cadre du présent projet pourraient être placés en berge sans mesure de confinement. Par contre, il n'y a pas de zones en berge à l'intérieur de la zone d'étude où un tel dépôt serait souhaitable. La seule exception serait la mise en place des sédiments sableux (matériel de type 1) à l'intérieur de la zone du futur quai. À première vue, les autres matériaux à grandes proportion d'argile ou de silt n'ont pas les caractéristiques physiques

recherchées pour la construction des nouvelles installations et ne pourraient être utilisés de cette façon. Par contre, l'utilisation d'une nouvelle technique de réhabilitation par stabilisation et solidification permettrait de solidifier ces matériaux et ainsi accroître leur capacité portante.

En ce qui concerne les berges non visées par les futures structures, leur recouvrement aurait comme effet de fortement perturber les habitats présents et serait presque sûrement jugé inacceptable par les autorités responsables.

7.1.5 Confinement en berge

Le confinement en berge peut être une solution intéressante pour la mise en dépôt des matériaux dont la qualité varie de bonne à modérée (Centre Saint-Laurent, 1992). Il consiste à recouvrir les matériaux et à stabiliser le site de dépôt de façon à le protéger contre les conditions du milieu à l'aide de structures appropriées. Les sédiments peuvent ainsi être utilisés comme matériaux de remblai dans le cadre d'un projet d'agrandissement ou de construction d'une structure maritime. Les sédiments peuvent également être déposés dans un ouvrage de confinement construit à cet effet exclusif (PIANC, 2002). Dans ce dernier cas, le confinement en berge peut être utilisé pour la gestion de matériel présentant un grand potentiel de toxicité.

Comme pour le confinement en milieu aquatique, les objectifs de la protection ou du recouvrement sont, d'une part, d'empêcher la migration des sédiments vers d'autres sites et, d'autre part, d'éliminer complètement tout contact direct avec les sédiments contaminés. Toujours à l'instar du confinement en milieu aquatique, cette intervention a pour effet de réduire de façon très significative les échanges d'eau entre le milieu aquatique et les matériaux, sans toutefois les éliminer complètement; ceci a pour effet de maintenir les conditions physico-chimiques propices aux liaisons entre les sédiments et les contaminants. Des études ont d'ailleurs démontré le respect de ces objectifs sur des périodes de plusieurs années, prouvant l'efficacité à long terme de ce mode d'élimination (Travaux publics Canada, 1991).

Selon PIANC (2002), les avantages des installations de confinement en berge sont :

- Si le site demeure saturé et en condition anoxique, les métaux lourds resteront immobiles.
- L'excavation exigée est moins importante que pour les sites de confinement aquatique.
- Sites généralement très visibles, rendant une perturbation accidentelle du site peu probable.
- Moins de dispersion dans l'eau environnante à cause des digues. La seule possibilité de dispersion est liée à l'effluent du site pendant le remplissage.
- La surveillance est relativement simple et les endroits à surveiller sont faciles à identifier et sont d'accès facile.

Selon PIANC (2002), les désavantages des installations de confinement en île/près des berges sont :

- Ces sites sont construits en eau libre et peuvent causer une obstruction à la navigation.
- Les digues sont très visibles et peuvent engendrer des préoccupations de la part des populations.

Puisque la qualité des sédiments à draguer dans le cadre du projet à l'étude permettrait son dépôt sans confinement (voir section 7.1.1), cette option n'est pas retenue.

7.1.6 Mise en dépôt en milieu terrestre

Une fois placés en milieu terrestre, les sédiments dragués sont gérés comme des sols excavés. Au Québec, les utilisations permises pour ce type de matériel sont prescrites dans la Grille de gestion des sols excavés intérimaire de la *Politique de protection des sols et de réhabilitation des terrains contaminés* (MEF, 1998). Dans cette grille, les utilisations permises sont déterminées par le niveau de contamination en fonction des critères génériques de qualité des sols « A », « B » et « C ». Le Tableau 6 présente les options admissibles pour la gestion et la valorisation des sols en vertu de

cette politique. Ces règles s'appliquent aux sols contaminés, mais également aux matériaux dragués ayant des caractéristiques physiques comparables aux sols lorsqu'ils sont gérés en milieu terrestre.

L'élimination terrestre des sédiments dragués peut être une alternative intéressante au point de vue environnemental. Toutefois, les sédiments doivent être gérés de telle sorte qu'ils ne constituent pas une nouvelle source de contamination pour l'environnement. De plus, en raison de la nature même des matériaux, certaines utilisations ne peuvent être envisagées (par exemple, l'argile n'a pas une bonne capacité portante).

Les modalités de gestion prévues par cette grille sont complétées par les principes de base suivants :

- la qualité des sols propres doit être maintenue et protégée;
- la décontamination des sols contaminés excavés est privilégiée;
- la dilution est inacceptable;
- l'objectif de décontamination est la réutilisation des sols. (MENV, 1998, mis à jour en 2001).

Tableau 6 Options de gestion des sols contaminés excavés, selon la *Politique de protection des sols et de réhabilitation des terrains contaminés* du Ministère de l'environnement du Québec, modifiée en novembre 2001

Niveau de contamination	Options de gestion
< A	- Utilisation sans restriction.
Plage A - B	- Utilisation comme matériaux de remblayage sur les terrains contaminés à vocation résidentielle en voie de réhabilitation* ou sur tout terrain à vocation commerciale ou industrielle, à la condition que leur utilisation n'ait pas pour effet d'augmenter la contamination** du terrain récepteur et, de plus, pour un terrain à vocation résidentielle, que les sols n'émettent pas d'odeurs d'hydrocarbures perceptibles. - Utilisation comme matériaux de recouvrement journalier dans un lieu d'enfouissement sanitaire (LES). - Utilisation comme matériaux de recouvrement final dans un LES à la condition qu'ils soient recouverts de 15 cm de sol propre.
Plage B - C	- Décontamination de façon optimale*** dans un lieu de traitement autorisé et gestion selon le résultat obtenu. - Utilisation comme matériaux de remblayage sur le terrain d'origine à la condition que leur utilisation n'ait pas pour effet d'augmenter la contamination** du terrain et que l'usage de ce terrain soit à vocation commerciale ou industrielle. - Utilisation comme matériaux de recouvrement journalier dans un LES.
> C	- Décontamination de façon optimale*** dans un lieu de traitement autorisé et gestion selon le résultat obtenu. - Si l'option précédente est impraticable, dépôt définitif dans un lieu d'enfouissement sécuritaire autorisé pour recevoir des sols.

* Les terrains contaminés à vocation résidentielle en voie de réhabilitation sont ceux voués à un usage résidentiel dont une caractérisation a démontré une contamination supérieure au critère B et où l'apport de sols en provenance de l'extérieur sera requis lors des travaux de restauration.

** La contamination renvoie à la nature des contaminants et à leur concentration.

*** Le traitement optimal est défini pour l'ensemble des contaminants par l'atteinte du critère B ou la réduction de 80 % de la concentration initiale et pour les composés organiques volatils par l'atteinte du critère B. À cet égard, les volatils sont définis comme étant les contaminants dont le point d'ébullition est < 180 °C ou dont la constante de la Loi de Henry est supérieure à 6,58 x 10-7 atm-m^3/g incluant les contaminants répertoriés dans la section III de la grille des critères de sols incluse à l'annexe 2 de la *Politique de protection des sols et de réhabilitation des terrains contaminés*.

Ainsi, la mise en dépôt terrestre consiste à disposer des matériaux dans un lieu terrestre où ils pourront être utilisés comme remblai général. Cette option peut être envisagée pour des matériaux peu contaminés respectant les critères d'utilisation des sols. Les sédiments à draguer pour la construction du nouveau terminal à Contrecœur ont des teneurs soit sous le critère A du MDDEP ou dans la plage A-B. Étant donné que les dépassements du critère A sont surtout liés à des teneurs naturellement élevées dans les argiles postglaciaires locales, les sédiments à draguer pourrait être utilisée localement en milieu terrestre sans contrainte par rapport à la qualité chimique. Cependant, il pourrait être requis de démontrer que les sédiments mis en place ne porteront pas atteinte à la qualité du site choisi.

Les manipulations et les traitements nécessaires pour amener les sédiments sur terre ferme varient selon le type de matériel dragué et le type d'équipement utilisé (voir sections 3.4.1 et 3.4.2).

La nature physique des matériaux limite leur utilisation dans le cadre de travaux de remblayage sur des sites qui nécessiteraient une capacité de portance élevée. Cependant, une nouvelle technique de réhabilitation par stabilisation et solidification permettrait de solidifier les matériaux et ainsi accroître sa capacité portante (traité à la section 7.2.4).

Par ailleurs, ces argiles possèdent des caractéristiques physiques, incluant une bonne imperméabilité, qui pourraient les rendre intéressantes comme matériaux de remplissage et/ou de recouvrement dans un processus de réhabilitation ou de fermeture de sites.

Les matériaux pourraient également être disposés de façon stratégique sur la propriété de l'APM afin de créer des écrans acoustiques végétalisés. L'étude géotechnique et la caractérisation des sols confirmera la hauteur adéquate afin de ne pas créer une rupture de sol porteur et déterminera les pentes à créer afin d'assurer la stabilité. Par ailleurs, l'APM devra être conscient que la réalisation d'un tel projet exige des niveaux d'entretien, d'irrigation ou de désherbage qui ne sont peut-être pas souhaités.

7.1.7 Confinement sécuritaire en milieu terrestre

Le confinement en milieu terrestre consiste à disposer des matériaux dans un lieu approprié de manière sécuritaire et définitive. De façon générale, le confinement en milieu terrestre de matériaux de dragage devrait être retenu uniquement dans le cas de matériaux fortement contaminés. Cette méthode constitue généralement une mesure qui assure une protection appropriée de l'environnement pour ce type de matériel. Le principal objectif d'un dépôt sécuritaire en milieu terrestre est de fournir des conditions qui minimalisent non seulement les pertes de matériaux mais également la migration dans l'environnement des polluants contenus dans ces matériaux. L'aménagement des sites de dépôt doit donc comprendre l'utilisation de membranes ou de matériaux de construction imperméables et la collecte et le traitement des eaux de drainage et de lixiviation. Comme dans le cas de la mise en dépôt en milieu terrestre, le confinement en milieu terrestre requiert plusieurs manipulations pour accomplir le séchage et le transport des sédiments. En plus, il nécessite un site de confinement autorisé. Les coûts de cette alternative sont donc relativement élevés.

Selon PIANC (2002), les avantages des installations de confinement en milieu terrestre sont :

- Sites généralement très visibles, rendant une perturbation accidentelle du site peu probable.
- La surveillance est relativement simple et les endroits à surveiller sont faciles à identifier et sont d'accès facile.

Selon PIANC (2002), les désavantages des installations de confinement en milieux terrestre sont :

- Des mesures d'isolation peuvent être nécessaires pour réduire la migration des polluants.
- L'élimination de l'eau peut conduire à des conditions permettant l'oxydation du matériel dragué, augmentant les chances que les métaux lourds soient mobilisés.
- Les coûts de remplissage d'un site de confinement terrestre sont élevés.

Puisque la qualité des sédiments à draguer dans le cadre du projet à l'étude permettrait leur utilisation en milieu terrestre sans confinement (voir section 7.1.6), leur confinement n'est pas requis.

7.2 Évaluation des variantes pour la disposition terrestre ou aquatique des sédiments dragués

7.2.1 Rejet en eau libre

Trois sites de rejet en eau libre sont identifiés dans le secteur de Contrecœur : M-21, M-23 et M-27.

- Le site M-21 se trouve à proximité de la berge de l'île Bouchard, entre l'île aux Prunes et l'île aux Bœufs. Le site est à une distance de 5 km en amont du terminal existant. Selon les données de Procéan inc. *et al.* (1996), le fond du site est de sable sur silt argileux et contient des concentrations de chrome dépassant le CEO. Le site a une profondeur moyenne de 4 m et sa capacité est estimée à 30 000 m³ (Procéan inc. *et al.*, 1996). Ce site a possiblement servi lors des travaux d'approfondissement et d'élargissement de la voie navigable, mais il n'a probablement pas été utilisé récemment. Ce site est très rapproché d'une zone de fraie localisée près de la berge de l'île Bouchard. Il est également près de colonies d'hirondelles de rivage sur l'île aux Prunes et l'île aux Bœufs, et d'habitats du Rat musqué sur l'île Bouchard dans une aire de concentration d'oiseaux aquatiques (FAPAQ, 2001). Le site M-21 est enfin localisé dans une aire considérée comme un habitat propice pour l'Esturgeon jaune (Procéan inc. *et al.*, 1996). Selon SIGHAP (2007), le site M-21 se trouve dans une aire de concentration et d'alimentation de l'Esturgeon jaune, ainsi que dans une aire de reproduction de la Barbotte brune, du Crapet-soleil, du Grand brochet et de la Perchaude. Compte tenu des contraintes liées à la présence d'habitats fauniques d'intérêt et de sa capacité relativement restreinte, ce site est éliminé de l'analyse.
- Le site M-23 est le plus rapproché du Terminal maritime Contrecœur. Il se trouve juste au nord de la voie navigable, en aval de la pointe de l'île Bouchard à une distance de 2,4 km en aval du terminal. Ce site est caractérisé par un fond de sable sur silt argileux et sa capacité est estimée à 18 000 m3 (Procéan inc. *et al.*, 1996). La présence de sable en surface a été confirmée lors de l'échantillonnage en 2002 (CJB Environnement inc., 2003). Aucune concentration de contaminant au-dessus de la CEO n'a été détectée dans l'échantillon prélevé en 2002, mais l'échantillon prélevé en 1995 contenait des niveaux de chrome et de nickel au-dessus de la CEO (Procéan inc. *et al.*, 1996). Selon les données de Procéan inc. *et al.* (1996), la profondeur de l'eau à M-23 serait de 5,3 m et le site serait généralement stable. Toutefois, en condition de forte crue, une faible proportion de sédiments fins et non cohésifs pourrait être entraînée par le courant. Ce site aurait été utilisé dans le passé par la compagnie Iron Ore, probablement pour le dépôt des matériaux dragués lors de l'entretien du Terminal maritime Contrecœur durant la période où ces installations lui appartenaient (Procéan inc. *et al.*, 1996). Il est permis de croire que le site M-23 n'a pas été utilisé récemment. La pointe de l'île Bouchard constitue une frayère pour plusieurs espèces de poissons, un habitat du Rat musqué et il accueille une héronnière (Armellin et Mousseau, 1998; FAPAQ, 2001; SIGHAP, 2007). Malgré ces contraintes, la position de M-23 à une distance de quelques centaines de mètres en aval de ces habitats limite beaucoup les impacts potentiels de son utilisation. Par contre, ce site se trouve dans une aire de concentration d'oiseaux aquatiques lors de leur migration (FAPAQ, 2001) ainsi que dans un secteur autorisé et utilisé pour la pêche commerciale. Il se trouve également dans une aire de concentration de l'Esturgeon jaune (SIGHAP, 2007). Les contraintes environnementales et l'utilisation de ce secteur à des fins de pêche commerciale, combinées au fait que ce cite n'ait pas été perturbé depuis plusieurs années par des mises en dépôt et qu'il ne pourrait accueillir qu'une petite partie des sédiments à draguer font en sorte que cette alternative est exclue de l'analyse.

– Le site M-27 se trouve du côté Nord du fleuve vis-à-vis Lanoraie-D'Autray à une distance d'environ 12 km en aval du Terminal maritime Contrecœur. Selon les données de Procéan inc. *et al.* (1996), la profondeur de l'eau à M-27 serait de 4,3 m et le site serait généralement stable même si, en condition de forte crue, une faible proportion de sédiments fins et non cohésifs pourrait être entraînée par le courant. En 1996, le fond à M-27 était de sable et gravier sur silt argileux (Procéan inc. *et al.*, 1996). M-27 est dans une aire de concentration d'oiseaux aquatiques qui englobe toute la moitié nord du fleuve dans ce secteur (FAPAQ, 2001), mais ne se trouve à proximité d'aucun autre habitat faunique d'importance particulière. En effet, ce site ne chevauche aucun des habitats répertoriés par SIGHAP (2007). M-27 se trouve aussi à l'extérieur du secteur faisant l'objet d'une autorisation pour la pêche commerciale. Ce site a été utilisé lors d'un dragage d'entretien de la voie navigable en 1988 par la Garde Côtière. C'était aussi un des sites retenus pour le dépôt des matériaux dragués lors du dragage sélectif des hauts-fonds dans la voie navigable en 1999. Un volume de 2150 m³ de silts et d'argiles a été déposé sur le site en 1999 (CJB Environnement inc. et Procéan inc., 2000). Avant ces travaux, la capacité de ce site était de 150 000 m³ (Procéan inc. *et al.*, 1996). Le site est aussi utilisé à chaque année pour le dépôt de petits volumes lors de l'entretien de la voie navigable. L'utilisation plus récente de ce site fait qu'il représente un habitat déjà perturbé par des activités de dépôt de matériaux dragués. Compte tenu de l'absence de contraintes environnementales, l'utilisation du site de mise en dépôt M-27 pourrait constituer une solution acceptable pour la mise en dépôt des matériaux dragués lors de la construction du nouveau terminal à conteneurs à Contrecœur. Cependant, ce site ne peut accueillir qu'une fraction des sédiments à draguer et une fois rempli il ne pourrait plus être utilisé lors de l'entretien de la voie navigable. Par ailleurs, en raison du volume à disposer, l'impact que génèrerait le rejet d'un si gros volume sur l'habitat du poisson serait vraisemblablement inacceptable pour le ministère des Pêches et des Océans. Cette option n'est pas retenue.

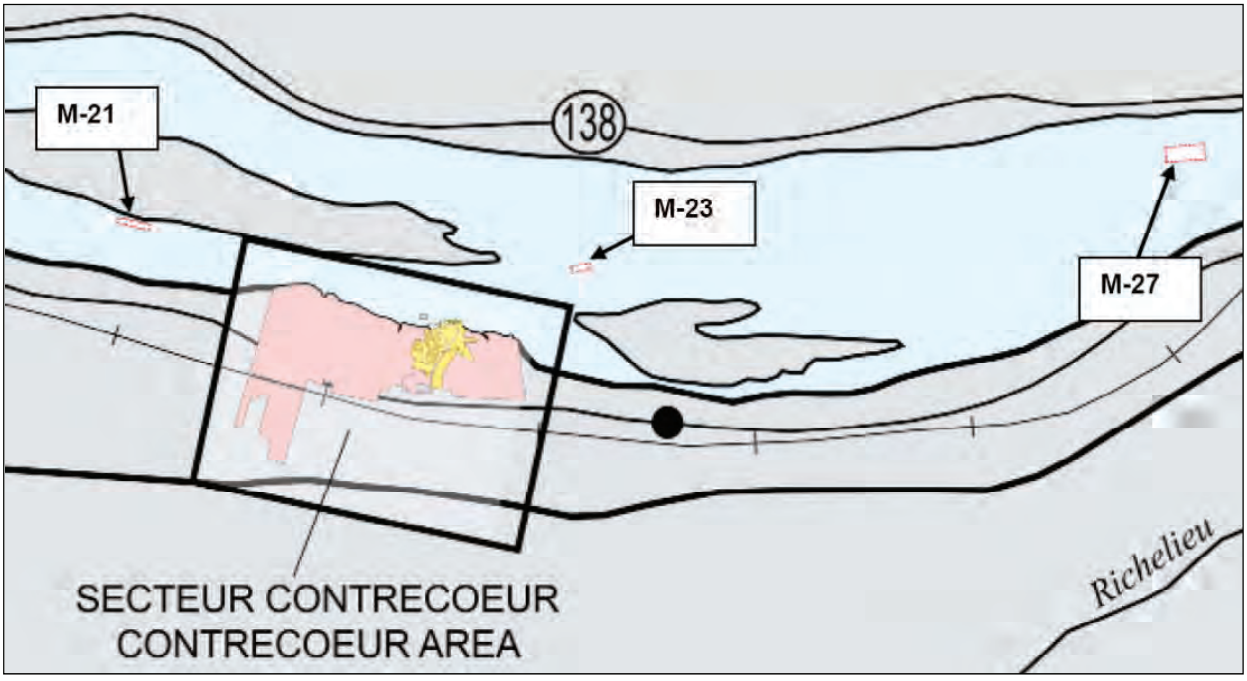


Figure 6 Localisation des sites potentiels de mise en dépôt dans le secteur de Contrecœur

7.2.2 Utilisation des matériaux à des fins d'aménagement faunique

Dans les années 1960 et 1970, plusieurs îles ont été créées ou ont été agrandies suite au dépôt de matériel de dragage provenant de l'approfondissement du chenal de navigation dans la région de Contrecoeur. Ce chapelet d'îles joue un rôle stratégique puisqu'il protège un immense marais émergent et submergé contre les vagues générées par le vent et le batillage. Ce marais offre des habitats de qualité à la sauvagine, aux poissons et à de nombreuses autres espèces animales, ce qui explique en très grande partie la valeur faunique de l'archipel de Contrecœur (Lehoux *et al*., 1997 cité dans Dauphin, 2000).

Le Service canadien de la faune (SCF) (comm. pers. Diane Dauphin, décembre 2011), d'Environnement Canada, rapporte que certaines de ces îles barrières, implantées en avant des îles de Contrecœur, se sont érodées depuis leur création. L'hypothèse que des matériaux de dragage pourraient être utilisés dans le but de préserver ces îles barrières afin qu'elles puissent poursuivre leur vocation de protection, a été soulevée. Le potentiel pour la faune avienne pourrait être augmenté en gérant bien l'aménagement.

Le SCF doit évaluer plus en profondeur la possibilité de créer cet aménagement et statuera sur la pertinence et la faisabilité d'un tel projet.

Plusieurs éléments devront être pris en compte :

- Des travaux d'enrochement au niveau de la réserve nationale de faune des îles de Contrecœur seraient vraisemblablement plus appropriés pour contrer l'érosion.
- Le secteur est localisé dans une Réserve nationale de faune (autre législation à gérer).
- Une évaluation environnementale devra être réalisée.
- Présence d'espèces en péril.
- Les plans d'aménagement de départ devront être étudiés pour connaître la hauteur des dépôts initiaux, les quantités de matériel utilisées et l'état de l'érosion actuelle.
- Le phragmite est très présent dans ce secteur. Il faudrait prévoir la plantation de phalaris pour permettre à la sauvagine de nicher. Cependant, préalablement, il faudrait valider que l'habitat soit adéquat.
- Après les travaux, un suivi serré devra être fait afin que le phragmite n'envahisse pas le phalaris.
- Un projet pilote pourrait être envisagé avant la réalisation des travaux.

Selon le ministère des Pêches et des Océans (MPO) (comm. pers. François Hazel et Stéphanie Rioux, décembre 2011), à priori, l'utilisation des matériaux de dragage pour réaménager les îles barrières semble davantage prioriser la faune avienne que la faune aquatique.

Plusieurs éléments tendent à diminuer l'intérêt d'un tel projet :

- En raison de la localisation des travaux et de son statut de Réserve nationale de faune, la réalisation de ces travaux impliquerait la province et vraisemblablement des autorisations à obtenir et l'ajout de délais supplémentaires dans le calendrier.
- Le projet d'expansion du terminal produira des perturbations et des impacts au niveau de l'habitat du poisson. Le projet d'aménagement faunique engendrera des impacts additionnels aux impacts globaux du projet initial. On pense entre autres à l'empiètement additionnel dans l'habitat du poisson, la perturbation au niveau du transport maritime dans la voie navigable, la remise en suspension des matériaux lors du dépôt, la présence des espèces en péril particulièrement au niveau des herbiers (ex. : fouille roche, chevalier cuivré), etc.

7.2.3 Confinement en milieu aquatique

Tel que mentionné à la section 7.1.3, cette option n'est pas retenue puisque la qualité des sédiments à draguer dans le cadre du projet à l'étude permettrait leur rejet en eau libre sans confinement (voir section 7.1.1).

7.2.4 Dépôt en berge

Tel que spécifié précédemment (section 7.1.4), les sédiments sableux (matériel de type 1) pourraient vraisemblablement être utilisés comme matériaux de remblayage à l'intérieur de la zone du futur quai. Ce mode de gestion aurait comme avantage de minimiser le déplacement et la manipulation des sédiments dragués. Étant donné la petite distance sur laquelle les sédiments seraient déplacés, les impacts sur le milieu seraient faibles. Ce mode de gestion pourrait aussi diminuer la quantité de matériel de remblayage requise dans la structure du quai et la quantité de matériel à gérer à l'extérieur de l'eau. Pour ces raisons, cette option peut être considérée comme un confinement du matériel dragué ainsi qu'une valorisation de ce matériel. Par contre, cette gestion aura un impact temporaire faible sur la qualité de l'eau au moment du dépôt via la mise en suspension de particules.

Il faut aussi noter que ce mode de gestion est seulement possible si les matériaux dragués sont acceptables pour la construction d'un point de vue géotechnique. Cette option devra être évaluée plus en profondeur sur le plan technique par les gens de l'APM si son utilisation est envisagée. Par ailleurs, le rapport de Moffatt & Nichol (2012) indique que:

> *The preliminary geotechnical data for the material within the expected dredge cut indicates that it is not suitable as structural fill and will definitely not be suitable as immediate fill to raise the terminal site or as backfill behind an SSP bulkhead or caisson wharf. At best, the material may be suitable as fill in a limited fashion after a few to several years of dewatering and consolidation*.

À cet effet, tel que mentionné précédemment, une technique relativement récente permettrait de solidifier les matériaux et ainsi accroître leur capacité portante. La technique de Retraitement Haute Performance (RHP) par stabilisation et solidification (S/S) des argiles par ajout dosé de ciment est une option qui peut être considérée a priori dans le cas présent. Généralement, cette technique de S/S permet de traiter des sédiments contaminés en y incorporant un liant d'inertage (ex. ciment), de l'eau et des additifs afin de le rendre sécuritaire au point de vue environnemental en immobilisant les contaminants. Des matériaux argileux ainsi solidifiés peuvent être valorisés en les utilisant comme remblai à haute capacité portante. Des projets ont été réalisés avec cette technique en Amérique du Nord et en Europe. Un entrepreneur spécialisé nous informe que des routes à grande capacité portante ont été construites de cette manière au Québec. Une intervention, sur une grande superficie et une épaisseur de plusieurs mètres, destinée à un usage industriel très spécifique et très exigeant, tel qu'un terminal à conteneurs, n'a toutefois pas été réalisée à notre connaissance avec le type de matériaux argileux dont il est question à Contrecoeur.

Dans le cas présent, bien que les matériaux ne soient pas contaminés, la technique de RHP par S/S servirait non pas à stabiliser des contaminants, mais plutôt à solidifier le matériau et ainsi accroître sa capacité portante, exigence fondamentale pour construire le terre-plein d'arrière-quai.

Selon quelques experts et entrepreneurs consultés, il semblerait envisageable de pouvoir utiliser des argiles champlainiennes consolidées au ciment comme remblai pour construire le terre-plein d'arrière-quai, même si la capacité portante recherchée pour ce remblai devra être très élevée (circulation de grues géantes et d'équipement de manutention de conteneurs).

Il est à noter qu'avant d'entreprendre le traitement à pleine échelle, il est impératif de réaliser des analyses en laboratoire et un essai pilote sur le site (plasticité de cette argile sur des échantillons intacts et sur des échantillons remaniés selon la méthode de dragage retenue, étude de mélange en appréciant la résistance en compression qui en résultera pour diverses teneurs en ciment).

Il faut noter que, sur la base d'informations préliminaires fournies par un entrepreneur spécialisé, l'approche de Retraitement Haute Performance (RHP) des argiles par ajout de ciment dans le cas du projet de Contrecoeur impliquerait très vraisemblablement que les travaux devraient s'étaler sur environ quatre ans, en raison du fait que les argiles enrichies au ciment devraient être placées et

compactées en couches annuelles successives (une couche de 1 m de matériaux de carrière serait tout de même requise en surface). Préliminairement, il est permis de penser que 4 couches seraient nécessaires pour placer une épaisseur totale de 4 mètres d'argile. Cette contrainte est limitante en ce sens qu'elle implique que les travaux de dragage pourraient devoir également être étalés dans le temps, entraînant possiblement plusieurs activités de mobilisation/démobilisation. Les matériaux dragués pourraient aussi être dragués en une seule fois et entreposés sur la propriété.

Les informations préliminaires obtenues d'un entrepreneur spécialisé indiquent d'autre part que les coûts de la « récupération » des argiles provenant du dragage pourraient se comparer avantageusement à ceux de l'utilisation de matériaux importés d'une carrière. Concernant uniquement cette composante, il est évalué très préliminairement que l'utilisation de l'approche RHP avec les argiles draguées, pour une superficie de 1 m² et une épaisseur de 5 m, pourrait représenter un coût de 150-200, alors que l'approche conventionnelle (importation de matériaux de carrière) représenterait un coût estimé à 275$. Cet avantage pourrait être réduit si les coûts sont influencés à la hausse en raison des contraintes de dragage et en raison de l'étalement dans le temps requis pour réaliser les travaux. Cette approche élimine toutefois les coûts de disposition des argiles à l'extérieur de la propriété si cette option est inévitable.

L'approche RHP par ajout de ciment comporte donc des avantages puisqu'elle permet de revaloriser sur le site les sédiments dragués, de réduire le transport et la disposition hors site et finalement, de minimiser l'importation de matériaux pour le remblayage. En contrepartie, cette approche comporte une certaine incertitude puisqu'elle nécessite un examen géotechnique approfondi en plus de représenter un défi technique car une telle utilisation à grande échelle ne connaît pas de précédent. De plus, elle requiert très vraisemblablement un étalement du calendrier de réalisation du projet de construction, ce qui peut entraîner des effets sur les coûts et la faisabilité globale du projet.

7.2.5 Confinement en berge

Tel que rapporté à la section 7.1.5, cette option n'est pas retenue puisque la qualité des sédiments à draguer dans le cadre du projet à l'étude permettrait son dépôt sans confinement (voir section 7.1.1).

7.2.6 Mise en dépôt en milieu terrestre

Tel que mentionné à la section 2.2.3, quelques dépassements du critère « A » du MDDEP sont observés dans les matériaux à draguer. Cependant, il faut noter que les teneurs en chrome, en cuivre et en nickel sont naturellement plus élevées dans les argiles postglaciaires (EC & MDDEP, 2007) et que les teneurs mesurées en profondeur ne peuvent pas être associées à une contamination anthropique. Aucun dépassement du critère « B » du MDDEP n'a été rapporté.

Ainsi, dans le cas où une gestion terrestre des sédiments dragués serait envisagée, il n'est pas certain a priori qu'une utilisation sans aucune restriction serait possible à l'extérieur de la propriété de l'APM. Cependant, les matériaux pourraient être utilisés comme matériel de remblayage sur un terrain à vocation commerciale ou industrielle (voir section 7.1.6).

Peu importe le type de mise en dépôt retenu, les organismes promoteurs des aménagements qui impliqueront une utilisation des matériaux dragués au port de Contrecœur devront déterminer les besoins et les contraintes spécifiques à leur projet, conduire les études techniques requises, obtenir les permis environnementaux et absorber les coûts additionnels associés aux travaux préliminaires de faisabilité et de conception, aux diverses caractérisations pré et post-travaux sur le terrain récepteur, aux acquisitions de terrain, aux ententes avec les propriétaires, aux permis et autorisations qui seront requis, à la mise en place des aménagements permanents de même qu'au suivi, si requis par les autorités.

L'évaluation des diverses options de gestion potentielle en milieu terrestre est présentée selon les regroupements suivants :

- Sites potentiels pour la disposition terrestre des sédiments dragués, sur la propriété de l'APM (section 7.3), et
- Sites potentiels pour la disposition terrestre des sédiments dragués, à l'extérieur de la propriété de l'APM (section 7.4).

7.2.7 Confinement sécuritaire en milieu terrestre

Puisque la qualité des sédiments à draguer dans le cadre du projet à l'étude permettrait leur utilisation en milieu terrestre sans confinement (voir section 7.1.6), leur confinement n'est pas requis.

7.3 Sites potentiels pour la disposition terrestre des sédiments dragués, sur la propriété de l'APM

Les résultats physico-chimiques des sédiments à draguer permettent de gérer les matériaux en milieu terrestre. La présente section traite uniquement de la disposition terrestre des matériaux sur la propriété même de l'APM.

Le moment des travaux (avant ou après la construction des installations portuaires) et la méthode de dragage privilégiée (mécanique ou hydraulique) détermineront la localisation des zones potentielles d'entreposage.

Un dragage réalisé avant la construction du terminal portuaire laisserait plus de latitude pour entreposer les matériaux à assécher. Cependant, selon le lieu d'entreposage sélectionné, il faudra peut-être prévoir le déplacement des matériaux afin de ne pas nuire aux futures opérations du terminal. Par contre, si les travaux de dragage sont réalisés après la construction du terminal, ceci déterminera inévitablement l'emplacement disponible restant. La Figure 7 présente les opportunités de zones de disposition avant les travaux et la Figure 8 celles après les travaux. Quatre grands secteurs ont été identifiés pour recevoir les matériaux dragués.

Si le dragage mécanique est choisi, les matériaux seront entreposés directement sur le site. Si le dragage hydraulique est sélectionné, les matériaux iront obligatoirement dans des bassins de sédimentation. Il est à noter que les matériaux pourront être entreposés pour une durée permanente ou temporaire peu importe la disposition retenue. Seuls les matériaux dragués hydrauliquement nécessiteront un temps de décantation dans les bassins de sédimentation avant une seconde manipulation, si nécessaire. Cette durée pourra varier de quelques semaines à quelques mois selon les caractéristiques voulues.

La propriété est bordée au nord-ouest par le Saint-Laurent et comprend trois ruisseaux ou portions de ruisseaux, qui s'écoulent tous trois du sud-est vers le nord-ouest, en direction du fleuve. Ces ruisseaux traversent des zones agricoles ou zones artificialisées, adoptant pour une partie de leur parcours un tracé rectiligne typique des fossés agricoles. Ces ruisseaux sont localisés sur les Figures 7 et 8. Le ruisseau du centre, le seul qui soit verbalisé, porte le nom de « Fossé noir ». Pour les besoins de présentation des résultats, les trois ruisseaux sont nommés d'après leur position du nord-est au sud-ouest, soit les « Ruisseau 1 », « Ruisseau 2 » et « Ruisseau 3 ». Le Fossé noir correspond ainsi au « Ruisseau 2 ». Il s'agit dans les trois cas de ruisseaux intermittents, dont les apports proviennent de secteurs agricoles dans le cas des Ruisseaux 2 et 3, et de la zone industrialo-portuaire dans le cas du Ruisseau 1.

Les zones 1 et 2 sont identifiées comme zones potentielles de disposition terrestre et/ou zones potentielles de mise en place de bassin de sédimentation. Des pourparlers sont présentement en cours pour que, lors des travaux de construction, le ruisseau 3 puisse être relocalisé/détourné. Pour

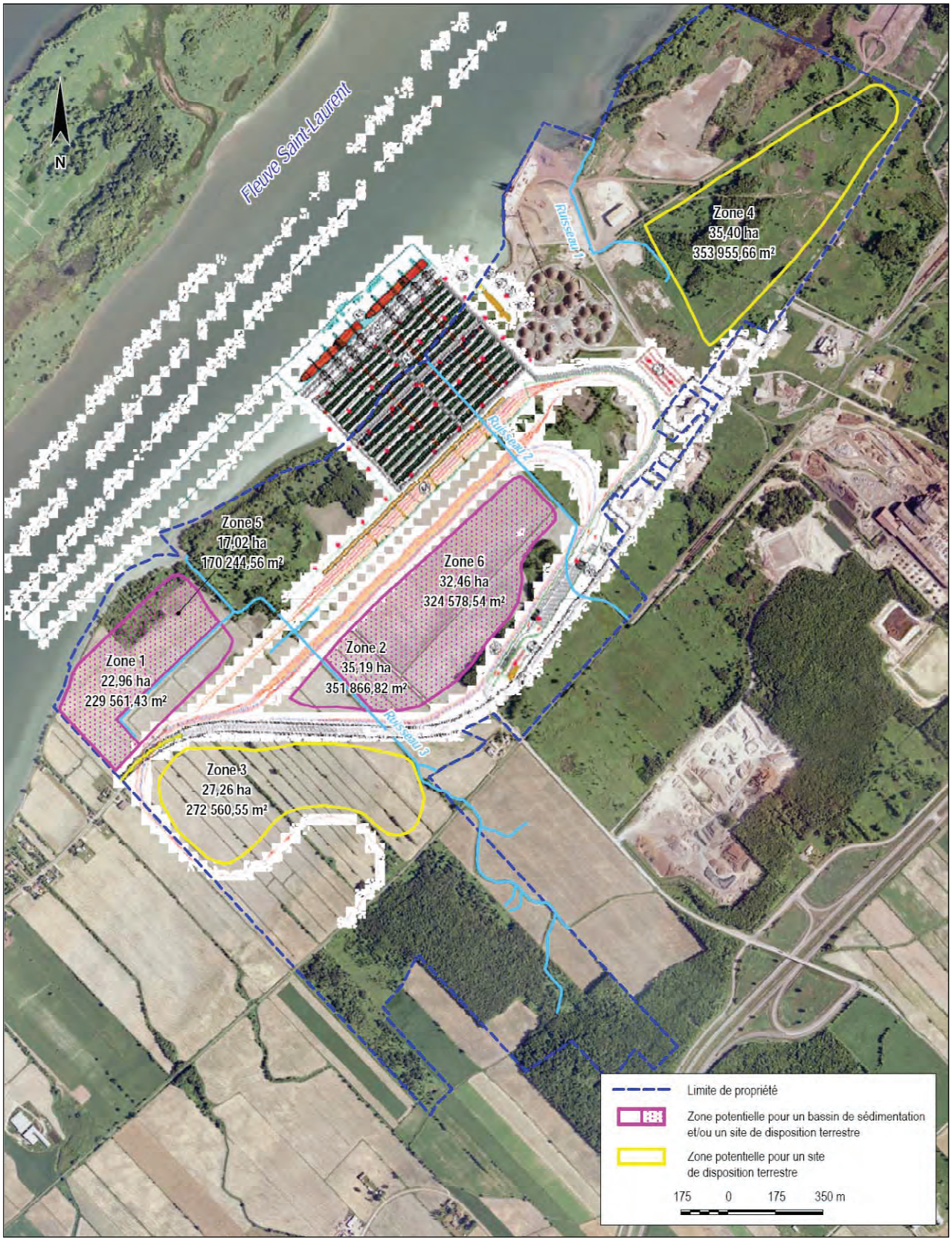
l'instant, afin de tenir compte de la présence du ruisseau 3, des zones plus petites ont été délimitées à l'intérieur du périmètre comme étant les zones 5 et 6.

Pour leur part, les zones 3 et 4 ont été identifiées comme zones potentielles de disposition terrestre seulement. Ainsi, elles pourraient recevoir les matériaux dragués mécaniquement ou bien les matériaux asséchés dans les bassins de décantation. La zone 3 est localisée au sud de la route 132, tandis que la zone 4 est à proximité du futur site de compensation.



Source : APM, 2011.

Figure 7 Emplacements potentiels sur la propriété de l'APM (avant les travaux) pour mettre des bassins de sédimentation et/ou entreposer des matériaux



Source, APM, 2011.

Figure 8 Emplacements potentiels sur la propriété de l'APM (après les travaux) pour mettre en place des bassins de sédimentation et/ou entreposer des matériaux

7.3.1 Superficies disponibles sur la propriété de l'APM

La propriété de l'APM est très étendue et présente des opportunités de mise en place de bassins de décantation et de sites de disposition terrestre. Par contre, certains facteurs doivent être pris en compte dont entre autres :

- la limite de la propriété ;
- la présence des cours d'eau sur le site ;
- la présence des milieux humides;
- la route 132 qui sépare les deux secteurs de la propriété ;
- les futures installations portuaires ;
- l'emplacement des possibles aménagements de compensation.

La zone 1 est localisée à l'endroit où sera construite la phase 2 du projet de développement d'un terminal à Contrecoeur. Ce secteur sera disponible pour encore plusieurs années. Cependant, il faudra prévoir qu'il sera réutilisé éventuellement. La zone 1 ne rencontre aucun obstacle (voies de transport routières ou ferroviaires). La superficie disponible est estimée à près de 23 ha, soit une zone de 650 m x 350 m, pour un site de disposition terrestre ou un bassin de sédimentation.

L'emplacement 2, immédiatement au sud des futures installations, offre un espace de 70 ha, avant les travaux. Une fois les installations portuaires construites (terminal, voies ferrées, etc,), cette zone est restreinte à 35 ha. L'APM ne prévoit pas utiliser ce secteur à court ou long terme. Les matériaux dragués pourraient demeurer définitivement dans cette dernière zone, le bassin de sédimentation étant transformé en site de disposition terrestre permanent.

Au sud de la route 132, à plus de 1,2 km de la rive du fleuve, un troisième emplacement est identifié. La présence de la route ne constitue pas un obstacle pour la mise en place d'une conduite de pompage en cas de dragage hydraulique, mais la distance peut présenter des contraintes. Pour cette raison, seul un site de disposition terrestre est privilégié. Une zone de 51 ha (avant les travaux) ou de 27 ha (après les travaux) pourrait s'y insérer.

Finalement, un quatrième secteur est localisé à l'est du site, soit dans la partie au sud de la zone de marais à quenouilles, entre le chemin vers Acerlor Mittal et la route 132. L'APM ne prévoit aucun projet dans ce secteur d'environ 35 ha. Cet espace pourrait être utilisé pour une disposition finale des matériaux asséchés. La mise en place d'un bassin de décantation dans ce secteur serait plus problématique (opérations à proximité, voies de transport routières ou ferroviaires, distance, etc.). Il est à noter que, dans le cadre du projet de compensation pour l'habitat du poisson, la zone de marais à quenouilles est susceptible d'être utilisée pour des aménagements compensatoires. D'autres aménagements ont également été proposés par la firme Écogénie, dont entre autres, l'aménagement d'un lac et le détournement d'un cours d'eau (ruisseau #2 ou #3). L'APM devra statuer sur le projet de compensation qui sera mis en place.

Tel que mentionné précédemment, les zones 5 et 6 sont des zones plus petites qui ont été délimitées à l'intérieur du périmètre des zones 1 et 2 pour tenir compte du ruisseau 3. Ainsi la zone 5 passerait à 17 ha. En ce qui a trait à la zone 6, elle passerait à 57 ha, avant les travaux, ou à 32 ha, après les travaux. Puisque que ces zones sont des parties intégrantes des zones 1 et 2, elles pourront également être utilisées pour un site de disposition terrestre ou un bassin de sédimentation.

Le Tableau 7 présente l'ensemble des dimensions pour chacune des zones potentielles identifiées aux Figures 7 et 8.

Tableau 7 Dimensions approximatives des zones potentielles pour la mise en place de bassin de sédimentation et/ou de site de disposition terrestre sur la propriété de l'APM

Zone potentielle pour un bassin de sédimentation et / ou un site de disposition terrestre	Avant ou après la mise en place des infrastructures portuaires	Dimensions approximatives	Surface en hectares	Superficie en mètres carrés
Zone 1	Avant	650 m x 350 m	22,96 ha	229 561,43 m²
	Après	650 m x 350 m	22,96 ha	229 561,43 m²
Zone 2	Avant	1240 m x 565 m	70,03 ha	700 338, 64 m²
	Après	938 m x 375 m	35,19 ha	351 866,82 m²
Zone 3	Avant	765 m x 670 m	51,26 ha	512 616,60 m²
	Après	593 m x 460 m	27,26 ha	272 560,55 m²
Zone 4	Avant	1042 m x 340 m	35,40 ha	353 955,66 m²
	Après	1042 m x 340 m	35,40 ha	353 955,66 m²
Zone 5*	Avant	670 m x 255 m	17,02 ha	170 243,77 m²
	Après	670 x 255 m	17,02 ha	170 243,77 m²
Zone 6*	Avant	995 x 580 m	57,7 ha	576 992,77 m²
	Après	984 x 330 m	32,46 ha	324 578,54 m²

* Les zones 5 et 6 sont des zones plus petites qui ont été délimitées à l'intérieur du périmètre des zones 1 et 2 pour tenir compte du ruisseau 3.

7.3.2 Superficie nécessaire pour l'entreposage terrestre des matériaux dragués

La superficie nécessaire pour entreposer les matériaux dragués sur un site de disposition terrestre a été évaluée en considérant un empilement d'une hauteur maximale de 5 mètres de matériaux argileux. L'étude géotechnique et la caractérisation des sols confirmera si cette hauteur est adéquate afin de ne pas créer une rupture de sol porteur et déterminera les pentes à créer afin d'assurer la stabilité.

Puisque les sédiments à draguer sont constitués majoritairement d'argile, un facteur de foisonnement de 1,3 a été ajouté aux matériaux ce qui porterait à 1 300 000 m³ le volume chaland à disposer. Si une hauteur de 5 mètres est autorisée pour l'entreposage final, alors une superficie d'environ 260 000 m² (près de 510 m x 510 m) sera nécessaire pour entreposer les matériaux.

En considérant les zones potentielles pour un site de disposition terrestre temporaire ou permanent, soit avant ou après les travaux, les zones 2, 3, 4 et 6 pourraient être utilisées sans contrainte de superficie (Figure 7 et Figure 8). Par contre, bien que les zones 1 et 5 puissent recevoir des matériaux pour un entreposage temporaire à long terme, la superficie ne permettrait pas de recevoir l'ensemble des matériaux dragués. Il manque une superficie de 30 439 m², pour recevoir environ

152 200 m³ de matériaux. Une combinaison avec une autre zone d'entreposage pourrait toutefois être envisagée.

7.3.3 Superficie nécessaire pour la mise en place de bassin de sédimentation

Le dragage hydraulique de 1 000 000 m³ de sédiment nécessitera la création de vastes bassins de sédimentation aptes à recevoir le mélange eau-déblais, puisque la teneur en eau sera très considérable.

La dimension nécessaire aux bassins de sédimentation a été établie à partir des données recueillies dans le cadre d'un projet de dragage ayant des matériaux et un volume similaires, soit le projet du port de Bécancour (Marsan, 1983).

Pour entreposer un volume de 1 110 000 m³ de sédiments, le port a utilisé un bassin de 84 ha et placé les sédiments sur une épaisseur de 2 mètres. La superficie des installations n'était pas problématique. Certains spécialistes en dragage recommandent d'évaluer un rapport 3:1 en ce qui a trait au volume des bassins de sédimentation par rapport au volume en place du matériel à draguer. Ainsi, pour un volume correspondant à 3 000 000 m³ (sédiments et eau), l'aménagement de tels bassins de sédimentation nécessiterait un espace de 150 hectares (1 224,7 m x 1 224,7 m).

Toutefois, dans le cadre du présent projet, la nature des matériaux à draguer et le volume étant similaires au projet réalisé à Bécancour, il est permis de croire qu'une superficie de 840 000 m² ou 84 ha (916,5 m x 916,5 m) serait adéquate pour aménager des bassins de sédimentation avec une profondeur de 2 mètres.

Ceci étant dit, la présence de multiples bassins de sédimentation permettrait de pomper le matériel d'un bassin à l'autre, laissant les premiers bassins remplis le temps de s'assécher tout en poursuivant les activités de dragage. Il ne serait pas souhaitable d'avoir une drague hydraulique ultra-performante car le volume d'eau à gérer serait davantage problématique et l'assèchement du matériel dans les bassins de sédimentation pourrait limiter les activités de dragage.

Si le dragage hydraulique est effectué avant la construction des installations portuaires, et ce, en une seule saison, l'utilisation des zones 1 et 2 (Figure 7) seraient nécessaires pour obtenir la superficie recommandée pour la mise en place des bassins de sédimentation.

Par contre, si le dragage hydraulique est effectué après la construction des installations portuaires, et ce, en une seule saison, l'utilisation combinée des zones 1 et 2 (Figure 8) serait insuffisante pour retenir les matériaux dragués et l'eau générée par cette méthode de dragage.

Toutefois, si les travaux de dragage sont effectués sur deux saisons, alors, il pourrait être envisagé de réorganiser les matériaux dans les bassins ce qui permettrait de poursuivre les travaux de dragage en utilisant les bassins déjà en place.

7.4 Sites potentiels pour la disposition terrestre des sédiments dragués, à l'extérieur de la propriété de l'APM

La présente section traite uniquement des sites potentiels pour la disposition terrestre des sédiments dragués, à l'extérieur de la propriété même de l'APM. L'ensemble des démarches est présenté à l'Annexe 2.

7.4.1 Sites miniers

Le ministère des Ressources naturelles et de la Faune (MRNF) gère la restauration des sites miniers abandonnés au Québec. Des efforts importants ont été consentis afin de développer des méthodes de restauration efficaces et économiques. L'utilisation et la revalorisation de matières résiduelles, la conception de systèmes de traitement passif et finalement l'intégration des concepts d'aménagement d'habitats fauniques aux travaux de restauration des sites miniers s'intègrent parfaitement au concept de développement durable.

Selon le MRNF (comm. pers. Jean Dionne, décembre 2011), l'utilisation de matériaux de type argileux, provenant du dragage à Contrecœur, serait une option très intéressante pour confiner ces résidus acidogènes.

D'ici 2 ou 3 ans, de nombreux sites miniers abandonnés au fil des ans devront être restaurés. Les principaux sites visés sont localisés principalement dans le secteur de Montauban, région administrative de la Mauricie, soit à environ 175 km de Contrecœur. Le MRNF (comm. pers. Jean Dionne, décembre 2011) stipule que le report des travaux de restauration de ces sites pourrait être envisagé si l'APM peut leur garantir que les matériaux rencontrent les exigences au niveau des caractéristiques physico-chimiques et que ces matériaux seront disponibles au moment opportun.

D'autres sites miniers, dans le secteur de Sherbrooke, pourraient également faire l'objet de restauration. Cependant, il n'y a rien de définitif pour le moment dans cette région.

En février 2012, le MRNF (comm. pers. Jean Dionne) affirme que dans la mesure où ces matériaux sont requis pour la restauration de sites miniers et qu'ils sont livrés gratuitement sur le site minier, le MRNF prendrait en charge la disposition de ces derniers sur le terrain.

7.4.2 Sablières et carrières

Selon le *Règlement sur les carrières et sablières* (Q-2, r. 7, Q-2, r.2), la restauration du sol a pour objet de réinsérer la carrière ou la sablière dans l'environnement après la cessation de son exploitation. Ainsi le plan de restauration du sol d'une carrière ou d'une sablière doit être constitué d'une ou plusieurs des options suivantes:

a) régalage et restauration de la couverture végétale du sol (arbres, arbustes, pelouse ou culture);
b) remblayage par l'une ou l'autre des matières suivantes:
   i. de la terre, du sable, du gravier ou de la pierre;
   ii. des résidus de nature minérale issus de l'extraction d'agrégats;
   iii. des boues générées par les bassins de sédimentation utilisés dans les procédés d'extraction d'agrégats ou de transformation de pierre de taille, dont la siccité est égale ou supérieure à 15% et qui, lorsque mises à l'essai par un laboratoire accrédité par le ministre en vertu de l'article 118.6 de la Loi, ne contiennent pas de liquide libre;
   iv. des particules de nature minérale récupérées par un système d'épuration d'air et issues du concassage et du tamisage d'agrégats, de pièces de béton de ciment ou de brique, à l'exception de la brique réfractaire;

   et restauration de la couverture végétale de la surface;
c) aménagement avec plans d'eau;
d) projet d'aménagement récréatif ou projet de construction.

Les carrières abandonnées qui ne font pas l'objet de réaménagement et de réhabilitation au moment de leur fermeture peuvent constituer une menace pour l'environnement et pour le paysage.

Le MDDEP (comm. pers. Pierre Fortin, décembre 2011) croit qu'il pourrait y avoir des opportunités de réutilisation des matériaux de dragage dans des carrières qui sont en processus de fermeture. Si les matériaux ont des caractéristiques physico-chimiques adéquates, ils pourraient être utilisés comme matériaux de recouvrement dans le processus de réhabilitation de carrières localisées dans la région administrative de la Montérégie.

Étant donné qu'il n'est pas du mandat du MDDEP de négocier avec les propriétaires, en février 2012, M. Fortin du MDDEP a fourni les coordonnées de CJB Environnement inc. aux personnes impliquées dans le projet de réhabilitation de l'ex-carrière Landreville.

M. Fabrice Fua, de Écosynergie et gestionnaire de projets chez Les Carrières Rive-Sud, montre un vif intérêt pour les matériaux argileux, tout particulièrement pour la réhabilitation de l'ex-carrière Landreville, localisée à Boucherville, soit à environ 40 km de Contrecoeur. Ce site a été identifié dans le cadre du programme du Groupe d'étude et de restauration des lieux d'élimination de déchets dangereux (GERLED), dans le but de réaliser l'inventaire des lieux d'élimination de déchets dangereux se trouvant sur le territoire québécois. En février 2012, Écosynergie (comm. pers. Fabrice Fua) mentionne que la disposition des matériaux dragués représente des coûts. Cependant, ils sont prêts à proposer un service clé en mains qui pourrait inclure le transport des matériaux asséchés jusqu'à leur site, sans toutefois spécifier de montant. Puisque leur calendrier de travail n'est pas arrêté, il est difficile de statuer sur le moment de la prise de possession des matériaux et de l'endroit (directement au quai ou au site d'entreposage).

Suite à la consultation des caractéristiques physico-chimiques des matériaux, Écosynergie (comm. pers. Fabrice Fua, 16 mars 2012) affirme qu'il serait envisageable d'intégrer les matériaux dans le cadre de la restauration de l'ex-carrière Landreville. Au cours des prochains mois, ils feront une demande de certificat d'autorisation pour leur futur projet de réhabilitation. Par la suite, des ententes avec le MDDEP et la Ville suivront. Suite à l'obtention de ces éléments, M. Fua prévoit qu'ils seront en mesure d'élaborer un plan d'affaire avec l'APM, soit vraisemblablement au cours de l'automne 2012.

En ce qui a trait à la possibilité de disposer les matériaux dragués dans une sablière, la sablière Gersol, située à Saint-Roch-de-Richelieu, soit à moins de 15 km du site des travaux, serait intéressée à recevoir ces matériaux.

Les coûts estimés, selon la valeur du marché de 2012 (comm. pers. Jules Colette, Gersol Construction Inc. / Sables Colette, février 2012), vont comme suit : le transport des matériaux dragués vers la sablière serait de 7,50 $/m³ et la disposition de 2,50 $/m³. Le calcul est basé sur 1 mètre cube = 2 tonnes métriques. Ce prix pourrait être modifié en fonction du matériel à disposer et de l'opportunité de retourner des matériaux de remblayage vers les installations de Contrecoeur.

7.4.3 Site de traitement des sols contaminés

Les sites de traitement des sols contaminés doivent se conformer au *Règlement sur l'enfouissement de sols contaminés* émis en 2001 par le ministère de l'environnement.

Lorsqu'une cellule à sécurité maximale, aménagée pour recevoir des sols contaminés, atteint sa pleine capacité, elle est recouverte de façon définitive à l'aide d'une couche d'étanchéité imperméable. Les matériaux argileux provenant du dragage à Contrecœur seraient adéquats pour ce type d'intervention.

Enfoui-Bec, localisé à Bécancour, est un site d'enfouissement autorisé par le MDDEP pour la disposition sécuritaire des sols contaminés. Selon Louis-Marc Bourgouin (comm. pers., Directeur du développement, décembre 2011), Enfouibec prévoit fermer quelques cellules de manière définitive dans 3 ans et un plus grand nombre dans environ 5 ans.

Suite à l'étude des résultats et autres renseignements disponibles sur la nature physico-chimique des matériaux à disposer, Enfoui-Bec s'est montrée intéressée par l'acquisition des matériaux. Le tarif de disposition est estimé à 10 $/t.m., après avoir fourni la preuve que les résultats des matériaux à disposer proviennent d'un laboratoire certifié et qu'ils soient conformes aux exigences réglementaires sur les sols contaminés. Ce tarif pourra être revu à la baisse si Enfoui-Bec est à la recherche de matériaux de recouvrement pour la fermeture de certaines cellules.

Sise à Contrecoeur, l'usine de traitement de Northex Environnement est une compagnie de traitement et de valorisation des sols. Leur usine de traitement et de technologies permettent de traiter une gamme impressionnante de sols à contamination organiques ou mixtes (plages B-C, C+ et >RESC). Les sables et graviers ont une valeur certaine, les argiles et silts également, s'ils sont amendés avec des engrais dans le cadre de traitement biologique, leur donnant ainsi une valeur ajoutée permettant d'envisager une réutilisation dans des cultures spécifiques en se substituant à d'autres intrants. Après avoir fourni les détails supplémentaires sur les besoins de l'APM, la compagnie ne s'est pas manifestée.

7.4.4 Lieux d'enfouissement sanitaire

Dans un lieu d'enfouissement sanitaire (L.E.S.), les cellules sont progressivement remplies par des matières résiduelles, étendues et compactées en couches successives jusqu'au niveau maximal autorisé, sur lequel est appliqué un recouvrement final composé d'une couche de sable, d'une couche d'argile et d'une couche de terre propice à l'ensemencement de végétaux. Ce matériel argileux imperméable est du même type que celui qui sera dragué à Contrecœur.

La disposition de l'argile dans un L.E.S. à proximité de Contrecœur serait une solution très intéressante. Malheureusement, la région administrative de la Montérégie ne dispose plus de lieu d'enfouissement sanitaire (L.E.S.) sur son territoire. Tous les déchets sont maintenant transportés et gérés à Lachenaie, région administrative de Lanaudière. Le L.E.S. de Lachenaie est construit sur un lit d'argile et n'a nullement besoin de ce matériel.

Des démarches ont également été entreprises auprès des L.E.S. de Sainte-Cécile-de-Milton (M.R.C. La Haute-Yamaska) et de Cowansville (MRC Brome-Missisquoi). Ces deux sites n'ont aucunement besoin de ce type de matériaux.

En ce qui a trait à l'agglomération de la Ville de Longueuil, cette dernière achemine ses déchets à deux sites, soit à St-Nicéphore, près de Drummondville et à Sainte-Sophie, près de Saint-Jérôme. Le site de St-Nicéphore, localisé à environ 100 km de Contrecoeur, prévoit fermer quelques cellules en 2013-2014 (comm. pers., Simon Mercier de Waste Management, mars 2012). Une demande d'agrandissement est présentement en cours et si le site obtient l'autorisation pour prendre de l'expansion, alors d'autres cellules devront être fermées dans environ 5 ans. L'utilisation de matériaux de type argileux pourrait être à considérer. Pour sa part, le site de Sainte-Sophie, localisé sur la rive nord du fleuve, présente à première vue moins d'intérêt compte tenu de sa localisation et de sa distance (100 km). Toutefois, selon un représentant de Waste Management (comm. pers. Simon Mercier, mars 2012), le site de Sainte-Sophie aura bientôt 10 ans d'exploitation et les matériaux argileux pourraient être utilisés par-dessus le recouvrement final des cellules. Pour le moment, les coûts de disposition sont estimés à 5-10 $/t.m. Ce tarif pourra être revu à la baisse si Waste Management est à la recherche de matériaux de recouvrement pour la fermeture de certaines cellules. De plus, une entente « clé en mains », incluant la disposition et le coût du transport pourrait être envisagée (comm. pers. Patrick Arnould, Waste Management, mars 2012).

7.4.5 Autre site

La compagnie ArcelorMittal, voisin des installations portuaires de Contrecoeur, pourrait être intéressée par les matériaux argileux. AcerlorMittal envisage la possibilité d'effectuer un traitement sur des scories entreposées dans des cellules, libérant par le fait ces dernières. Les matériaux argileux pourraient être utilisés pour restaurer le site (comm. pers. Luc Chabot, Chef de service

environnement, mars 2012). Après la validation des caractéristiques physico-chimiques des matériaux argileux et des volumes, le directeur Environnement chez ArcelorMittal (comm. pers. Jean Lavoie, mai 2012) nous rapporte que la compagnie n'opère pas de cellules de scories. Ils ont un site près du fleuve, où des opérations de traitement de scories ont été effectuées depuis les années 1970 jusqu'à récemment. Par contre, ArcelorMittal utilise des cellules pour un autre résidu d'opération pour lesquelles ils ont obtenu un décret ministériel. Selon lui, pour le moment, la compagnie n'a aucun intérêt à recevoir de tels résidus. Par contre, la compagnie demeure ouverte pour toute autre proposition éventuelle.

7.5 Synthèse des sites potentiels, des distances et des coûts associés à la disposition terrestre des sédiments dragués

La méthode de dragage utilisée déterminera l'emplacement initial des matériaux dragués. Ainsi, si le dragage mécanique est retenu, les matériaux pourront être entreposés presque immédiatement, à l'endroit préétabli sur la propriété de l'APM ou bien transportés à l'extérieur de la propriété. Par contre, si le dragage hydraulique est retenu, alors les matériaux devront obligatoirement être déposés dans les bassins de sédimentation. Par la suite, ils pourront soit demeurer dans les bassins, être transférés dans un autre secteur de la propriété ou bien être dirigés à l'extérieur de la propriété. Cela va de soi qu'une combinaison des méthodes de dragage peut également être envisagée, de même qu'une utilisation de plusieurs sites de dépôt terrestre.

Bien que certaines informations tardent toujours à entrer, quelques opportunités de gestion terrestre semblent se dégager. Toutefois, elles devront toutes être réévaluées au moment opportun afin de valider leur disponibilité et par la suite, des ententes officielles devront être conclues entre les parties, si nécessaire.

À première vue, le choix le plus intéressant serait vraisemblablement de gérer les matériaux sur la propriété même de l'APM. Toutefois, si le dragage hydraulique est favorisé, la construction de bassins de sédimentation sera nécessaire et fera augmenter considérablement les coûts, sans oublier tous les autres frais indirects (ajout de floculant, suivi de la qualité de l'eau, etc.).

Par ailleurs, si une fois asséchés, il est prévu de déplacer les sédiments sur la propriété, alors les coûts d'une deuxième et même d'une troisième manipulation devront s'ajouter. Si les matériaux doivent être dirigés à l'extérieur de la propriété des frais de transport et de disposition s'ajouteront.

Si le dragage mécanique est favorisé, la disposition des matériaux sur la propriété de l'APM est également possible, avec une deuxième et même une troisième manipulation. Par contre, il n'y aura aucun autre frais (transport à l'extérieur et frais de disposition).

Si le dragage mécanique est favorisé, mais que les matériaux trouvent preneur à l'extérieur de la propriété, alors les coûts de gestion varieront selon les variantes suivantes :

- les coûts d'une deuxième et même d'une troisième manipulation des matériaux;
- la distance séparant le secteur à draguer et la destination des matériaux;
- les coûts de transports;
- les coûts de disposition.

La majorité des preneurs potentiels sont localisés à l'intérieur d'un rayon de 100 km, soit à moins de 5 km, à 40 km et à environ 100 km de la propriété de l'APM. Un site a également été identifié à 175 km de Contrecoeur. Bien que les coûts de disposition soient nuls, la distance peut devenir un facteur très limitant dans les coûts de transport et des impacts environnementaux.

Afin de déterminer un ordre de grandeur des coûts reliés au camionnage des matériaux dragués vers un site de disposition terrestre éventuel, le recueil des tarifs de camionnage en vrac du ministère des Transports du Québec (MTQ, 2011) a été consulté. L'Annexe 3 présente les tarifs de

camionnage de matières en vrac qui sont fixés par le ministère des Transports à l'intérieur de ses contrats. Ces tarifs sont utilisés uniquement comme points de référence et leur application n'engage pas la responsabilité du ministère des Transports.

Pour les fins de calcul : « Le transporteur prend en compte la distance totale parcourue. Aux fins de la facturation, la distance de transport est déterminée par le nombre de kilomètres parcourus à partir du point de chargement jusqu'au retour à celui-ci, en ne tenant compte que de la première décimale pour les fractions de kilomètre, et ce, sans aucun arrondissement. La distance totale obtenue doit être divisée par deux. Le prix par tonne transportée est applicable à l'ensemble du kilomètre, peu importe la fraction de kilomètre en charge parcourue. La distance est établie selon l'itinéraire le plus court que peut emprunter le transporteur, en tenant compte des dispositions législatives et réglementaires en vigueur qui s'appliquent au type de véhicule utilisé. », (MTQ, 2011).

D'autres facteurs peuvent également entrer en ligne de compte dans le calcul, tel que les limites de charges imposées aux camionneurs (exemples : transport durant la période de dégel, les charges portantes maximales d'un pont ou d'un chemin dans une région marécageuse, ou l'imposition d'une charge maximale conformément aux clauses d'un cahier des charges), le prix à la tonne des grilles tonne-kilomètre est alors ajusté à la hausse. De plus, l'obligation d'avoir une benne de camion étanche peut également faire augmenter les tarifs.

Le Tableau 8 présente une synthèse des sites potentiels pour la disposition terrestre des sédiments dragués. Les coûts de déchargement au quai sont assumés par les travaux de dragage (section 3.5). Les frais engagés comprennent uniquement les coûts reliés au camionnage des matériaux dragués sortant de la propriété de l'APM vers le site de mise en dépôt terrestre privilégié et les coûts de disposition. Les frais d'une seconde ou troisième manipulation ne sont pas évalués.

Tableau 8 Sites potentiels, distances et coûts associés à une disposition terrestre

Localisation de la mise en dépôt terrestre	Distance	Frais engagés pour les éléments suivants	Coûts approximatifs évalués en 2012
Propriété de l'APM	< 2 km	- Considéré comme une 2e manipulation, 10 $/m³ à 12 $/m³, soit 10 000 000 $ à 12 000 000 $ - Disposition : 0 $	- Transport : (10 000 000 $ à 12 000 000 $) - Disposition : 0 $ **Total :** 5 040 000 $
Autre site (Arcelor Mittal)	< 5 km	- Devra être réévalué au moment opportun	- Devra être réévalué au moment opportun
Sablières et carrières (sablière potentielle à St-Roch-de-Richelieu)	15 km	- Transport : 7,50 $/m³* - Disposition : 2,50 $/m³$ (en considérant 1 m³ = 2 t.m.)	- Transport : 7 500 000 $ - Disposition : 2 500 000 $ **Total :** 10 000 000 $***
Sablières et carrières (carrière potentielle à Boucherville)	40 km	- Transport** : 9,525 $/t.m. - Disposition : à déterminer Plan clé en mains, disponible en septembre 2012	- Transport : 19 050 000 $ - Disposition : à déterminer **Total :** 19 050 000 $ et coûts de disposition Plan clé en mains disponible en septembre 2012
Site de traitement des sols contaminés (Bécancour)	90 km	- Transport** : 15,281 $/t.m. - Disposition : 10 $/t.m. (en considérant 1 m³ = 2 t.m.)	- Transport : 30 562 000 $ - Disposition : 20 000 000 $ **Total :** 50 562 000 $***
Lieu d'enfouissement sanitaire (L.E.S. potentiels : St-Nicéphore et Ste-Sophie)	~100 km	- Transport** : 16,221 $/t - Disposition : 5 à 10 $/ t.m. Possibilité d'un plan clé en mains	- Transport : 32 442 000 $ - Disposition : 10 000 000 $ à 20 000 000 $ **Total :** 42 442 000 $ à 52 442 000 $*** Possibilité d'un plan clé en mains
Sites miniers (site potentiel à Montauban)	175 km	- Transport** : 22,967 $/t.m. - Disposition : 0 $	- Transport : 45 934 000 $ - Disposition : 0 $ **Total :** 45 934 000 $

- Le ratio 1 m³ = 2 tonnes métriques a été considéré, tel que suggéré par un entrepreneur (compagnie Sables Colette).
- Les coûts de déchargement au quai n'ont pas été considérés dans ce tableau puisqu'ils sont considérés avec le dragage (section 3.5).
- Les frais d'une seconde ou troisième manipulation ne sont pas évalués.
- * Ce coût a été déterminé par un particulier, dans un contexte de conditions d'opportunité.
- ** Les frais de transport (tarif horaire ou tonne-kilomètre) sont des montants approximatifs établis à partir des tarifs de camionnage en vrac du ministère des Transports du Québec (MTQ, 2011), tel que présenté à l'Annexe 3, à moins que les compagnies aillent fourni leurs propres taux. Le tarif horaire a été établi en considérant que les travaux prendraient 6 mois à 24 h/j, soit 4320 heures.
- *** Ces prix pourraient être modifiés à la baisse en fonction du matériel à disposer, de l'opportunité de retourner des matériaux de remblayage vers les installations de Contrecoeur ou bien si les matériaux sont en demande pour leur propre besoin.

8 Transport et transbordement des déblais lors d'un dragage mécanique

8.1.1 Transport des déblais

Lors d'un dragage mécanique, les sédiments sont acheminés par chalands à une zone de débarquement et par la suite, sont transbordés vers des camions à benne à l'aide d'une pelle mécanique.

Les sédiments peuvent être déposés dans des chalands d'une capacité variant entre 240 m³ à 1400 m³. En considérant que les sédiments à draguer sont constitués majoritairement d'argile, un facteur de foisonnement de 1,3 a été ajouté aux matériaux ce qui porterait à 1 300 000 m³ le volume chaland à disposer. Ainsi, le nombre de chalands requis, suivant leur dimension, pourrait varier entre 930 et 5420. Compte tenu du volume à draguer, on suppose que les équipements de dragage mécanique seront très performants. Ainsi, seuls les chalands de dimensions supérieures (1400 m³) ont été utilisés pour les fins du calcul, ce qui donne un besoin de 930 chalands.

Dans l'éventualité d'un dragage terrestre avec chemin-digue temporaire, les matériaux dragués seraient déposés directement dans la benne des camions.

L'utilisation de conteneurs adaptés (reposant sur une barge) pouvant être transbordés directement sur des camions de type *roll-on/roll-off* permettrait d'éviter la double manutention des sédiments au débarcadère. Une grue serait cependant requise en rive afin de transférer les bennes sur les camions. Les coûts (la grue devra être sous-traitée par l'entrepreneur et les conteneurs fabriqués sur mesure) et les contraintes de mise en place de la grue représentent un désavantage par rapport à l'autre méthode.

8.1.2 Transbordement des déblais

En se référant à la section 3.5, il est indiqué que, selon le rendement des équipements utilisés, la durée des travaux pourrait varier entre 70 et 170 jours et même aussi peu que 50 jours. Une fois dragué, les matériaux seront déposés dans des chalands qui viendront s'amarrer au quai. Pour vider ces chalands, un minimum de deux pelles seront nécessaires à la zone de débarquement. Ces pelles devront être de bonne capacité afin de parvenir à vider les chalands au même rythme que les équipements dans l'eau. L'inconvénient majeur sera la redistribution des matériaux dragués dans les camions.

Ainsi, en considérant que les camions seront de grand gabarit et auront une capacité de benne de 25 m³ :

- Pour un volume dragué de 14 400 m³/j (18 720 m³/j, si l'on considère le facteur de foisonnement), environ 14 chalands d'une capacité de 1400 m³ viendront s'amarrer au quai pour être déchargés quotidiennement. Ainsi, plus de 800 m³ devront être transbordés et mis dans des camions par heure, ce qui représente 32 camions/heure soit près de 750 camions/jour.
- Pour un volume dragué de 6000 m³/j (7800 m³/j, si l'on considère le facteur de foisonnement), environ 6 chalands d'une capacité de 1400 m³ viendront s'amarrer au quai pour être déchargés quotidiennement. Ainsi, environ 325 m³ devront être transbordés et mis dans des camions par heure, ce qui représente 13 camions/heure, soit 312 camions/jour.

Afin de faciliter le transbordement et d'éviter l'ouverture accidentelle des clapets des chalands lors du transbordement, des plaques d'acier pourront être déposées au fond des chalands au début des opérations.

Ces camions feront une boucle entre le site de disposition terrestre et la zone de débarquement.

Une fois les sédiments placés dans les camions, ces derniers se rendront déposer les déblais directement au site de disposition terrestre sur la propriété de l'APM (section 7.3) ou à l'extérieur de la propriété de l'APM (section 7.4).

L'utilisation des sites à proximité des installations portuaires aurait comme objectif de réaliser le transport le plus court possible afin d'assurer que cette opération ne retarde pas le dragage.

Selon le site de déchargement des chalands (quai no 2, installations temporaires ou nouvelle infrastructure), un chemin de desserte pourrait être construit spécifiquement pour le transport des sédiments à l'intérieur de la propriété de l'APM, où aucune circulation « routière » ne serait rencontrée. La longueur de ce tracé serait d'un maximum de 3 km. Pour accéder à la zone 3, les camions devraient cependant traverser la route 132, située au sud de cette dernière.

Dans l'éventualité d'un dragage terrestre avec chemin-digue temporaire, la pelle déposera directement les matériaux dragués dans les camions. Ainsi, aucun transbordement « chaland-camion » ne serait nécessaire, ce qui diminuerait énormément l'encombrement du site, le temps d'une seconde manipulation et les coûts de réalisation.

8.1.2.1 Transbordement au quai no 2

Si le dragage est effectué avant la construction des installations portuaires, le seul quai existant à proximité de l'aire des travaux et qui pourrait être utilisé pour le transbordement des déblais de dragage est le quai 2 du terminal de Contrecœur. Ce quai a une longueur d'environ 150 m et une profondeur de 6,1 m. Malgré le fait que ce quai n'est pas actuellement utilisé, sauf pour l'accostage temporaire de petits navires, les infrastructures associées aux activités au quai 1 limitent l'espace libre derrière le quai. Notamment, il y a un convoyeur juste derrière la ligne du quai 2 sur sa moitié la plus au nord. L'espace qui serait libre pour le transbordement des déblais de dragage serait donc une aire très réduite de 40 m par 65 m (2600 m²) (Figure 9).

Étant donné l'espace limité pour installer des équipements de déchargement, la capacité de ces équipements serait probablement ce qui limiterait le plus la vitesse à laquelle les sédiments pourraient être dragués mécaniquement. À partir de l'arrière du quai 2, les sédiments pourraient être camionnés vers un site de dépôt (temporaire ou permanent) à l'aide des routes existantes donnant accès au quai ou d'une nouvelle route se dirigeant vers l'aire du nouveau terminal à l'ouest. Il serait aussi possible de les acheminer vers le réseau ferroviaire en utilisant les voies ferrées desservant le terminal et placées à moins de 300 m du quai 2. Cependant, en raison de la logistique qui devrait être déployée pour la redistribution des matériaux dragués dans les wagons et de l'efficacité globale des opérations, cette opportunité a été écartée.



Figure 9 Espace disponible au quai 2, du terminal maritime de Contrecoeur

8.1.2.2 Transbordement aux installations temporaires

Si le dragage est réalisé avant ou pendant la construction du quai, des chemins-digues temporaires pourront être réalisés dans la zone du futur quai. La vitesse de déchargement pourra donner un bon rendement puisque la hauteur du bras de la pelle pour décharger les chalands sera moindre et l'opérateur pourra mieux contrôler l'équipement. Ainsi, l'accessibilité des matériaux et la manœuvrabilité des équipements pourront être plus favorables. Cependant, les chemins-digues temporaires limiteront le nombre d'équipements en position sur le site par rapport à un quai déjà construit.

8.1.2.3 Transbordement sur le nouveau quai

Si le dragage est réalisé après la construction du nouveau quai, le déchargement des chalands remplis par des dragues mécaniques pourrait se faire à cet endroit, et la zone adjacente au nouveau quai pourrait même être draguée à l'aide d'équipements terrestres (voir section 3.1.4). Étant donné la dimension du futur quai, celui-ci pourrait accommoder un plus grand nombre d'équipements de grande taille, comparativement au quai no 2 existant ou bien aux installations temporaires. Ceci permettrait de draguer à un rythme accéléré. Ainsi, avec plus d'équipement pour décharger, le transbordement serait plus rapide.

8.1.3 Entreposage des déblais

Une fois les matériaux transbordés dans les camions, ces derniers se rendront au site de disposition terrestre sélectionné et ils déposeront à tour de rôle leur chargement. Un tracteur ou une pelle mécanique sera disponible pour étendre, au besoin, le matériel.

Le contenu en solide du matériel dragué par équipement mécanique est élevé, de sorte que la quantité d'eau contenue dans les déblais est faible. Ainsi, les eaux contenues dans les déblais ne retourneront pas au fleuve. En effet, la configuration des sites de dépôt fait en sorte que les eaux demeureront à l'intérieur du site et s'évaporeront ou s'infiltreront au cours de l'année ou des années suivantes. Cependant, au besoin, des aménagements de faible envergure pourront être mis en place pour réduire les charges de MES avant un rejet dans l'environnement.

Une fois les sédiments asséchés, ils pourront demeurer de manière permanente dans ces sites de disposition terrestre ou être relocalisés vers un site de valorisation sur ou à l'extérieur de la propriété de l'APM (sections 7.3 et 7.4), ce qui impliquerait une autre manipulation. La zone d'entreposage pourrait alors être utilisée pour la mise en place des aménagements portuaires.

Advenant que les sédiments soient transportés vers des sites de disposition terrestre à l'extérieur de la propriété, les camions sortiront de la propriété de l'APM à la jonction de la route Marie-Victorin (route 132) et Montée Lapierre. Une distance de <1,5 km devra être parcourue pour accéder très rapidement à l'autoroute 30.

9 Transport, transbordement et entreposage des déblais lors d'un dragage hydraulique

9.1.1 Transport et transbordement des déblais

La dragage hydraulique utilise une pompe qui aspire les sédiments avec de l'eau et refoule ce mélange dans un tuyau dont l'extrémité est fixée au point de rejet ou au point de transfert.

Les conditions d'opération normales prévoient un mélange composé de 20% de solides et de 80% d'eau. Le dragage hydraulique permet d'éviter les remises en suspension au point de dragage. Cependant, le point de rejet ou de transfert ne peut pas être éloigné au-delà d'une certaine distance sans que des problèmes techniques n'apparaissent. Des pompes de surpression peuvent être utilisées si les distances dépassent la capacité de la pompe de la drague. Cependant, il faut noter que les tuyaux de pompage sont des obstacles et que des mesures, potentiellement d'envergure importante, doivent être prises s'ils doivent traverser des voies de transport routières, ferroviaires ou maritimes. De plus, des mesures additionnelles doivent être prises afin d'éviter les inconvénients potentiels liés à un bris de conduite.

La dénivellation entre le niveau du fleuve au zéro des cartes et les zones potentielles pour la mise en place des bassins de sédimentation (zones 1 et 2) est d'environ 4 à 6 m. La distance séparant le fleuve et ces zones varie entre 700 m et 1,5 km. Rappelons que les zones 3 et 4 ont été exclues en raison de la distance en plus de la présence d'infrastructures routières et ferroviaires.



Source : http://geoboutique.mrnf.gouv.qc.ca/edel/pages/recherche/resultats.faces

Figure 10 Topographie et dénivellation

9.1.2 Entreposage des déblais

Une fois les travaux complétés, les sédiments pompés dans un bassin de sédimentation doivent y demeurer pour permettre leur assèchement.

La superficie nécessaire pour la mise en place d'un bassin de sédimentation a été établie à la section 7.3.3. La surface de décantation nécessaire serait approximativement de 84 ha. Le temps de rétention dans la zone de décantation est évaluée à quelques semaines ou quelques mois suivant la productivité de la drague. L'effluent du bassin de sédimentation est acheminé vers un bassin de traitement des eaux pour être par la suite retourné vers le fleuve. L'eau retournant au fleuve devra respecter les restrictions sur la qualité des eaux.

Les recommandations du Conseil canadien des ministres de l'environnement (CCME) sont à l'effet que les activités ne devraient pas engendrer une augmentation des sédiments en suspension de plus de 25 mg/L lorsque les concentrations de matières en suspension totales de fond sont moins de 250 mg/L et lorsque l'exposition est de courte durée. Lorsque les concentrations de fond sont plus élevées que 250 mg/L, les activités humaines ne devraient pas engendrer un dépassement des sédiments en suspension de plus de 10% par rapport à la concentration de matières particulaires totales de fond (CCME, 1994).

Une fois les sédiments asséchés, ils pourront demeurer de manière permanente dans les bassins ou être relocalisés vers un site de valorisation sur ou à l'extérieur de la propriété de l'APM (sections 7.3 et 7.4), ce qui impliquerait une autre manipulation. Le bassin de sédimentation pourrait alors servir à des travaux éventuels d'agrandissement du terminal.

10 Principales contraintes

10.1 Disponibilité des équipements de dragage

Puisqu'aucune date n'est encore déterminée pour le début des travaux, il est difficile pour les compagnies de dragage consultées d'anticiper leur calendrier de charge de travail et de statuer sur la disponibilité de leurs équipements. Toutefois, pour obtenir le mandat, elles affirment être prêtes à louer des équipements, à réparer de vieilles dragues pour les remettre en fonction, à fabriquer de nouvelles dragues et même à en importer des États-Unis (section 10.1.1). À priori, la disponibilité des équipements de dragage ne semble pas être une contrainte.

10.1.1 Exigences règlementaires ou contraintes légales à l'égard d'importation d'équipement étranger

L'APM doit se conformer à l'application de la « Clause d'outillage flottant » (Floating plant clause, FPC). La FPC, adoptée par le Cabinet en 1930, oblige le gouvernement canadien à octroyer des contrats de dragage à des entrepreneurs utilisant des équipements fabriqués au Canada.

Les dragues et autres outillages flottants qui seront utilisés dans l'exécution des travaux devront être immatriculées au Canada. Dans le cas des dragues et autres outillages flottants non fabriqués au Canada, un certificat de qualification émis par Industrie Canada (IC) confirmant que l'équipement proposé est conforme aux exigences de la FPC devra être présenté à l'APM. L'émission du certificat de qualification est actuellement assujettie à certaines conditions, l'une d'elle étant que l'équipement soit de propriété canadienne depuis au moins un an au moment de la présentation de la demande de certificat et que des améliorations aient été apportées à l'équipement pour une valeur au moins équivalente à son coût d'acquisition.

Après l'analyse des options de dragage et la disposition des sédiments dragués, l'APM aura à déterminer quel type de drague sera préconisé pour réaliser les travaux. Advenant une non-disponibilité de dragues conformes à la FPC, une dérogation à la FPC pourrait être faite pour une période donnée. Pour cette raison, il sera nécessaire d'accorder le contrat pour les travaux le plus tôt possible et que l'échéancier ne permette pas une nouvelle évaluation environnementale.

Ainsi, les compagnies de dragage qui décideront d'importer des équipements étrangers devront démontrer qu'aucune drague ou autre outillage flottant immatriculé et fabriqué au Canada n'était approprié pour effectuer le mandat.

Une fois cette étape acquise, un permis d'importation temporaire, en vertu de la *Loi sur le cabotage*, sera nécessaire.

10.2 Contraintes environnementales

Le calendrier de travail devra tenir compte des conditions climatiques de la région ainsi que des restrictions environnementales, relatives aux ressources fauniques, qui seront émises dans l'évaluation environnementale.

10.2.1 Les glaces

L'*Atlas climatique des glaces de mer pour la Côte Est 1971-2001*, secteur Saint-Laurent (Environnement Canada, 2011), rapporte que :

> *« La région examinée dans cette section s'étend de Montréal à Québec. Bien que l'effet des marées puisse se faire sentir en aval de Trois-Rivières, la glace typique qu'on y trouve est de la glace de rivière. Le plus souvent, la banquise côtière commence à se former durant la première semaine de décembre et son contour principal est établi au début de janvier. En général, elle recouvre les eaux peu profondes des rives, alors que*

la glace dérivante couvre le chenal navigable. La banquise côtière devient particulièrement étendue dans le lac Saint-Pierre ainsi que dans les chenaux non navigables entre Sorel et Montréal. La fonte de la glace commence au début de mars et amène un dégagement graduel du chenal navigable en aval de Montréal à mesure que la glace existante est entraînée vers la mer et que la formation de nouvelle glace s'arrête. La disparition de la banquise côtière s'ensuit, et des fragments de glace peuvent être emportés dans le chenal à mesure que la débâcle se développe. Cette période est courte toutefois, et la totalité de la zone est normalement libre de glace vers le milieu d'avril. »

Ainsi, selon les conditions climatiques du moment, un épais couvert de glace peut être présent en front du secteur de Contrecoeur, de janvier à la mi-mars.

10.2.2 Éléments sensibles du milieu naturel

Bien que la majorité de sa superficie soit dédiée aux activités industrielles et à l'agriculture, la propriété de l'APM recèle la présence d'habitats naturels d'intérêt. Les habitats qui présentent le plus d'intérêt sur le plan écologiques sont : les habitats riverains de part et d'autre du terminal portuaire existants, ainsi que l'assemblage de marécages et forêts humides dans la partie sud-ouest de la propriété.

Dans la partie nord-est du site, le marais à quenouilles n'existe plus. Les barrages à castor qui avaient causé le rehaussement du niveau d'eau et, conséquemment, le développement du marais, ont été démantelés. Ces faits ont été constatés le 15 juin 2010 par l'équipe de CJB Environnement. Or le petit blongios, une espèce menacée en vertu de l'annexe 1 de la LEP, y avait été recensé à trois reprises dans le cadre des inventaires réalisés en juin 2009.

Le marais à quenouilles, constituait un milieu d'intérêt pour une variété d'espèces floristiques et fauniques. D'une superficie de plus de 8 hectares, cet habitat était susceptible d'être utilisé comme site de nidification pour plusieurs espèces d'oiseaux. Les inventaires menés en 2008 ont permis de constater la présence en période de nidification de canards chipeaux, de guiffettes noires et de gallinules poules d'eau, ce qui laisse présumer que ces espèces y nichaient. Le marais était également fréquenté par les canards et autres oiseaux aquatiques en période de nidification, en plus de présenter un potentiel d'habitat pour le petit blongios, une espèce visée par l'Annexe 1 de la *Loi sur les espèces en péril du Canada*. Ce marais pouvait également constituer un habitat d'intérêt pour les mammifères, notamment le rat musqué, et pour les amphibiens.

Soumis aux variations saisonnières du niveau d'eau du fleuve, les habitats riverains localisés de part et d'autre du terminal portuaire de Contrecœur présentent également un intérêt sur les plans floristique et faunique. Ces habitats sont fréquentés par la sauvagine en période de migration et servent vraisemblablement de sites de fraie pour plusieurs espèces de poissons. Le complexe marais et marécage riverains offre une variété d'habitats qui en augmente la valeur écologique. Au sud du Ruisseau 3, les habitats riverains sont moins étendus en raison de la pente plus abrupte de la rive. On y trouve par contre une colonie d'hirondelles de rivage, qui s'étend sur une longueur d'environ 80 mètres.

Dans la partie de la propriété localisée au sud de la voie ferrée, on trouve un amalgame d'habitats forestiers comprenant des forêts marécageuses et des forêts humides. Ces milieux présentent un intérêt tant sur le plan floristique que sur le plan des habitats fauniques qu'ils soutiennent. Dans ce secteur, les inventaires ont permis de recenser la présence de deux espèces floristiques à statut précaire, l'asaret gingembre et la matteuccie fougère-à-l'autruche, qui sont désignées vulnérables au Québec. Ils ont permis également de confirmer la présence d'une espèce faunique désignée vulnérable, soit la rainette faux-grillon de l'Ouest. Selon les informations disponibles, cette mention pour l'espèce serait même celle qui est située le plus au nord et à l'est pour la province de Québec.

Des inventaires d'oiseaux, effectués entre 2008 et 2010 (CJB Environnement inc., 2009 et 2010), afin de préciser le potentiel et de confirmer la présence d'espèces protégées au fédéral en vertu de l'annexe 1 de la *Loi sur les espèces en péril*, ont permis de recenser cinquante-huit (58) espèces d'oiseaux nicheurs sur le site à l'étude. Aucune espèce protégée en vertu de l'Annexe 1 de la LEP n'a toutefois été recensée, bien qu'une mention incertaine ait été attribuée au quiscale rouilleux, une espèce jugée préoccupante (Annexe 1 de la LEP). Quoique possible, cette mention n'est pas confirmée car l'observateur qui la rapporte se dit incertain de l'identification de l'oiseau observé en vol. Mentionnons que des groupes de quiscale rouilleux avaient été observés au printemps 2008 dans les secteurs marécageux localisés au sud et à l'ouest de la propriété.

La faune benthique vivant sur les fonds pourrait être affectés par des activités de remblayage ou de dragage dans le cadre du projet de développement portuaire de Contrecœur. Les organismes benthiques les plus abondants sont, en ordre décroissant, les chironomidés, les oligochètes, les cératopogonidés et les amphipodes. La densité et la diversité des organismes sont variables à l'intérieur de l'aire d'étude, mais aucune station n'a une grande diversité (indice de Shannon > 3) indiquant la présence d'un habitat de grande qualité. Les stations avec les plus grandes diversités se trouvent en eau peu profonde le long de la rive à l'ouest du terminal maritime. Plusieurs de ces stations ont des indices de diversité de Shannon dépassant 1 et peuvent être considérées de qualité moyenne. Les stations à l'est du terminal ont des diversités plus faibles liées à la présence en grand nombre d'organismes généralement tolérants des perturbations humaines (notamment les chironomidés). Les résultats obtenus en eau plus profonde sont variables. À certaines stations le fond est constitué surtout d'argile post-glaciaire compactée avec des roches, ce qui cause des refus de la benne sur le fond.

Des zones de végétation aquatique ont surtout été observées à des profondeurs de 1,5 à 3 m à l'est du quai, ainsi que formant une bande relativement continue à ces mêmes profondeurs du côté ouest du quai jusqu'à l'embouchure du Ruisseau 3. Ces herbiers submergés sont formés par ce qui semble être de la vallisnérie américaine (*Valisneria americana*) parfois accompagnée par du potamot faux-buplèvre (*Potamogeton perfoliatus*) et du myriophylle à épi (*Myriophyllum spicatum*).

Tel que mentionné dans le rapport *Inventaires biologiques, Saison 2008, Contrecoeur* (CJB Environnement inc., 2009), un certain nombre d'espèces fauniques à statut précaire, désignées en vertu de la *Loi sur les espèces en péril* (LEP) fédérale ou de la *Loi sur les espèces menacées et vulnérables* du Québec, sont susceptibles se trouver dans la zone d'étude.

On y rapporte également que le MRNF indique que l'ensemble de la zone fluviale en front de la propriété de l'APM à Contrecœur est utilisé par l'esturgeon jaune et le chevalier cuivré (CDPNQ, 2008, cité dans CJB Environnement inc., 2009). À cet effet, le Programme de rétablissement du chevalier cuivré (*Moxostoma hubbsi*) au Canada, proposé par le MPO (MPO, 2012), identifie une zone présentant les caractéristiques de l'habitat essentiel pour l'alimentation des adultes en front des futures installations portuaires.

Par ailleurs, lors des inventaires de terrain effectués en 2008, la présence des espèces à statut précaire suivantes a été confirmée :

- le méné laiton, une espèce susceptible d'être désignée menacée ou vulnérable au Québec ;
- le méné d'herbe (*Notropis bifrenatus*), une espèce préoccupante de l'Annexe 1 de la LEP et susceptible d'être désignée menacée ou vulnérable au Québec ;
- l'anguille d'Amérique *(Anguilla rostrata*), une espèce préoccupante de l'Annexe 1 de la LEP et désignée vulnérable au Québec ;
- le chevalier de rivière (*Moxostoma carinatum*), une espèce préoccupante de l'Annexe 1 de la LEP et susceptible d'être désignée menacée ou vulnérable au Québec.

Notons également que de jeunes chevaliers et des alevins de catostomidés non identifiés ont été capturés. Ils pourraient vraisemblablement être des chevaliers de rivière, car les chevaliers cuivrés juvéniles ont seulement été capturés dans le rivière Richelieu, tel que rapporté dans le *Programme de rétablissement du chevalier* cuivré (Moxostoma hubbsi) au Canada (MPO, 2012) : « *La rivière Richelieu est le seul cours d'eau où des larves et des jeunes chevaliers cuivrés de l'année ont été observés. Les chevaliers juvéniles de moins de 100 mm, dont le chevalier cuivré, sont inféodés aux herbiers de la zone littorale. L'habitat pour la croissance des juvéniles se trouve dans les herbiers présents dans la zone littorale de la rivière Richelieu, désignée habitat essentiel*. ».

10.2.3 Calendrier des travaux

Le calendrier des travaux devra tenir compte de la présence des ressources fauniques. À cet effet, un survol de travaux similaires effectués dans la région de Sorel permet de prédire qu'une période d'interdiction sera vraisemblablement émise pour tous les travaux en eau susceptibles de créer des matières en suspension (MES), plus spécifiquement lors de la mise en place du remblai en pleine eau et lors des opérations de dragage.

Ainsi, lors de la mise en place du remblai en pleine eau et lors des opérations de dragage, la période de restriction pourrait s'étendre du 1er avril jusqu'à la fin août puisqu'un certain nombre d'espèces fauniques à statut précaire, désignées en vertu de la *Loi sur les espèces en péril* (LEP) fédérale ou de la *Loi sur les espèces menacées et vulnérable*s du Québec, sont susceptibles se trouver dans la zone d'étude.

De plus, advenant que des travaux du déboisement doivent être réalisés, une relocalisation des nids d'oiseaux devra être envisagée préalablement aux travaux et ces derniers devront également tenir compte de la période de nidification des oiseaux.

Car rappelons qu'en vertu du paragraphe 58.(1) de la LEP, « *il est interdit de détruire un élément de l'habitat essentiel d'une espèce sauvage inscrite comme espèce en voie de disparition ou menacée – ou comme espèce disparue du pays dont un programme de rétablissement a recommandé la réinsertion à l'état sauvage au Canada, si l'espèce inscrite est une espèce d'oiseaux migrateurs protégée par la Loi de 1994 sur la convention concernant les oiseaux migrateurs* ».

10.3 Contraintes humaines

Les travaux se feront sur la propriété même de l'APM. Actuellement, les terres sont louées à des agriculteurs qui eux devront relocaliser leurs activités.

Pour une disposition terrestre éventuelle dans la zone 3 (voir Figures 7 et 8), les camions devront traverser la route 132. Bien que contraignante, la situation peut être gérée assez facilement.

Advenant que les sédiments soient transportés vers des sites de disposition terrestre à l'extérieur de la propriété, les camions sortiront de la propriété de l'APM à la jonction de la route Marie-Victorin (route 132) et Montée Lapierre. Une distance de <1,5 km devra être parcourue pour accéder très rapidement à l'autoroute 30. Par la suite, pour atteindre le site de mise en dépôt définitif, les camions emprunteront des routes locales et régionales. Il est difficile pour le moment de prévoir le parcours, cependant, dans les zones habitées, les parcours suscitant le moins de nuisances devront être retenus.

10.4 Contraintes techniques de la méthode de dragage en comparaison avec la mise en suspension des sédiments

Sur le plan technique, les équipements de dragage retenus sont appropriés pour faire le dragage. Toutefois, ils se distinguent au niveau de la quantité de sédiments remis en suspension.

De façon générale, la drague mécanique entraînera une mise en suspension de matériel dans toute la colonne d'eau alors que la drague hydraulique générera des nuages de turbidité dans la partie

profonde de la colonne d'eau, à proximité de la tête de la drague. Les sédiments mis en suspension dans la partie supérieure de la colonne d'eau seront généralement ceux qui se disperseront sur de plus longues distances, la distance parcourue par une particule étant fonction de la vitesse du courant et de sa vitesse intrinsèque de sédimentation. Cependant, en comparant des dragages antérieurs dans des conditions similaires, les expériences du dragage révèlent que les dragues hydrauliques ou mécaniques résultent toutes les deux en des niveaux de matières en suspension environnementalement acceptables.

Par ailleurs, puisqu'il sera possiblement recommandé de débuter les travaux après le mois d'août, pour ne pas nuire à une période de restriction environnementale (section 10.2), ce moment de l'année correspondra à une période de basses eaux et selon toute vraisemblance, facilitera les activités de dragage et, par le fait même, minimisera la dispersion des sédiments mis en suspension.

11 Conclusion

Pour faire face à des besoins croissants en transport maritime, l'APM, à ses installations de Contrecoeur, envisage de construire 2 postes à quai dédiés aux porte-conteneurs. Ces travaux donneront 675 m de ligne de quai et permettront d'accueillir 1,1 millions de conteneurs annuellement. Pour réaliser ce nouvel aménagement, un volume de 1 000 000 m³ de sédiments devra être dragué. Principalement constitués d'argile silteuse mélangée avec des couches de gravier et de sable, ces matériaux sont considérés acceptables autant pour une disposition aquatique que terrestre.

Dans le but de préparer une étude d'impact environnementale pour le projet, l'APM voulait amorcer une réflexion concernant les différentes méthodes de dragages pouvant être envisagées et identifier les opportunités de disposition pour ces sédiments.

Plusieurs options ont été envisagées, toutefois, à ce stade, il est difficile de statuer sur la méthode de dragage et sur la disposition des matériaux qui sera préconisée par l'APM. Un organigramme présentant une synthèse de l'ensemble des scénarios réalisables avec l'évaluation des options est offert à la fin de la section (Figure 11).

À la lumière des différentes alternatives et variantes des équipements de dragage, tous les types de dragues mécaniques pourraient être utilisés. En contrepartie, seule la drague à désagrégateur est retenue parmi les dragues hydrauliques car les autres ne sont pas adaptées aux types de matériaux ou aux conditions de dragage du projet. Ainsi, un seul type de drague ou une combinaison de ces types de drague pourrait être envisagé, allant même à l'utilisation d'équipement terrestre pour draguer une portion non négligeable des matériaux. Il est à noter que l'APM devra se conformer à l'application de la « Clause d'outillage flottant ».

L'option d'un dragage mécanique demandera une bonne coordination entre les opérations de dragage, de transbordement et de disposition, car l'inconvénient majeur d'un dragage mécanique sera vraisemblablement la redistribution des matériaux dragués dans les camions. Ainsi, l'efficacité globale des dragues mécaniques sera limitée par l'opération du point de déchargement des chalands.

Le scénario utilisant des équipements terrestres sur des chemins-digues temporaires (section 6.1) pourrait toutefois limiter le transbordement « chaland-camion », ce qui diminuerait énormément l'encombrement du site, le temps d'une seconde manipulation et les coûts de réalisation. La zone non atteignable par des équipements terrestres sur les chemins-digues temporaires serait draguée par des équipements conventionnels flottants.

Pour sa part, l'option d'un dragage hydraulique demande un espace très considérable pour la mise en place de bassin de sédimentation. Cet emplacement doit être disponible pour un certain nombre d'années, voir indéfiniment, afin de permettre l'assèchement des matériaux avant une disposition ultérieure ou tout simplement, pour sa disposition définitive. Si l'on considère l'aménagement d'une cour ferroviaire, d'un portail d'entrée et de sortie des camions, de la mise en place des différentes structures et bâtiments nécessaires à l'opération d'un terminal à conteneurs, la propriété de l'APM, bien que très spacieuse, ne permet pas la mise en place d'un seul et même bassin de sédimentation de 84 ha. La construction de deux bassins de sédimentation ne rencontrerait pas non plus la superficie nécessaire pour contenir les sédiments et les eaux de dragage générés par les activités (possibilité de 58,15 ha). De plus, il ne serait pas souhaitable d'avoir une drague hydraulique ultra-performante car le volume d'eau à gérer serait davantage problématique et l'assèchement du matériel dans les bassins de sédimentation pourrait diriger les activités de dragage. Ainsi, le dragage en une seule saison présente une problématique pour la mise en place de bassins de sédimentation en raison de la capacité du territoire à recevoir les sédiments dragués hydrauliquement.

Somme toute, le rendement et la productivité des équipements semblent relativement comparables. Selon la méthode et les équipements de dragage préconisés, les opérations de dragage pourraient être réalisées à l'intérieur d'une période variant entre 50 et 200 jours.

En ce qui a trait aux options et sites potentiels de disposition des matériaux, seule la disposition terrestre est retenue. Une gestion en milieu aquatique, bien que réalisable en raison de la bonne qualité des sédiments, a été exclue des variantes en raison du volume des matériaux à disposer et de l'impact inapproprié qui serait généré sur l'habitat du poisson. Malheureusement, d'un point de vue économique, l'option du dépôt en milieu terrestre s'avère plus coûteuse et contraignante qu'une disposition en eaux libres.

Quelques opportunités de gestion terrestre semblent se dégager. Toutefois, elles devront toutes être réévaluées au moment opportun afin de valider leur disponibilité et par la suite, des ententes officielles devront être conclues entre les parties, si nécessaire.

À première vue, la nature physique des matériaux dragués limite leur réutilisation dans le cadre de travaux de remblayage sur des sites qui nécessitent une capacité portante élevée. Cependant, la solidification des argiles par ajout de ciment augmenterait leur capacité portante et permettrait leur utilisation comme remblai dans la construction du terre-plein d'arrière-quai en plus de réduire le transport et la disposition hors site et finalement, de minimiser l'importation de matériaux pour le remblayage. En contrepartie, cette approche comporte une certaine incertitude puisqu'elle nécessite un examen géotechnique approfondi en plus de représenter un défi technique. De plus elle requiert très vraisemblablement un étalement du calendrier de réalisation du projet de construction, ce qui peut entraîner des effets sur les coûts et la faisabilité globale du projet.

Par ailleurs, ces argiles possèdent des caractéristiques physiques, incluant une bonne imperméabilité, qui pourraient les rendre intéressantes comme matériaux de remplissage et/ou de recouvrement dans un processus de réhabilitation ou de fermeture de sites (sites miniers, sablières et carrières, site de traitement des sols contaminés, lieux d'enfouissement sanitaire).

Les coûts d'une gestion en milieu terrestre peuvent s'avérer compétitive lorsque la distance entre le site de dragage et celui de transbordement est courte. Par contre, au fur et à mesure que le niveau de complexité augmente tel que la distance de transport, les manipulations supplémentaires, les aires d'entreposage temporaires, l'utilisation de camions étanches pour le transport, cette option peut devenir de plus en plus onéreuse.

De manière générale, parmi les différentes alternatives et variantes de gestion du matériel dragué, le scénario d'une gestion des sédiments en milieu terrestre comporte, sur le plan environnemental, des impacts liés aux émissions atmosphériques incluant des gaz à effet de serre, bruit, dérangement des résidents sur le parcours des camions, encombrement des routes et soulèvement de poussières. Cette opération qui entrainera la manutention d'environ 1 300 000 m³ de sédiments impliquerait des dépenses énergétiques et des émissions atmosphériques non négligeables en provenance d'environ 52 000 voyages de camions d'une capacité de 25 m³.

Dans le cadre du présent projet, idéalement, une distance minimale serait à privilégier pour le choix du site de disposition terrestre. Ainsi, en comparant les opportunités de gestion terrestre, la disposition sur la propriété de l'APM semble inévitablement la meilleure solution tant au niveau économique qu'environnementale. Une disposition terrestre dans la zone 3 obligerait les camions à traverser la route 132, cependant, bien que contraignante, cette situation peut être gérée assez facilement.

La présence de milieux sensibles, tel que des ruisseaux sur la propriété impliquera vraisemblablement leur relocalisation ou leur détournement.

Puisque le calendrier de travail devra tenir compte des conditions climatiques de la région ainsi que des restrictions environnementales, relatives aux ressources fauniques, qui seront émises dans l'étude d'impact, il est possible que les travaux doivent être répartis sur deux années.

Figure 11 Synthèse des alternatives et variantes réalisables pour le dragage et la disposition des sédiments dragués

METHODE DE DRAGAGE ENVISAGÉE*

Dragage mécanique

- Tous les types de drague mécanique peuvent être utilisés.
- Rendement : 6000 m³/j à 14 400 m³/j (+ réaliste), allant même jusqu'à 20 160 m³/j.
- Durée des travaux : Entre 70 et 170 jours (avec 2 dragues) (+ réaliste) et même aussi peu que 50 jours.
- Coûts : 21 000 000 $ à 33 500 000 $, inclus le transbordement
  - ➢ + suivi de la qualité des eaux : 2000 $/j.

ET/OU

Dragage terrestre

- Des équipements terrestres pourraient prendre place sur des chemins-digues temporaires.
- Évite 2e manipulation « chaland-camion ».
  - ➢ Diminue l'encombrement
  - ➢ Coûts de réalisation
- Réutilisation des matériaux du chemin-digue pour la construction du quai.

Dragage hydraulique

- Seule la drague à désagrégateur peut être retenue.
- Rendement : 5000 m³/j à 10 000 m³/j (+ réaliste), allant même jusqu'à 20 000 m³/j.
- Durée des travaux : Entre 100 et 200 jours (+ réaliste) et même aussi peu que 50 jours.
- Coûts : 8 000 000 $ à 20 500 000 $
  - ➢ système de bassins de décantation (1 000 000$, inclus);
  - ➢ + ajout de floculant (100 000 $);
  - ➢ + suivi de la qualité des eaux : 3000 $/j.

Implique

- Suivi de la qualité de l'eau au niveau de la drague.
- 2e manipulation des sédiments.
- Primordial d'avoir une bonne coordination entre les opérations de dragage, de transbordement et de disposition, car l'inconvénient majeur d'un dragage mécanique sera vraisemblablement la redistribution des matériaux dragués dans les camions.
  - ➢ Transbordement de 325 m³/h à 800 m³/h.
  - ➢ Prévoir au moins deux pelles pour le transbordement.
  - ➢ 13 à 32 camions benne de 25 m³ de capacité feront une boucle entre le site de disposition terrestre et la zone de débarquement par heure.
- Espace pour transbordement
  - ➢ Quai no 2 (espace très limité, 40 m x 65 m).
  - ➢ Chemin digue-temporaire (bonne vitesse de transbordement, cependant, le nombre d'équipements en position sera limité).
  - ➢ Nouveau quai (pourrait accommoder un grand nombre d'équipement de grande taille et le transbordement serait plus rapide).

Implique

- Suivi de la qualité de l'eau au niveau de la drague.
- Ajout d'un agent floculant en continu et dans le bassin de sédimentation.
- Suivi de la qualité de l'eau à la sortie du bassin de polissage.
- Besoin de 84 ha pour construire un bassin de sédimentation pouvant accueillir 1 000 000 m³ de sédiments.
  - ➢ Sans les installations portuaires 93 ha de disponibles.
  - ➢ Avec les futures installations portuaires 58,15 ha de disponibles.
- Les sédiments devront demeurer quelques semaines/mois dans les bassins de sédimentation afin de permettre leur assèchement.

DISPOSITION TEMPORAIRE ET/OU FINALE DES SÉDIMENTS

Sur la propriété de l'APM

- Solidification par ajout de ciment et utilisation dans le remblai.
  - ➢ Coûts : à déterminer (à comparer aux coûts d'une construction conventionnelle)
- Demeurent dans les zones initiales de disposition (zones 1, 2, 3 et/ou 4) :
  - ➢ Coûts : 0 $.
- Déplacement entre les zones 1, 2, 3 et/ou 4, implique une 3e manipulation :
  - ➢ Coûts : 10 000 000 $ à 20 000 000$

ET/OU

À l'extérieur de la propriété de l'APM

Peut impliquer 52 000 voyages avec des camions de 25 m³

- Autre site (< 5 km) : devra être évalué au moment opportun
- Sablière (15 km) : 10 000 000$**
- Carrière (40 km) : 19 050 000$ + coûts de disposition
- Site de traitement des sols contaminés (90 km) : 50 562 000$**
- Lieu d'enfouissement sanitaire (~100 km) : 42 442 000$ à 52 442 000$**
- Sites miniers (175 km) : 45 934 000$

+

- Une 3e manipulation est nécessaire, si les sédiments ont été préalablement entreposés sur la propriété :
  - ➢ Coûts : 10 000 000 $ à 20 000 000 $.

DISPOSITION FINALE DES SÉDIMENTS
(une fois les sédiments asséchés)

Sur la propriété de l'APM

- Demeurent dans les bassins de sédimentation (zones 1 et/ou 2) :
  - ➢ Coûts : 0 $.
- Déplacement dans les zones 1, 2, 3 et/ou 4, implique une 2e manipulation :
  - ➢ Coûts : 10 000 000 $ à 20 000 000$

ET/OU

À l'extérieur de la propriété de l'APM

- 2e manipulation : Coûts : 10 000 000 $ à 20 000 000 $.

+

Peut impliquer 52 000 voyages avec des camions de 25 m³

- Autre site (< 5 km) : devra être évalué au moment opportun
- Sablière (15 km) : 10 000 000$**
- Carrière (40 km) : 19 050 000$ + coûts de disposition
- Site de traitement des sols contaminés (90 km) : 50 562 000$**
- Lieu d'enfouissement sanitaire (~100 km) : 42 442 000$ à 52 442 000$**
- Sites miniers (175 km) : 45 934 000$

*Une combinaison des méthodes de dragage et de disposition peut être envisagée.
** Ces prix pourraient être modifiés à la baisse en fonction du matériel à disposer, de l'opportunité de retourner des matériaux de remblayage vers les installations de Contrecoeur ou bien si les matériaux sont en demande pour leur propre besoin.

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ANNEXE 1
Résultats analytiques des sédiments

Tableau A

PARAMÈTRES CHIMIQUES	Unités	Critères sédiments (EC & MDDEP, 2007)					Critères sols MDDEP			F1-TM1	F1-TM4	F1-TM11	F2-TM1	F2-TM4	F2-TM10	F3-TM1	F3-TM1 DUP	F3-TM3	F3-TM
		CER	CSE	CEO	CEP	CEF	A	B	C	0-0,61m	2,44-3,05m	7,77-8,38m	0-0,61m	2,74-3,35m	7,31-7,92m	0-0,61m	0-0,61m	1,98-2,59m	6,55-7,16m
		Aucune action requise		Rejet en eau libre seulement après bioessais		Aucun rejet en eau libre; Traitement ou confinement													
Métaux																			
Aluminium (Al)	mg/kg	-	-	-	-	-	-	-	-	8420	37000	38500	3550	8770	36000	7920	5580	8980	35600
Arsenic (As)	mg/kg	4.1	5.9	7.6	17	23	6	30	50	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0
Cadmium (Cd)	mg/kg	0.33	0.6	1.7	3.5	12	1.5	5	20	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9
Chrome (Cr)	mg/kg	25	37	57	90	120	85	250	800	<45	112	119	<45	<45	109	<45	<45	<45	114
Cuivre (Cu)	mg/kg	22	36	63	200	700	40	100	500	<40	50	53	<40	<40	51	<40	<40	<40	52
Fer (Fe)	mg/kg	-	-	-	-	-	-	-	-	15600	44000	45300	7980	14000	42500	11400	8240	13500	42700
Mercure (Hg)	mg/kg	0.094	0.17	0.25	0.49	0.87	0.2	2	10	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2
Nickel (Ni)	mg/kg	ND	ND	47	ND	ND	50	100	500	<30	84	85	<30	<30	79	<30	<30	<30	84
Plomb (Pb)	mg/kg	25	35	52	91	150	50	500	1000	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Zinc (Zn)	mg/kg	80	120	170	310	770	110	500	1500	<100	104	106	<100	<100	107	<100	<100	<100	100
HAP																			
Acénaphtène	mg/kg	0.0037	0.0067	0.021	0.089	0.94	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Acénaphtylène	mg/kg	0.0033	0.0059	0.03	0.13	0.34	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Anthracène	mg/kg	0.016	0.047	0.11	0.24	1.1	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(a)anthracène	mg/kg	0.014	0.032	0.12	0.39	0.76	0.1	1	10	0.02	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(a)pyrène	mg/kg	0.011	0.032	0.15	0.78	3.2	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(b+j+k)fluoranthène	mg/kg	-	-	-	-	-	0.1	1	10	0.03	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(c)phénanthrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(g,h,i)pérylène	mg/kg	-	-	-	-	-	0.1	1	10	0.01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Chrysène	mg/kg	0.026	0.057	0.24	0.86	1.6	0.1	1	10	0.02	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,h)anthracène	mg/kg	0.0033	0.0062	0.043	0.14	0.2	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,i)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,h)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,l)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Diméthyl-7,12 benzo(a)anthracène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Fluoranthène	mg/kg	0.047	0.11	0.45	2.4	4.9	0.1	10	100	0.04	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Fluorène	mg/kg	0.01	0.021	0.061	0.14	1.2	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Indéno(1,2,3-cd)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Méthyl-3 cholanthrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Naphtalène	mg/kg	0.017	0.035	0.12	0.39	1.2	0.1	5	50	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Phénanthrène	mg/kg	0.025	0.042	0.13	0.52	1.1	0.1	5	50	0.02	<0,01	<0,01	<0,01	0.01	<0,01	<0,01	<0,01	<0,01	<0,01
Pyrène	mg/kg	0.029	0.053	0.23	0.88	1.5	0.1	10	100	0.03	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Méthyl-1 naphtalène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Méthyl-2 naphtalène	mg/kg	0.015	0.02	0.063	0.2	0.38	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Diméthyl-1,3 naphtalène	mg/kg	-	-	-	-	-	-	-	-	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Triméthyl-2,3,5 naphtalène	mg/kg	-	-	-	-	-	-	-	-	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
HAP Totaux (somme des substances individuelles)	mg/kg	-	-	-	-	-	-	-	-	0.17	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
BPC totaux (sommation des congénères)	mg/kg	0.025	0.034	0.079	0.28	0.78	0.05	1	10	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017
Hydrocarbures pétroliers C_{10}-C_{50}	mg/kg	-	-	-	-	-	300	700	3500	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Carbone organique total (COT)	%	-	-	-	-	-	-	-	-	1.1	0.8	0.8	0.3	0.8	0.8	0.7	0.4	0.6	0.7
Granulométrie																			
Gravier	%	-	-	-	-	-	-	-	-	0%	0.0%	0.0%	1%	0.0%	0.0%	0%	--	0.0%	0.0%
Sable	%	-	-	-	-	-	-	-	-	41%	0.0%	0.0%	49%	54.0%	0.0%	59%	--	2.0%	0.0%
Particules fines (silt+argile)	%	-	-	-	-	-	-	-	-	59%	100.0%	100.0%	50%	46.0%	100.0%	41%	--	98.0%	100.0%
Silt	%	-	-	-	-	-	-	-	-	--	22.1%	14.8%	--	--	18.0%	--	--	20.0%	21.0%
Argile	%	-	-	-	-	-	-	-	-	--	77.9%	85.2%	--	--	82.0%	--	--	78.0%	79.0%

Concentration d'effets rares **CER**
Concentration seuil produisant un effet **CSE**
Concentration d'effets occasionnels **CEO**
Concentration produisant un effet probable **CEP**
Concentration d'effets fréquents **CEF**

Dépassement de la CEO
Dépassement de la CEF

tramé Dépassement du critère A du MDDEP (sols)

Tableau A

PARAMÈTRES CHIMIQUES	Unités	Critères sédiments (EC & MDDEP, 2007)					Critères sols MDDEP			SED-1	SED-2	SED-3	SED-3-DUP	SED-4	SED-5	SED-6	SED-7	SED-8	SED-9
		CER	CSE	CEO	CEP	CEF	A	B	C	0-0,15m	0-0,15m	0-0,15m	0-0,15m	0-0,15m	0-0,15m	0-0,15m	0-0,15m	0-0,15m	0-0,15m
		Aucune action requise		Rejet en eau libre seulement après bioessais		Aucun rejet en eau libre; Traitement ou confinement													
Métaux																			
Aluminium (Al)	mg/kg	-	-	-	-	-	-	-	-	27200	23700	24600	28500	20900	28600	21200	25300	5610	4150
Arsenic (As)	mg/kg	4.1	5.9	7.6	17	23	6	30	50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Cadmium (Cd)	mg/kg	0.33	0.6	1.7	3.5	12	1.5	5	20	1.1	1.4	1.3	1.3	1.1	1.3	1.3	1.2	<0,9	<0,9
Chrome (Cr)	mg/kg	25	37	57	90	120	85	250	800	49	53	53	55	50	52	52	53	<45	<45
Cuivre (Cu)	mg/kg	22	36	63	200	700	40	100	500	<40	**44**	**42**	**43**	<40	**43**	**41**	**42**	<40	<40
Fer (Fe)	mg/kg	-	-	-	-	-	-	-	-	42700	36100	38400	43300	33500	43500	34000	39400	26700	14400
Mercure (Hg)	mg/kg	0.094	0.17	0.25	0.49	0.87	0.2	2	10	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2
Nickel (Ni)	mg/kg	ND	ND	47	ND	ND	50	100	500	<30	<30	<30	30	<30	<30	<30	<30	<30	<30
Plomb (Pb)	mg/kg	25	35	52	91	150	50	500	1000	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Zinc (Zn)	mg/kg	80	120	170	310	770	110	500	1500	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
HAP																			
Acénaphtène	mg/kg	0.0037	0.0067	0.021	0.089	0.94	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Acénaphtylène	mg/kg	0.0033	0.0059	0.03	0.13	0.34	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Anthracène	mg/kg	0.016	0.047	0.11	0.24	1.1	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(a)anthracène	mg/kg	0.014	0.032	0.12	0.39	0.76	0.1	1	10	<0,01	<0,01	<0,01	0.03	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(a)pyrène	mg/kg	0.011	0.032	0.15	0.78	3.2	0.1	1	10	<0,01	<0,01	<0,01	0.02	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(b+j+k)fluoranthène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	0.05	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(c)phénanthrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(g,h,i)pérylène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	0.01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Chrysène	mg/kg	0.026	0.057	0.24	0.86	1.6	0.1	1	10	<0,01	<0,01	<0,01	0.03	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,h)anthracène	mg/kg	0.0033	0.0062	0.043	0.14	0.2	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,i)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,h)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,l)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Diméthyl-7,12 benzo(a)anthracène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Fluoranthène	mg/kg	0.047	0.11	0.45	2.4	4.9	0.1	10	100	<0,01	<0,01	<0,01	0.03	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Fluorène	mg/kg	0.01	0.021	0.061	0.14	1.2	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Indéno(1,2,3-cd)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	0.02	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Méthyl-3 cholanthrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Naphtalène	mg/kg	0.017	0.035	0.12	0.39	1.2	0.1	5	50	<0,01	<0,01	<0,01	<0,01	0.05	<0,01	<0,01	<0,01	<0,01	<0,01
Phénanthrène	mg/kg	0.025	0.042	0.13	0.52	1.1	0.1	5	50	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Pyrène	mg/kg	0.029	0.053	0.23	0.88	1.5	0.1	10	100	<0,01	<0,01	<0,01	0.02	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Méthyl-1 naphtalène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	0.06	<0,01	<0,01	<0,01	<0,01	<0,01
Méthyl-2 naphtalène	mg/kg	0.016	0.02	0.063	0.2	0.38	0.1	1	10	<0,01	<0,01	<0,01	<0,01	0.11	<0,01	<0,01	<0,01	<0,01	<0,01
Diméthyl-1,3 naphtalène	mg/kg	-	-	-	-	-	-	-	-	<0,01	<0,01	<0,01	<0,01	0.03	<0,01	<0,01	<0,01	<0,01	<0,01
Triméthyl-2,3,5 naphtalène	mg/kg	-	-	-	-	-	-	-	-	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
HAP Totaux (somme des substances individuelles)	mg/kg	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.21	0.25	0.00	0.00	0.00	0.00	0.00
BPC totaux (sommation des congénères)	mg/kg	0.025	0.034	0.079	0.28	0.78	0.05	1	10	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017
Hydrocarbures pétroliers C_{10}-C_{50}	mg/kg	-	-	-	-	-	300	700	3500	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Carbone organique total (COT)	%	-	-	-	-	-	-	-	-	7.1	8	9.7	7.1	8.7	5.5	6.7	7.7	2.8	3.5
Granulométrie																			
Gravier	%	-	-	-	-	-	-	-	-	7.0%	0.0%	0.0%	--	0.0%	0.0%	0.0%	0.0%	20.0%	8.0%
Sable	%	-	-	-	-	-	-	-	-	17.1%	0.6%	7.0%	--	6.0%	10.4%	7.0%	1.0%	42.5%	86.0%
Particules fines (silt+argile)	%	-	-	-	-	-	-	-	-	75.9%	99.4%	93.0%	0.0%	94.0%	89.6%	93.0%	99.0%	37.5%	6.0%
Silt	%	-	-	-	-	-	-	-	-	24.6%	27.2%	27.7%	--	23.9%	28.2%	29.2%	26.8%	16.2%	--
Argile	%	-	-	-	-	-	-	-	-	51.3%	72.2%	65.3%	--	70.1%	61.4%	63.8%	72.2%	21.3%	6.0%

Concentration d'effets rares **CER**
Concentration seuil produisant un effet **CSE**
Concentration d'effets occasionnels **CEO**
Concentration produisant un effet probable **CEP**
Concentration d'effets fréquents **CEF**

Dépassement de la CEO
Dépassement de la CEF

tramé Dépassement du critère A du MDDEP (sols)

Tableau A

PARAMÈTRES CHIMIQUES	Unités	Critères sédiments (EC & MDDEP, 2007)					Critères sols MDDEP			SED-10	SED-10-DUP	SED-11	SED-12A	SED-12B	SED-13A	SED-13B	SED-14A	SED-14A-DUP	SED-14B
		CER	CSE	CEO	CEP	CEF	A	B	C	0-0.15m	0-0,15m	0-0,15m	0-0,15m	1,2-1,45m	0-0,3m	1,2-1,45m	0-0,4m	1,4-1,65m	1,4-1,65m
		Aucune action requise		Rejet en eau libre seulement après bioessais		Aucun rejet en eau libre; Traitement ou confinement													
Métaux																			
Aluminium (Al)	mg/kg	-	-	-	-	-	-	-	-	4250	4040	13100	8330	8190	16400	13000	20000	19800	19800
Arsenic (As)	mg/kg	4.1	5.9	7.6	17	23	6	30	50	<5	<5	<5	<5	<5	**7**	<5	<5	<5	<5
Cadmium (Cd)	mg/kg	0.33	0.6	1.7	3.5	12	1.5	5	20	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9	1	<0,9
Chrome (Cr)	mg/kg	25	37	57	90	120	85	250	800	<45	<45	<45	<45	<45	<45	<45	49	48	48
Cuivre (Cu)	mg/kg	22	36	63	200	700	40	100	500	<40	<40	<40	<40	<40	<40	<40	**42**	**42**	**43**
Fer (Fe)	mg/kg	-	-	-	-	-	-	-	-	12600	12200	26300	17400	17100	30500	27600	33100	35200	32600
Mercure (Hg)	mg/kg	0.094	0.17	0.25	0.49	0.87	0.2	2	10	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2
Nickel (Ni)	mg/kg	ND	ND	47	ND	ND	50	100	500	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Plomb (Pb)	mg/kg	25	35	52	91	150	50	500	1000	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Zinc (Zn)	mg/kg	80	120	170	310	770	110	500	1500	<100	<100	**128**	<100	<100	<100	<100	<100	<100	<100
HAP																			
Acénaphtène	mg/kg	0.0037	0.0067	0.021	0.089	0.94	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Acénaphtylène	mg/kg	0.0033	0.0059	0.03	0.13	0.34	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Anthracène	mg/kg	0.016	0.047	0.11	0.24	1.1	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(a)anthracène	mg/kg	0.014	0.032	0.12	0.39	0.76	0.1	1	10	<0,01	<0,01	0.03	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(a)pyrène	mg/kg	0.011	0.032	0.15	0.78	3.2	0.1	1	10	<0,01	<0,01	0.04	0.01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(b+j+k)fluoranthène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	0.07	0.03	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(c)phénanthrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(g,h,i)pérylène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	0.03	0.02	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Chrysène	mg/kg	0.026	0.057	0.24	0.86	1.6	0.1	1	10	<0,01	<0,01	0.04	0.01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,h)anthracène	mg/kg	0.0033	0.0062	0.043	0.14	0.2	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,i)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,h)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,l)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Diméthyl-7,12 benzo(a)anthracène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Fluoranthène	mg/kg	0.047	0.11	0.45	2.4	4.9	0.1	10	100	<0,01	<0,01	0.08	0.02	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Fluorène	mg/kg	0.01	0.021	0.061	0.14	1.2	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Indéno(1,2,3-cd)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	0.02	0.02	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Méthyl-3 cholanthrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Naphtalène	mg/kg	0.017	0.035	0.12	0.39	1.2	0.1	5	50	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Phénanthrène	mg/kg	0.025	0.042	0.13	0.52	1.1	0.1	5	50	<0,01	<0,01	0.04	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Pyrène	mg/kg	0.029	0.053	0.23	0.88	1.5	0.1	10	100	<0,01	<0,01	0.06	0.02	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Méthyl-1 naphtalène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Méthyl-2 naphtalène	mg/kg	0.016	0.02	0.063	0.2	0.38	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Diméthyl-1,3 naphtalène	mg/kg	-	-	-	-	-	-	-	-	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Triméthyl-2,3,5 naphtalène	mg/kg	-	-	-	-	-	-	-	-	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
HAP Totaux (somme des substances individuelles)	mg/kg	-	-	-	-	-	-	-	-	0.00	0.00	0.41	0.13	0.00	0.00	0.00	0.00	0.00	0.00
BPC totaux (sommation des congénères)	mg/kg	0.025	0.034	0.079	0.28	0.78	0.05	1	10	<0.017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017
Hydrocarbures pétroliers C_{10}-C_{50}	mg/kg	-	-	-	-	-	300	700	3500	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Carbone organique total (COT)	%	-	-	-	-	-	-	-	-	2.6	4.8	11.4	7.5	7.7	4.9	6.9	9.4	9.2	11.1
Granulométrie																			
Gravier	%	-	-	-	-	-	-	-	-	10.0%	--	0.0%	2.0%	--	21.0%	--	1.0%	--	--
Sable	%	-	-	-	-	-	-	-	-	81.6%	--	0.0%	66.1%	--	30.2%	--	8.5%	--	--
Particules fines (silt+argile)	%	-	-	-	-	-	-	-	-	8.4%	0.0%	100.0%	31.9%	0.0%	48.8%	0.0%	90.5%	0.0%	0.0%
Silt	%	-	-	-	-	-	-	-	-	--	--	74.4%	12.8%	--	15.4%	--	22.5%	--	--
Argile	%	-	-	-	-	-	-	-	-	8.4%	--	25.6%	19.1%	--	33.4%	--	68.0%	--	--

Concentration d'effets rares **CER**
Concentration seuil produisant un effet **CSE**
Concentration d'effets occasionnels **CEO**
Concentration produisant un effet probable **CEP**
Concentration d'effets fréquents **CEF**

Dépassement de la CEO
Dépassement de la CEF

tramé Dépassement du critère A du MDDEP (sols)

Tableau A

PARAMÈTRES CHIMIQUES	Unités	Critères sédiments (EC & MDDEP, 2007)					Critères sols MDDEP			SED-15A	SED-15B	SED-16A	SED-16B	SED-17A	SED-17B	SED-18A	SED-18B	SED-19A	SED-19B
		CER	CSE	CEO	CEP	CEF	A	B	C	0-0,4m	1,0-1,4m	0-0,15m	1,2-1,5m	0-0,2m	1,3-1,5	0-0,3m	1,3-1,5m	0-0,15m	1,3-1,4m
		Aucune action requise		Rejet en eau libre seulement après bioessais		Aucun rejet en eau libre; Traitement ou confinement													
Métaux																			
Aluminium (Al)	mg/kg	-	-	-	-	-	-	-	-	9000	6960	23200	9290	25000	10200	13200	5950	8020	5300
Arsenic (As)	mg/kg	4.1	5.9	7.6	17	23	6	30	50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Cadmium (Cd)	mg/kg	0.33	0.6	1.7	3.5	12	1.5	5	20	<0,9	<0,9	1	<0,9	1	<0,9	<0,9	<0,9	<0,9	<0,9
Chrome (Cr)	mg/kg	25	37	57	90	120	85	250	800	<45	<45	46	<45	46	<45	<45	<45	<45	<45
Cuivre (Cu)	mg/kg	22	36	63	200	700	40	100	500	<40	<40	<40	<40	<40	<40	<40	<40	<40	<40
Fer (Fe)	mg/kg	-	-	-	-	-	-	-	-	21400	19000	39000	20000	40900	25800	28600	16400	18400	15700
Mercure (Hg)	mg/kg	0.094	0.17	0.25	0.49	0.87	0.2	2	10	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	0.2	<0,2	<0,2	<0,2
Nickel (Ni)	mg/kg	ND	ND	47	ND	ND	50	100	500	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Plomb (Pb)	mg/kg	25	35	52	91	150	50	500	1000	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Zinc (Zn)	mg/kg	80	120	170	310	770	110	500	1500	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
HAP																			
Acénaphtène	mg/kg	0.0037	0.0067	0.021	0.089	0.94	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Acénaphtylène	mg/kg	0.0033	0.0059	0.03	0.13	0.34	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Anthracène	mg/kg	0.016	0.047	0.11	0.24	1.1	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(a)anthracène	mg/kg	0.014	0.032	0.12	0.39	0.76	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(a)pyrène	mg/kg	0.011	0.032	0.15	0.78	3.2	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(b+j+k)fluoranthène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(c)phénanthrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(g,h,i)pérylène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Chrysène	mg/kg	0.026	0.057	0.24	0.86	1.6	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,h)anthracène	mg/kg	0.0033	0.0062	0.043	0.14	0.2	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,i)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,h)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,l)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Diméthyl-7,12 benzo(a)anthracène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Fluoranthène	mg/kg	0.047	0.11	0.45	2.4	4.9	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Fluorène	mg/kg	0.01	0.021	0.061	0.14	1.2	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Indéno(1,2,3-cd)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Méthyl-3 cholanthrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Naphtalène	mg/kg	0.017	0.035	0.12	0.39	1.2	0.1	5	50	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Phénanthrène	mg/kg	0.025	0.042	0.13	0.52	1.1	0.1	5	50	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Pyrène	mg/kg	0.029	0.053	0.23	0.88	1.5	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Méthyl-1 naphtalène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Méthyl-2 naphtalène	mg/kg	0.016	0.02	0.063	0.2	0.38	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Diméthyl-1,3 naphtalène	mg/kg	-	-	-	-	-	-	-	-	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Triméthyl-2,3,5 naphtalène	mg/kg	-	-	-	-	-	-	-	-	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
HAP Totaux (somme des substances individuelles)	mg/kg	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BPC totaux (sommation des congénères)	mg/kg	0.025	0.034	0.079	0.28	0.78	0.05	1	10	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017
Hydrocarbures pétroliers C_{10}-C_{50}	mg/kg	-	-	-	-	-	300	700	3500	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Carbone organique total (COT)	%	-	-	-	-	-	-	-	-	6	3.7	9.8	4.7	10	5	4.7	8.7	5.7	5.1
Granulométrie																			
Gravier	%	-	-	-	-	-	-	-	-	31.0%	--	21.0%	--	10.0%	--	38.0%	--	8.0%	--
Sable	%	-	-	-	-	-	-	-	-	33.7%	--	18.3%	--	24.7%	--	37.8%	--	45.6%	--
Particules fines (silt+argile)	%	-	-	-	-	-	-	-	-	35.3%	0.0%	60.7%	0.0%	65.3%	0.0%	24.2%	0.0%	46.4%	0.0%
Silt	%	-	-	-	-	-	-	-	-	11.4%	--	17.9%	--	17.6%	--	7.2%	--	20.1%	--
Argile	%	-	-	-	-	-	-	-	-	23.9%	--	42.8%	--	47.7%	--	17.0%	--	26.3%	--

Concentration d'effets rares CER
Concentration seuil produisant un effet CSE
Concentration d'effets occasionnels CEO
Concentration produisant un effet probable CEP
Concentration d'effets fréquents CEF

Dépassement de la CEO
Dépassement de la CEF

tramé Dépassement du critère A du MDDEP (sols)

Tableau A

PARAMÈTRES CHIMIQUES	Unités	Critères sédiments (EC & MDDEP, 2007)					Critères sols MDDEP			SED-20A	SED-20B	SED-21A	SED-21B	SED-22	SED-23	SED-24	SED-25	SED-26	SED-27
		CER	CSE	CEO	CEP	CEF	A	B	C	0-0,3m	1,3-1,45m	0-0,5m	1,3-1,5m	0-0,15m	0-0,15m	0-0,15m	0-0,15m	0-0,15m	0-0,15m
		Aucune action requise		Rejet en eau libre seulement après bioessais		Aucun rejet en eau libre; Traitement ou confinement													
Métaux																			
Aluminium (Al)	mg/kg	-	-	-	-	-	-	-	-	3700	3900	5630	2310	6830	4770	5010	2500	2910	3270
Arsenic (As)	mg/kg	4.1	5.9	7.6	17	23	6	30	50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Cadmium (Cd)	mg/kg	0.33	0.6	1.7	3.5	12	1.5	5	20	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9
Chrome (Cr)	mg/kg	25	37	57	90	120	85	250	800	<45	<45	<45	<45	<45	<45	<45	<45	<45	<45
Cuivre (Cu)	mg/kg	22	36	63	200	700	40	100	500	<40	<40	<40	<40	<40	<40	<40	<40	<40	<40
Fer (Fe)	mg/kg	-	-	-	-	-	-	-	-	14600	14600	14500	6970	15400	11800	12700	13100	13100	13300
Mercure (Hg)	mg/kg	0.094	0.17	0.25	0.49	0.87	0.2	2	10	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2
Nickel (Ni)	mg/kg	ND	ND	47	ND	ND	50	100	500	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Plomb (Pb)	mg/kg	25	35	52	91	150	50	500	1000	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Zinc (Zn)	mg/kg	80	120	170	310	770	110	500	1500	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
HAP																			
Acénaphtène	mg/kg	0.0037	0.0067	0.021	0.089	0.94	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Acénaphtylène	mg/kg	0.0033	0.0059	0.03	0.13	0.34	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Anthracène	mg/kg	0.016	0.047	0.11	0.24	1.1	0.1	10	100	<0,01	0.01	<0,01	<0,01	<0,01	0.01	0.02	<0,01	<0,01	<0,01
Benzo(a)anthracène	mg/kg	0.014	0.032	0.12	0.39	0.76	0.1	1	10	<0,01	0.03	<0,01	<0,01	<0,01	0.03	0.02	<0,01	<0,01	0.02
Benzo(a)pyrène	mg/kg	0.011	0.032	0.15	0.78	3.2	0.1	1	10	<0,01	0.02	<0,01	<0,01	<0,01	0.03	0.02	<0,01	<0,01	0.02
Benzo(b+j+k)fluoranthène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	0.05	<0,01	<0,01	0.02	0.07	0.05	<0,01	0.02	0.05
Benzo(c)phénanthrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(g,h,i)pérylène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	0.02	<0,01	<0,01	<0,01	0.03	0.01	<0,01	<0,01	0.01
Chrysène	mg/kg	0.026	0.057	0.24	0.86	1.6	0.1	1	10	<0,01	0.03	<0,01	<0,01	<0,01	0.04	0.04	<0,01	<0,01	0.02
Dibenzo(a,h)anthracène	mg/kg	0.0033	0.0062	0.043	0.14	0.2	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,i)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,h)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,l)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Diméthyl-7,12 benzo(a)anthracène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Fluoranthène	mg/kg	0.047	0.11	0.45	2.4	4.9	0.1	10	100	<0,01	0.04	<0,01	<0,01	0.02	0.07	0.05	<0,01	0.01	0.02
Fluorène	mg/kg	0.01	0.021	0.061	0.14	1.2	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	0.01	<0,01	<0,01	<0,01
Indéno(1,2,3-cd)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	0.02	<0,01	<0,01	<0,01	0.03	0.02	<0,01	<0,01	0.01
Méthyl-3 cholanthrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Naphtalène	mg/kg	0.017	0.035	0.12	0.39	1.2	0.1	5	50	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Phénanthrène	mg/kg	0.025	0.042	0.13	0.52	1.1	0.1	5	50	<0,01	0.01	<0,01	<0,01	<0,01	0.03	0.04	0.02	<0,01	<0,01
Pyrène	mg/kg	0.029	0.053	0.23	0.88	1.5	0.1	10	100	<0,01	0.04	<0,01	0.01	0.01	0.06	0.05	<0,01	0.01	0.02
Méthyl-1 naphtalène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	0.03	<0,01	<0,01
Méthyl-2 naphtalène	mg/kg	0.016	0.02	0.063	0.2	0.38	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	0.01	<0,01	0.07	<0,01	<0,01
Diméthyl-1,3 naphtalène	mg/kg	-	-	-	-	-	-	-	-	<0,01	<0,01	<0,01	<0,01	<0,01	0.01	0.01	0.04	<0,01	<0,01
Triméthyl-2,3,5 naphtalène	mg/kg	-	-	-	-	-	-	-	-	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	0.02	<0,01	<0,01	<0,01
HAP Totaux (somme des substances individuelles)	mg/kg	-	-	-	-	-	-	-	-	0.00	0.27	0.00	0.01	0.05	0.42	0.36	0.16	0.04	0.17
BPC totaux (sommation des congénères)	mg/kg	0.025	0.034	0.079	0.28	0.78	0.05	1	10	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017
Hydrocarbures pétroliers C_{10}-C_{50}	mg/kg	-	-	-	-	-	300	700	3500	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Carbone organique total (COT)	%	-	-	-	-	-	-	-	-	6.7	5.1	4.4	2.8	7	13.7	6.4	2.4	2.6	3.1
Granulométrie																			
Gravier	%	-	-	-	-	-	-	-	-	40.0%	--	12.0%	--	0.0%	0.0%	1.0%	1.0%	0.0%	0.0%
Sable	%	-	-	-	-	-	-	-	-	44.4%	--	69.8%	--	60.0%	77.3%	52.7%	89.0%	82.0%	76.8%
Particules fines (silt+argile)	%	-	-	-	-	-	-	-	-	15.6%	0.0%	18.2%	0.0%	40.0%	22.7%	46.3%	10.0%	18.0%	23.2%
Silt	%	-	-	-	-	-	-	-	-	7.6%	--	10.2%	--	26.3%	18.4%	37.0%	4.4%	12.9%	16.5%
Argile	%	-	-	-	-	-	-	-	-	8.0%	--	8.0%	--	13.7%	4.3%	9.3%	5.6%	5.1%	6.7%

Concentration d'effets rares CER
Concentration seuil produisant un effet CSE
Concentration d'effets occasionnels CEO
Concentration produisant un effet probable CEP
Concentration d'effets fréquents CEF

Dépassement de la CEO
Dépassement de la CEF

tramé Dépassement du critère A du MDDEP (sols)

Tableau A

PARAMÈTRES CHIMIQUES	Unités	Critères sédiments (EC & MDDEP, 2007)					Critères sols MDDEP			SED-27-DUP	SED-28	SED-29	SED-29-DUP	SED-30	SED-31	SED-32	SED-33	SED-34
		CER	CSE	CEO	CEP	CEF	A	B	C	0-0,15m	0-0,15m	0-0,15m	0-0,15m	0-0,15m	0-0,15m	0-0,15m	0-0,15m	0-0,15m
		Aucune action requise		Rejet en eau libre seulement après bioessais		Aucun rejet en eau libre; Traitement ou confinement												
Métaux																		
Aluminium (Al)	mg/kg	-	-	-	-	-	-	-	-	3360	22500	21900	22300	4010	2470	27800	6840	2560
Arsenic (As)	mg/kg	4.1	5.9	7.6	17	23	6	30	50	<5	<5	<5	<5	<5	<5	<5	<5	<5
Cadmium (Cd)	mg/kg	0.33	0.6	1.7	3.5	12	1.5	5	20	<0,9	1.2	1.1	1.1	<0,9	<0.9	1.2	<0,9	<0,9
Chrome (Cr)	mg/kg	25	37	57	90	120	85	250	800	<45	52	48	48	<45	<45	50	<45	<45
Cuivre (Cu)	mg/kg	22	36	63	200	700	40	100	500	<40	**48**	**43**	<40	<40	<40	**47**	<40	<40
Fer (Fe)	mg/kg	-	-	-	-	-	-	-	-	13500	36300	36100	36400	21900	17800	41300	14200	6440
Mercure (Hg)	mg/kg	0.094	0.17	0.25	0.49	0.87	0.2	2	10	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2
Nickel (Ni)	mg/kg	ND	ND	47	ND	ND	50	100	500	<30	33	<30	<30	<30	<30	<30	<30	<30
Plomb (Pb)	mg/kg	25	35	52	91	150	50	500	1000	<30	<30	<30	<30	<30	<30	<30	<30	<30
Zinc (Zn)	mg/kg	80	120	170	310	770	110	500	1500	<100	<100	<100	<100	<100	<100	<100	<100	<100
HAP																		
Acénaphtène	mg/kg	0.0037	0.0067	0.021	0.089	0.94	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Acénaphtylène	mg/kg	0.0033	0.0059	0.03	0.13	0.34	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Anthracène	mg/kg	0.016	0.047	0.11	0.24	1.1	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(a)anthracène	mg/kg	0.014	0.032	0.12	0.39	0.76	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(a)pyrène	mg/kg	0.011	0.032	0.15	0.78	3.2	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(b+j+k)fluoranthène	mg/kg	-	-	-	-	-	0.1	1	10	0.01	<0,01	<0,01	<0,01	0.014	<0,01	<0,01	<0,01	<0,01
Benzo(c)phénanthrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Benzo(g,h,i)pérylène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Chrysène	mg/kg	0.026	0.057	0.24	0.86	1.6	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,h)anthracène	mg/kg	0.0033	0.0062	0.043	0.14	0.2	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,i)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,h)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Dibenzo(a,l)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Diméthyl-7,12 benzo(a)anthracène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Fluoranthène	mg/kg	0.047	0.11	0.45	2.4	4.9	0.1	10	100	0.01	<0,01	<0,01	<0,01	0.02	<0,01	<0,01	<0,01	<0,01
Fluorène	mg/kg	0.01	0.021	0.061	0.14	1.2	0.1	10	100	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Indéno(1,2,3-cd)pyrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Méthyl-3 cholanthrène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Naphtalène	mg/kg	0.017	0.035	0.12	0.39	1.2	0.1	5	50	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Phénanthrène	mg/kg	0.025	0.042	0.13	0.52	1.1	0.1	5	50	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Pyrène	mg/kg	0.029	0.053	0.23	0.88	1.5	0.1	10	100	<0,01	<0,01	<0,01	<0,01	0.01	<0,01	<0,01	<0,01	<0,01
Méthyl-1 naphtalène	mg/kg	-	-	-	-	-	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Méthyl-2 naphtalène	mg/kg	0.016	0.02	0.063	0.2	0.38	0.1	1	10	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Diméthyl-1,3 naphtalène	mg/kg	-	-	-	-	-	-	-	-	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Triméthyl-2,3,5 naphtalène	mg/kg	-	-	-	-	-	-	-	-	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
HAP Totaux (somme des substances individuelles)	mg/kg	-	-	-	-	-	-	-	-	0.02	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00
BPC totaux (sommation des congénères)	mg/kg	0.025	0.034	0.079	0.28	0.78	0.05	1	10	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017	<0,017
Hydrocarbures pétroliers C_{10}-C_{50}	mg/kg	-	-	-	-	-	300	700	3500	<100	<100	<100	<100	<100	<100	<100	<100	<100
Carbone organique total (COT)	%	-	-	-	-	-	-	-	-	3.7	6.5	6.7	4.4	20.6	1.7	5.9	10	2.1
Granulométrie																		
Gravier	%	-	-	-	-	-	-	-	-	--	0.0%	0.0%	--	1.0%	4.0%	0.0%	3.0%	0.0%
Sable	%	-	-	-	-	-	-	-	-	--	1.5%	6.2%	--	67.0%	84.2%	0.6%	19.0%	93.0%
Particules fines (silt+argile)	%	-	-	-	-	-	-	-	-	0.0%	98.5%	93.8%	0.0%	32.0%	11.8%	99.4%	78.0%	7.0%
Silt	%	-	-	-	-	-	-	-	-	--	26.8%	34.8%	--	24.7%	6.3%	23.9%	65.6%	7.0%
Argile	%	-	-	-	-	-	-	-	-	--	71.7%	59.0%	--	7.3%	5.5%	75.5%	12.4%	--

Concentration d'effets rares CER
Concentration seuil produisant un effet CSE
Concentration d'effets occasionnels CEO
Concentration produisant un effet probable CEP
Concentration d'effets fréquents CEF

Dépassement de la CEO
Dépassement de la CEF

tramé Dépassement du critère A du MDDEP (sols)

ANNEXE 2
Communications

État d'avancement

Organisme	Coordonnées	Échange	Résumé du développement	Distance depuis le site de Contrecoeur	Coûts
SITES MINIERS					
Association minière du Québec Jean-Claude Belles-Isles, directeur - Environnement	Place de la Cité - Tour Belle Cour 2590, boulevard Laurier Bureau 720, 7e étage Québec (Québec) G1V 4M6 Tél. : (418) 657-2016 Adresse courriel générale : mines@amq-inc.com jcbellesisles@amq-inc.com	01/12/2011	- Les mines les plus proches sont localisées en Abitibi (400-500 km). - Nous dirige vers Jean Dionne (MRNF)	-	-
Ministère des Ressources naturelles et de la Faune Jean Dionne	4e étage 880, chemin Sainte-Foy Québec (Québec) G1S 4X4 Tél. (418) 627-6292, poste 5382 jean.dionne@mrnf.gouv.qc.ca	01/12/2011	- Message téléphonique. Sera de retour le 5 décembre.	Environ 175 km	Transport : Entre 22 $/km et 28 $/km, pour aller seulement, selon MTQ, 2011 Disposition, si le matériel est requis : 0 $
		05/12/2011	- Très intéressé par l'acquisition des argiles. - Plusieurs sites miniers sont abandonnés principalement dans le secteur de Montauban (175 km), sur la rive nord. Les matériaux de dragage pourraient être utilisés pour confiner des résidus acidogènes. - D'ici 2-3 ans, selon leur plan de restauration, ces sites devraient faire l'objet de fermeture. - S'il a une garantie que les matériaux rencontrent les exigences et qu'ils sont disponibles, il pourrait faire retarder la restauration de ces sites. - Le tenir informé des évènements. - Il y aurait peut-être d'autres sites miniers dans le secteur de Sherbrooke, cependant, il n'y a rien de définitif (>160 km).		
		22/12/2011	- Courriel et lettre transmis à Jean Dionne avec les propriétés et les caractéristiques physico-chimiques des matériaux.		
		04/01/2012	- Confirmation qu'il a bien reçu les documents.		
		19/01/2012	- Demande quels coûts seraient reliés à la disposition des matériaux dans un processus de réhabilitation ou de fermeture de sites miniers.		

Organisme	Coordonnées	Échange	Résumé du développement	Distance depuis le site de Contrecoeur	Coûts
			- Transfert des résultats chimiques révisés.		
		09/02/2012	- Réitère la demande pour les coûts de disposition dans un site minier.		
		10/02/2012	- Dans la mesure où ces matériaux sont requis pour la restauration de sites miniers et qu'ils sont livrés gratuitement sur le site minier, le MRNF prendrait en charge la disposition de ces derniers sur le terrain.		
SABLIÈRES ET CARRIÈRES					
GERSOL CONSTRUCTION INC Julie Collette, B.A.A. Directrice développement des affaires Jules Collette, président Tél. : 450 743-2705 poste 226 Fax : 450 743-2920 jules.collette@sablescollette.com	909, côte Saint-Jean Saint-Roch-de-Richelieu (Québec) J0L 2M0 Tél. : (450) 743-2705, poste 238 Adresse courriel générale : info@gersol.com julie.collette@gersol.com Jules Collette, président Tél. : (450) 743-2705 poste 226 jules.collette@sablescollette.com	01/12/2011	- Sur recommandation de la secrétaire, j'ai transmis un courriel car elle était en réunion.	<15 km	Transport des matériaux dragués vers la sablière : 7,50 $/m³ Dispositions sur le site : 2,50 $/m³ prix basé pour 2012 prévoir indexation dans le temps.
		02/12/2011	- Réponse par courriel : « J'en discute avec mon responsable et je vous reviens la semaine prochaine. »		
		19/12/2011	- Retourne un courriel pour savoir s'il y a des développements. Attend une réponse.		
		16/01/2012	- Jules Collette se montre intéressé par l'acquisition des argiles. Les propriétés et les caractéristiques physico-chimiques des matériaux lui seront transmis ainsi qu'une demande des coûts potentiels. - Courriel et lettre transmis à Julie et Jules Collette avec les propriétés et les caractéristiques physico-chimiques des matériaux.		
		17/01/2012.	- Confirmation qu'ils ont bien reçu les documents.		
		26/01/2012	- Fait un suivi pour savoir s'ils sont intéressés par les matériaux. - En discute et doit me revenir avec les informations le 30 janvier 2012.		
		01/02/2012	- M. Colette fournit les coûts suivants : - Transport des matériaux dragués vers la sablière : 7,50 $/m³ - Dispositions sur le site : 2,50 $/m³ prix basé pour 2012 prévoir indexation		

Organisme	Coordonnées	Échange	Résumé du développement	Distance depuis le site de Contrecoeur	Coûts
			dans le temps. - Calcul basé sur : 1 mètre cube = 2 tonnes métrique - Cette estimation est vraiment budgétaire et pourrait changer selon le matériel ou un retour avec remblai vers le port.		
	Sablière PMJ Inc (La) 950 côte St Jean, St-Roch-de-Richelieu, QC J0L 2M0 (450) 743-9045		Info à venir Aucun retour d'appel de leur part.		
Ministère du développement durable, de l'environnement et des parcs Richard Martel Service des lieux contaminés	9e étage, 675, boulevard René-Lévesque Est Québec (Québec) G1R 5V7 Tél. (418) 521-3950, poste 4951 richard.martel@mddep.gouv.qc.ca	09/12/2011 12/12/2011	- Message téléphonique. - Me dirige vers la direction régionale de la Montérégie, à Pierre Fortin (450) 928-7607, poste 275.		
Ministère du Développement durable, de l'Environnement et des Parcs Pierre Fortin	2e étage 201, place Charles-Le Moyne Longueuil (Québec) J4K 2T5 Tél. : (450) 928-7607, poste 275 pierre.fortin@mddep.gouv.qc.ca	12/12/2011 13/12/2011	- Message téléphonique, de retour le 13/12/2011. - Effectivement, il pourrait y avoir des opportunités de réutilisation dans des carrières qui sont en processus de fermeture. - Faire une demande écrite à Lyne Longpré, car lui dans 5 ans ne sera plus là. - Fournir les propriétés et les caractéristiques physico-chimiques des matériaux.	En Montérégie <200 km	

Organisme	Coordonnées	Échange	Résumé du développement	Distance depuis le site de Contrecoeur	Coûts
Ministère du Développement durable, de l'Environnement et des Parcs Lyne Longpré	2e étage 201, place Charles-Le Moyne Longueuil (Québec) J4K 2T5 Tél. : (450) 928-7607, poste 279 lyne.longpre@mddep.gouv.qc.ca	22/12/2011	- Courriel et lettre transmis à Lyne Longpré avec les propriétés et les caractéristiques physico-chimiques des matériaux. Pierre Fortin en cc.		
		23/12/2011	- Confirmation qu'elle a bien reçu les documents.		
		19/01/2012	- Demande quels coûts seraient reliés à la disposition des matériaux dans un processus de réhabilitation ou de fermeture d'une carrière. - Transfert des résultats chimiques révisés.		
		24/01/2012	- Téléphone de Pierre Fortin disant que ce n'est pas dans le mandat du MDDEP de négocier avec les propriétaires. - Il communiquera avec le consultant/propriétaire potentiel pour l'informer de nos démarches. - Habituellement, lors d'une fermeture, les sites sont restaurés en plan d'eau, en raison des coûts.		
		08/02/2012	- M. Fortin a transmis un courriel à : Ecosynergie Canada Monsieur Fabrice Fua - Il semble qu'il s'agisse de l'ex-carrière Landreville, située au 950, rue d'Anjou (intersection des rues Montbrun et du chemin d'Anjou), Boucherville, soit à environ 40 km de Contrecoeur		
Les Carrières Rive-Sud Écosynergie Monsieur Fabrice FUA gestionnaire de projets	1425, place Lussier Terrebonne Québec J6Y1G7 Tél : (514) 523-4045 e-mail: ecosynergie.americas@gmail.com www.ecosynergie.lu	16/02/2012	- M. Fabrice Fua communique avec CJB Environnement. Dans le cadre du projet de réhabilitation de l'ex-carrière Landreville, il semble très intéressé par l'acquisition des matériaux argileux. Son collègue, Paul Boissonnault, communiquera avec nous pour obtenir les informations techniques sur les matériaux.	40 km	Ne veulent pas s'avancer sur ce point pour l'instant. Présenteront un plan d'affaire à l'APM uniquement à l'automne 2012, après avoir obtenu
		28/02/2012	- Étant sans nouvelle de M. Paul Boissonnault, un courriel est transmis à M. Fua pour valider leur intention.		

Organisme	Coordonnées	Échange	Résumé du développement	Distance depuis le site de Contrecoeur	Coûts
			- M. Fua me confirme que M. Boissonnault devrait communiquer avec nous incessamment.		leur C.A. et en avoir parlé avec le MDDEP et la Ville.
		28/02/2012	- Courriel et lettre transmis à Paul Boissonnault avec les propriétés et les caractéristiques physico-chimiques des matériaux. Fabrice Fua en cc. - M. Boissonnault - (514) 238-7368 - pboissonnault@hotmail.com		
		14/03/2012	- Réitère ma demande auprès de Paul Boissonnault (Fabrice Fua en cc.), à savoir si les caractéristiques physico-chimiques des matériaux sont adéquates pour leur projet.		
		16/03/2012	- M. Fua affirme que les matériaux présentent des caractéristiques physico-chimiques envisageables pour la réhabilitation de la carrière.		
Site de traitement des sols contaminés					
Northex Environnement inc. Fabienne Montgrain	Administration et centre de traitement 699, montée de la Pomme d'or Contrecoeur (Québec) J0L 1C0 Téléphone : (450) 587-8877 Sans frais : 1-866-757-3353 Cell. (514) 617-3352 fmontgrain@northex.net	07/12/2011	- Message téléphonique. - Elle me retourne un autre message téléphonique me spécifiant que Northex est une compagnie de traitement et de valorisation des sols.	<5 km	
		09/12/2011	- Courriel lui expliquant ce que nous recherchons, car elle semble avoir mal interprété nos besoins. Attend une réponse. - Aucun retour de leur part.		

Organisme	Coordonnées	Échange	Résumé du développement	Distance depuis le site de Contrecoeur	Coûts
Enfoui-Bec (site de Saint-Grégoire) Louis-Marc Bourgouin Directeur du développement	18 055 rue Gauthier Bécancour (Québec) G9H 1C1 Tél. : (819) 233-2443 Cell. : (819) 996-0870 louis-marc@enfouibec.com	02/12/2011	- Parlé avec Louis-Marc Bourgouin. Évaluera la disposition possible et Raymond Lyonnais va me rappeler la semaine prochaine.	Environ 100 km	Transport : Entre 16 $/km et 20 $/km, pour aller seulement, selon MTQ, 2011 Disposition : 10 $/t.m., <10 $/t.m., si Enfoui-Bec est à la recherche de matériaux de recouvrement pour la fermeture de certaines cellules.
		08/12/2011	- Dans 3 ans, la fermeture de quelques cellules est à prévoir. - Par la suite, dans environ 5 ans, un plus grand nombre seront fermées. - M. Bourgouin désire obtenir quelques résultats granulométriques, la conductivité hydraulique de ces argiles et autres renseignements disponibles.		
		22/12/2011	- Courriel et lettre transmis à Louis-Marc Bourgouin avec les propriétés et les caractéristiques physico-chimiques des matériaux.		
		19/01/2012	- Demande quels coûts seraient reliés à la disposition des matériaux chez Enfoui-Bec. - Transfert des résultats chimiques révisés.		
		25/01/2012	- Le tarif budgétaire sera de 10 $/tm pour la disposition seulement. Le tarif pourra être révisé avec des analyses conformes ainsi que les besoins au moment des travaux. - Retourne courriel pour des éclaircissements.		
		02/02/2012	- Les résultats d'analyses devront venir d'un laboratoire certifié et être conformes à la loi sur les sols contaminés. - S'ils sont en processus de fermeture, donc à la recherche de matériaux argileux, les coûts pourront être moindres.		
AMENAGEMENT FAUNIQUE					
Environnement Canada	1550 avenue d'Estimauville Québec (Québec) G1J 0C3 Tél. : 1-800-668-6767	09/12/2011	- La téléphoniste me dirige vers Robert Helie. - Robert Helie me dirige vers le Centre Saint-Laurent.		

Organisme	Coordonnées	Échange	Résumé du développement	Distance depuis le site de Contrecoeur	Coûts
			- Courriel à enviroinfo@ec.gc.ca pour obtenir coordonnées de quelqu'un.		
Service canadien de la faune Daniel Bergeron Coordonnateur évaluations environnementales SCF	Conseiller scientifique Intégration des stratégies et des Programmes Prestation des services de conservation et permis Service canadien de la faune, région du Québec Direction générale de l'intendance environnementale Environnement Canada 801-1550 Ave d'Estimauville, Québec, Qc G1J 0C3 Tél. : (418) 648-7271 Fax : (418) 648-4871 **daniel.bergeron@ec.gc.ca**	19/12/2011	- Me transmet un courriel avec les techniques applicables d'aménagement faunique pouvant augmenter et améliorer le potentiel d'habitat pour les oiseaux, dont l'installation de nichoirs artificielle, la plantation de végétaux qui attirent les oiseaux, une gestion de l'eau d'un marais afin d'augmenter la productivité du marais, la création d'îlots, la modification du design d'un milieu humide afin d'en augmenter sa superficie et/ ou son hétérogénéité, etc. - Le SCF-Région du Québec n'a pas d'expertise particulière en aménagement ou restauration d'habitats fauniques (Depuis le départ de Denis Lehoux, il n'y a plus personne qui s'occupe de la recherche, de l'encadrement et de l'exploration à l'interne). - Il présentera ma demande à Diane Dauphin. - J'ai déjà laissé un message à cette personne le 15/12/2011.		
Service canadien de la faune Diane Dauphin Biologiste	SCF, région du Québec Environnement Canada 1141, route de l'Église Sainte-Foy (Québec) G1V 4H5 Tél. : (418) 648-3474 courriel: diane.dauphin@ec.gc.ca	15/12/2011	- Message téléphonique.		
		20/12/2011	- Des travaux d'enrochement au niveau de la Réserve nationale de faune des îles de Contrecœur seraient vraisemblablement plus appropriés pour contrer l'érosion. - Les îles barrières créées avec des matériaux de dragage, lors de l'aménagement de la voie navigable dans l'optique de protéger les îles de Contrecœur, pourraient nécessiter d'être réaménagées afin qu'elles puissent poursuivre leur vocation.		

Organisme	Coordonnées	Échange	Résumé du développement	Distance depuis le site de Contrecoeur	Coûts
			- En janvier 2012, le SCF statuera sur la pertinence et la faisabilité d'un tel projet. - Plusieurs éléments seront impliqués dans l'évaluation : Présence de la Réserve nationale de faune; Évaluation environnementale à faire; Espèces en péril (si présence pourrait toutefois aller plus à l'ouest ou plus à l'est; Revoir les plans d'aménagement de départ pour connaître la hauteur des dépôts initiaux, les quantités de matériaux utilisées, l'état de l'érosion actuel; Le phragmite est très présent dans ce secteur. Il faudrait prévoir planter du phalaris pour permettre à la sauvagine de nicher, cependant, préalablement, il faudrait que l'habitat est adéquat ; Prévoir un suivi serré afin que le phragmite n'envahisse pas le phalaris; Faire un projet pilote avec les matériaux de dragage; Etc.		
		21/12/2011	- Discussion avec François Hazel (418) 775-0630 et Stéphanie Rioux (418) 775-0646, du MPO - À l'époque, ces travaux étaient peut-être justifiés. - La réalisation des travaux impliquerait la province en raison du statut du secteur. - Plusieurs aspects devront être pris en compte. - Les espèces en péril susceptibles d'être présentes dans le secteur, particulièrement au niveau des		

Organisme	Coordonnées	Échange	Résumé du développement	Distance depuis le site de Contrecoeur	Coûts
			herbiers (ex. : fouille roche, chevalier cuivré). - À priori, ce n'est pas une solution favorable pour l'habitat du poisson. Favorise la valorisation en milieu terrestre ou créé un aménagement bénéfique pour le poisson. - Déjà que le projet de construction va engendrer une perturbation et des impacts au niveau de l'habitat du poisson, cette option produira des impacts additionnels (au niveau transport dans la voie navigable, le dérangement, la remise en suspension des matériaux, etc.).		
		22/12/2011	- Courriel et lettre transmis à Diane Dauphin avec les propriétés et les caractéristiques physico-chimiques des matériaux. - Aucun retour de leur part depuis.		
LIEUX D'ENFOUISSEMENT SANITAIRE (L.E.S.)					
BFI Usine de triage Lachenaie ltée Hector Chamberland Directeur du développement commercial	3779 Chemin des Quarante-Arpents Terrebonne (Québec) J6V 9T6 Tél. : (450) 474-2423, poste 203 lachenaie@bficanada.com	19/12/2011	- Message téléphonique.		
		20/12/2011	- Leur site est sur un lit d'argile. Lorsqu'ils creusent des cellules, eux-mêmes ne savent plus quoi faire avec. Me suggère de contacter Berthier Entreprise. Il pense qu'ils sont sur le sable…		
Les Entreprises Berthier Inc. Luc Turcotte	61, rue Montcalm BERTHIERVILLE, Québec J0K 1A0 Tél. : (450) 836-8111	22/12/2011	- Message téléphonique. - Aucun retour d'appel de leur part.		

Organisme	Coordonnées	Échange	Résumé du développement	Distance depuis le site de Contrecoeur	Coûts
L.E.S. de Sainte-Cécile-de-Milton (M.R.C. La Haute-Yamaska) LET Roland Thibault inc.	(450) 372-2399	12/2011	- Patrick Millot - En aurait eu besoin avant le printemps 2012 pour mettre par-dessus ses conduites de biogaz. - Mur écran à faire, cependant, il n'accepte que du A afin de ne pas contaminer le sol en place. - Le site vient d'ouvrir, sa fermeture ne se fera pas avant 40 ans.	Environ 90-105 km	
L.E.S. de Cowansville (MRC Brome-Missisquoi) Valérie Martin	749, rue Principale Cowansville (Québec) J2K 1J8 Tél. : 450 266-4900, poste 249	10/02/2012	- Message téléphonique. Elle sera de retour le 13 février.	125 km	
		13/02/2012	- Me réfère à Brigitte Nadeau (450) 263-2351 #225 de la Régie Intermunicipale d'élimination de déchets solides de Brome-Missisquoi (RIEDSBM) - Aucun besoin. S'informera auprès des autres municipalités.		
Ville de Longueuil, Travaux publics François Pelletier	Tél. : (450) 463-7000	15/02/2012	- Les déchets de la Ville de Longueuil sont transférés à St-Nicéphore (rive sud, ~100 km, chez Intersan) et à Ste-Sophie (rive nord, chez Waste Management à ~100 km). - Intersan / Waste Management, 25, rue Gagnon, Drummondville (Québec), Tél. : (819) 477-6609 p. 0 - Waste Management, 2535 Premiere rue, Ste-Sophie, QC J5J 2R7, Tél. 800-267-7874.	90 km (St-Nicéphore / Drummondville) 100 km (Ste-Sophie / Lachute)	
L.E.S. de Saint-Nicéphore	Michel Beauchemin Tél. : (819) 477-6609, poste 0	19/03/2012	- Intersan / Waste Management, 25, rue Gagnon, Drummondville (Québec) - Plusieurs cellules feront l'objet d'une fermeture d'ici 2013-2014. - En processus d'autorisation d'agrandissement, d'autres cellules seront à fermer d'ici 5 ans. - Me réfère à Simon Mercier.	100 km (St-Nicéphore / Drummondville)	
	Simon Mercier, dir. opérationnel Tél. : (450) 431-2313, poste 231	19/03/2012	- St-Nicéphore : confirme que le site fermera quelques cellules en 2013-2014. En processus d'autorisation d'agrandissement. Si l'expansion se concrétise, des cellules seront à	5-10 $/t.m. + frais de transport	

Organisme	Coordonnées	Échange	Résumé du développement	Distance depuis le site de Contrecoeur	Coûts
			fermer dans environ 5 ans. - Ste-Sophie : presque 10 ans d'exploitation. Les matériaux argileux pourraient être utilisés par-dessus le recouvrement final. - Démontre de l'intérêt particulièrement pour le site de Sainte-Sophie. - Me réfère à Patrick Arnould pour les coûts de transport.		
	Patrick Arnould, special waste manager Tél. : (514) 773-6584	29/03/2012	- En congé, attendre au 26 mars pour communiquer avec. - Laissé un message dans sa boîte vocale…. Toujours pas de rappel.		
AUTRES SITES					
ArcelorMittal Mines Canada Environnement Luc Chabot, Chef de service, Environnement Jean Lavoie, Directeur Environnement	900, route des Aciéries Contrecoeur (Québec) J0L 1C0 Tél. : (450) 392-3521	20/03/2012	- La cie envisage effectuer le traitement sur les scories entreposées dans des cellules, libérant par le fait ces dernières. - Courriel et lettre transmis à Luc Chabot avec les propriétés et les caractéristiques physico-chimiques des matériaux. - Attend retour d'appel de leur part.	5 km	
		07/05/2012	- Réitère ma demande, à l'effet s'il a eu le temps de valider les caractéristiques physico-chimiques des matériaux.		
		14/05/2012	- Jean Lavoie (Dir. Env., 450-392-3301) mentionne que la cie n'opère pas de cellules de scories. Ils ont un site près du fleuve, où des opérations de traitement de scories ont été effectuées depuis les années 1970 jusqu'à récemment. Par contre, ArcelorMittal utilise des cellules pour un autre résidu d'opération pour lesquelles nous avons obtenu un décret ministériel. Selon lui, pour le moment, la cie n'a aucun intérêt à recevoir de tels résidus. Par contre, la compagnie demeure ouverte pour toute autre proposition éventuelle.		

Autres personnes contactées

Ecogénie inc.
Ghislain Verreault
1675, Chemin Sainte-Foy
Québec (Québec) G1S 2P7
Tél. : (418) 682-0675
Fax. : (418) 682-6038
info@ecogenie.ca

Travaux publics et Services gouvernementaux Canada
Marc-André Baillargeon, Chef, Dragage et levés bathymétriques
ÉSC - MPO/TC
1550, avenue D'Estimauville
Québec (Québec) G1J 0C7
Tél. : (418) 649-2803
Fax : (418) 649-2755

Port de Bécancour
André Caron
Tél. : (819) 294-6656 poste 232

Harbour Development
Denis Caron, General Manager
P.O. Box 497
Darmouth, Nova Scotia B2Y 3Y8
Tél. : (902) 494-5767
dcaron.harbour@ns.sympatico.ca
http://www.harbourdev.com/

Le Groupe Océan Inc. (Ancien Dragage St-Maurice)
500-105, Abraham-Martin
Québec (Québec) G1K 8N1
Tél. : (418) 694-1414
dragage@groupocean.com
Louis-Pierre Dorval, Directeur aux opérations de dragage
Daniel Beauchamp
Daniel.Beauchamp@groupocean.com

Roland Thibault
Tél. : (450) 653-6351
hvrt@sympatico.ca

Verreault Navigation Inc.
Richard Beaupré, President and CEO
146, Principale
Les Méchins Québec G0J 1T0
Tél. : (418) 729-3733
richard.beaupre@groupeverreault.com
http://www.groupeverreault.com/fr/accueil/index.asp

Dragage Verreault inc.
Claudette Verreault, Présidente
245, route Bellevue Ouest
Les Méchins (Québec) G0J 1T0
Tél. : (418) 729.3609
Fax : (418) 729.3978
Courriel : cverreault@dragageverreault.com

Fraser River Pile & Dredge (GP) Inc.
John Halmarick, Dredging Operations Manager
1830 River Drive
New Westminster, B.C. V3M 2A8
Bus: (604) 522-7971 (available 24 hours)
Fax. : (604) 521-7530
Email: info@frpd.com
jhalmarick@frpd.com

Construction McNally du Québec inc.
Pierre Tetreault
Luc Dufresne, Ingénieur-Estimateur
1750 chemin St-Roch
C.P. 322 Succ. Bureau Chef
Sorel-Tracy (Québec) J3P 5N8
Tél. : (450) 742-9595
Fax. : (450) 742-0440
Courriel : ldufresne@mcnallycorp.com

Trans-Océan Dragage
1350 Rue Sherbrooke ouest
Bureau 1000,
Montréal (Québec) H3G 1J1
Tél. : (514) 486-4666
Fax. : (514) 486-4667
Courriel : info@transoceandragage.com

MARINE INTERNATIONAL DRAGAGE (M.I.D.) Inc.
Karine Gauthier
180, Chemin des Patriotes
Sorel-Tracy (Québec) J3P 2L3
Tél. : (450) 742-5648
Fax. : (450) 742-1537
Internet : www.marinedragage.com
Courriel : kgauthier@marinedragage.com

Ciment Québec inc.
M. Yves Brousseau, ing. 514-718-8308

Gabriel J. Assaf, ing., M.ing., Ph.D.
Professeur titulaire et Expert en génie routier
ETS-UQ 1100 Notre Dame O, Montréal, H3C 1K3
Tél : 514 396 8924

L.A. Hébert Ltée
Normand Brault
9700 Place Jade, Brossard,
Québec, J4Y 3C1
Téléphone : (450) 444-4847

ANNEXE 3
Tarifs de camionnage de matières en vrac fixés par le MTQ

Tarifs horaire

	2 essieux	3 essieux	4 essieux	5 essieux	6 essieux	7 essieux
Matières en vrac (sauf enrobé et pierre)	57,66 $	74,57 $	92,25 $	100,64 $	107,59 $	115,02 $
Pierre	66,31 $	85,75 $	106,09 $	115,75 $	123,73 $	132,28 $
Enrobé	63,42 $	82,02 $	101,48 $	110,70 $	118,35 $	126,53 $

Source : MTQ, 2011.

Table de prix tonne-kilomètre

Kilomètre en charge	Matériaux (prix par tonne)		
	Matière en vrac (sauf enrobé et pierre)	Enrobé	Pierre
2 à 2,9	1,744 $	1,928 $	2,182 $
5 à 5,9	2,491 $	2,762	3,121
10 à 10,9	3,713 $	4,122 $	4,657 $
15 à 15,9	4,843 $	5,362 $	6,077 $
40 à 40,9	9,525 $	10,517 $	11,967 $
50 à 50,9	10,905 $	12,047 $	13,707 $
90 à 90,9	15,281 $	17,257 $	19,133 $
100 à 100,9	16,221 $	18,437 $	20,283 $
150 à 150,9	20,921 $	24,337 $	26,033 $
175 à 175,9	22,967 $	26,951 $	28,604 $
199 à 199,9	24,767 $	29,279 $	30,908 $

Source : MTQ, 2011.

ANNEXE 4
Correspondance

INSPEC-SOL
INGÉNIERIE ET SOLUTIONS
445, ave Saint-Jean-Baptiste
Bureau 390
Québec (Québec)
Canada
G2E 5N7
Tél. : 418 657-6859
Fax : 418 657-1325

Le 22 décembre 2011

Mme Lyne Longpré
Ministère du Développement durable, de l'Environnement et des Parcs
2e étage
201, place Charles-Le Moyne
Longueuil (Québec) J4K 2T5

OBJET : Utilisation des matériaux dragués à Contrecœur par l'Administration portuaire de Montréal

Madame,

L'Administration portuaire de Montréal (APM) envisage l'expansion de son terminal portuaire de Contrecœur dans un horizon de 5 à 8 ans. Ce projet pourrait générer une quantité totale de déblais estimée à près de 1 000 000 m³. Nous avons été mandatés par l'APM pour, entre autres, déterminer le mode de gestion des déblais de dragage à privilégier et identifier les opportunités de disposition de ces matériaux.

La démarche que nous entreprenons ici, au nom de l'APM, s'inscrit dans un contexte de développement durable et elle vise la recherche de solutions de réutilisation à des fins bénéfiques des déblais de dragage. Dans cette optique, nous souhaitons savoir si le MDDEP pourrait identifier des propriétaires, de carrières, sablières, sites contaminés, etc., susceptibles d'être intéressés à recevoir ces déblais de dragage afin de les utiliser comme matériaux de remplissage et/ou de recouvrement dans un processus de réhabilitation ou de fermeture de sites.

Le cas échéant, l'étape suivante consistera à établir les modalités d'un partenariat entre l'APM et les futurs bénéficiaires de ces matériaux.

Il faut noter que, dans un tel partenariat, la participation technique et financière de l'APM serait vraisemblablement limitée à la coordination et aux coûts des interventions temporaires (dragage, bassin d'égouttement, aires d'entreposage, etc.).

Le transport des matériaux depuis le site de dragage jusqu'à un point de transbordement convenu entre les deux parties, pourrait faire l'objet d'une entente. L'APM se déchargerait des travaux à l'intérieur desquels le receveur souhaiterait utiliser les matériaux dragués (études de faisabilité et de conception, acquisitions de terrains, ententes, permis, certificat d'autorisation provincial, construction, etc.).

Le document joint à la présente détaille les caractéristiques physiques et chimiques des matériaux retrouvés à Contrecœur. Il fournit aussi une évaluation sommaire des aptitudes et des contraintes techniques, environnementales et administratives liées à leur réutilisation en milieu terrestre.

Pour toute information additionnelle concernant la présente, nous vous invitons à contacter Jonathan Olson (tél. : 418-657-6859, courriel : j.olson@cjb-environnement.com) ou moi-

même, Marie-Chantale Sauvageau (tél. 418-657-6859, courriel : mc.sauvageau@cjb-environnement.com).

Nous vous remercions à l'avance de donner suite à la présente.

Nous vous prions d'agréer l'expression de nos sentiments les meilleurs.

<Original signé par>

Marie-Chantale Sauvageau, biol.

Copie :

Mme Lyne Martin, Administration portuaire de Montréal

M. Pierre Fortin, MDDEP

INSPEC·SOL
INGÉNIERIE ET SOLUTIONS
445, ave Saint-Jean-Baptiste
Bureau 390
Québec (Québec)
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Le 22 décembre 2011

M. Jean Dionne
Ministère des Ressources naturelles et de la Faune
4e étage
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Tél. 418 627-6292, poste 5382

Transmis par courriel : jean.dionne@mrnf.gouv.qc.ca

OBJET : Utilisation des matériaux dragués à Contrecœur par l'Administration portuaire de Montréal

Monsieur,

L'Administration portuaire de Montréal (APM) envisage l'expansion de son terminal portuaire de Contrecœur dans un horizon de 5 à 8 ans. Ce projet pourrait générer une quantité totale de déblais estimée à près de 1 000 000 m³. Nous avons été mandatés par l'APM pour, entre autres, déterminer le mode de gestion des déblais de dragage à privilégier et identifier les opportunités de disposition de ces matériaux.

La démarche que nous entreprenons ici, au nom de l'APM, s'inscrit dans un contexte de développement durable et elle vise la recherche de solutions de réutilisation à des fins bénéfiques des déblais de dragage. Dans cette optique, nous souhaitons savoir si le MRNF pourrait identifier des propriétaires, de sites miniers susceptibles d'être intéressés à recevoir ces déblais de dragage afin de les utiliser comme matériaux de remplissage et/ou de recouvrement dans un processus de réhabilitation ou de fermeture de sites.

Le cas échéant, l'étape suivante consistera à établir les modalités d'un partenariat entre l'APM et les futurs bénéficiaires de ces matériaux.

Il faut noter que, dans un tel partenariat, la participation technique et financière de l'APM serait vraisemblablement limitée à la coordination et aux coûts des interventions temporaires (dragage, bassin d'égouttement, aires d'entreposage, etc.).

Le transport des matériaux depuis le site de dragage jusqu'à un point de transbordement convenu entre les deux parties, pourrait faire l'objet d'une entente. L'APM se déchargerait des travaux à l'intérieur desquels le receveur souhaiterait utiliser les matériaux dragués (études de faisabilité et de conception, acquisitions de terrains, ententes, permis, certificat d'autorisation provincial, construction, etc.).

Le document joint à la présente détaille les caractéristiques physiques et chimiques des matériaux retrouvés à Contrecœur. Il fournit aussi une évaluation sommaire des aptitudes et des contraintes techniques, environnementales et administratives liées à leur réutilisation en milieu terrestre.

Pour toute information additionnelle concernant la présente, nous vous invitons à contacter Jonathan Olson (tél. : 418-657-6859, courriel : j.olson@cjb-environnement.com) ou moi-même, Marie-Chantale Sauvageau (tél. 418-657-6859, courriel : mc.sauvageau@cjb-environnement.com).

Nous vous remercions à l'avance de donner suite à la présente.

Nous vous prions d'agréer l'expression de nos sentiments les meilleurs.

<Original signé par>

Marie-Chantale Sauvageau, biol.

Copie :

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Le 22 décembre 2011

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G1V 4H5
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OBJET : Utilisation des matériaux dragués à Contrecœur par l'Administration portuaire de Montréal

Madame,

L'Administration portuaire de Montréal (APM) envisage l'expansion de son terminal portuaire de Contrecœur dans un horizon de 5 à 8 ans. Ce projet pourrait générer une quantité totale de déblais estimée à près de 1 000 000 m³. Nous avons été mandatés par l'APM pour, entre autres, déterminer le mode de gestion des déblais de dragage à privilégier et identifier les opportunités de disposition de ces matériaux.

La démarche que nous entreprenons ici, au nom de l'APM, s'inscrit dans un contexte de développement durable et elle vise la recherche de solutions de réutilisation à des fins bénéfiques des déblais de dragage. Dans cette optique, nous souhaitons savoir si le SCF pourrait être intéressé à recevoir ces déblais de dragage afin de les utiliser pour la création ou le maintient d'aménagement faunique, entre autres au niveau des îles barrières à Contrecœur.

Le cas échéant, l'étape suivante consistera à établir les modalités d'un partenariat entre l'APM et les futurs bénéficiaires de ces matériaux.

Il faut noter que, dans un tel partenariat, la participation technique et financière de l'APM serait vraisemblablement limitée à la coordination et aux coûts des interventions temporaires (dragage).

Le transport des matériaux depuis le site de dragage jusqu'à un point de transbordement convenu entre les deux parties, pourrait faire l'objet d'une entente. L'APM se déchargerait des travaux à l'intérieur desquels le receveur souhaiterait utiliser les matériaux dragués (études de faisabilité et de conception, acquisitions de terrains, ententes, permis, certificat d'autorisation provincial, autorisation fédérale, construction, etc.).

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Le 22 décembre 2011

M. Louis-Marc Bourgouin
Directeur du développement
Enfoui-Bec
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Bécancour (Québec)
Tél. : (819) 233-2443

Transmis par courriel : louis-marc@enfouibec.com

OBJET : Utilisation des matériaux dragués à Contrecœur par l'Administration portuaire de Montréal

Monsieur,

L'Administration portuaire de Montréal (APM) envisage l'expansion de son terminal portuaire de Contrecœur dans un horizon de 5 à 8 ans. Ce projet pourrait générer une quantité totale de déblais estimée à près de 1 000 000 m³. Nous avons été mandatés par l'APM pour, entre autres, déterminer le mode de gestion des déblais de dragage à privilégier et identifier les opportunités de disposition de ces matériaux.

La démarche que nous entreprenons ici, au nom de l'APM, s'inscrit dans un contexte de développement durable et elle vise la recherche de solutions de réutilisation à des fins bénéfiques des déblais de dragage. Dans cette optique, nous souhaitons savoir si Enfoui-Bec pourrait être intéressé à recevoir ces déblais de dragage afin de les utiliser comme matériaux de remplissage et/ou de recouvrement dans un processus de réhabilitation ou de fermeture de site.

Le cas échéant, l'étape suivante consistera à établir les modalités d'un partenariat entre l'APM et les futurs bénéficiaires de ces matériaux.

Il faut noter que, dans un tel partenariat, la participation technique et financière de l'APM serait vraisemblablement limitée à la coordination et aux coûts des interventions temporaires (dragage, bassin d'égouttement, aires d'entreposage, etc.).

Le transport des matériaux depuis le site de dragage jusqu'à un point de transbordement convenu entre les deux parties, pourrait faire l'objet d'une entente. L'APM se déchargerait des travaux à l'intérieur desquels le receveur souhaiterait utiliser les matériaux dragués (études de faisabilité et de conception, acquisitions de terrains, ententes, permis, certificat d'autorisation provincial, construction, etc.).

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Le 16 janvier 2012

M. Jules Collette
Président
GERSOL CONSTRUCTION INC
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Saint-Roch-de-Richelieu (Québec)
J0L 2M0

Tél. : (450) 743-2705, poste 226

Transmis par courriel : jules.collette@gersol.com

OBJET : *Utilisation des matériaux dragués à Contrecœur par l'Administration portuaire de Montréal*

Monsieur,

L'Administration portuaire de Montréal (APM) envisage l'expansion de son terminal portuaire de Contrecœur dans un horizon de 5 à 8 ans. Ce projet pourrait générer une quantité totale de déblais estimée à près de 1 000 000 m³. Nous avons été mandatés par l'APM pour, entre autres, déterminer le mode de gestion des déblais de dragage à privilégier et identifier les opportunités de disposition de ces matériaux.

La démarche que nous entreprenons ici, au nom de l'APM, s'inscrit dans un contexte de développement durable et elle vise la recherche de solutions de réutilisation à des fins bénéfiques des déblais de dragage. Dans cette optique, nous souhaitons savoir si GERSOL CONSTRUCTION pourrait être intéressée à recevoir ces déblais de dragage afin de les utiliser comme matériaux de remplissage et/ou de recouvrement dans un processus de réhabilitation ou de fermeture de site.

Le cas échéant, l'étape suivante consistera à établir les modalités d'un partenariat entre l'APM et les futurs bénéficiaires de ces matériaux.

Il faut noter que, dans un tel partenariat, la participation technique et financière de l'APM serait vraisemblablement limitée à la coordination et aux coûts des interventions temporaires (dragage, bassin d'égouttement, aires d'entreposage, etc.).

Le transport des matériaux depuis le site de dragage jusqu'à un point de transbordement convenu entre les deux parties, pourrait faire l'objet d'une entente. L'APM se déchargerait des travaux à l'intérieur desquels le receveur souhaiterait utiliser les matériaux dragués (études de faisabilité et de conception, acquisitions de terrains, ententes, permis, certificat d'autorisation provincial, construction, etc.).

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Le 28 février 2012

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Cell. : (514)-238-7368

Transmis par courriel : pboissonnault@hotmail.com

OBJET : Utilisation des matériaux dragués à Contrecœur par l'Administration portuaire de Montréal

Monsieur,

L'Administration portuaire de Montréal (APM) envisage l'expansion de son terminal portuaire de Contrecœur dans un horizon de 5 à 8 ans. Ce projet pourrait générer une quantité totale de déblais estimée à près de 1 000 000 m³. Nous avons été mandatés par l'APM pour, entre autres, déterminer le mode de gestion des déblais de dragage à privilégier et identifier les opportunités de disposition de ces matériaux.

La démarche que nous entreprenons ici, au nom de l'APM, s'inscrit dans un contexte de développement durable et elle vise la recherche de solutions de réutilisation à des fins bénéfiques des déblais de dragage. Dans cette optique, nous souhaitons savoir si la carrière Landreville, localisée à Boucherville, serait apte à recevoir ces déblais de dragage afin de les utiliser comme matériaux de remplissage et/ou de recouvrement dans un processus de réhabilitation ou de fermeture de site.

Le cas échéant, l'étape suivante consistera à établir les modalités d'un partenariat entre l'APM et les futurs bénéficiaires de ces matériaux.

Il faut noter que, dans un tel partenariat, la participation technique et financière de l'APM serait vraisemblablement limitée à la coordination et aux coûts des interventions temporaires (dragage, bassin d'égouttement, aires d'entreposage, etc.).

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<Original signé par>

Marie-Chantale Sauvageau, biol.

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Mme Lyne Martin, Administration portuaire de Montréal

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Le 20 mars 2012

M. Luc Chabot
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Tél. : (450) 392-3521

Transmis par courriel : luc.chabot@arcelormittal.com

OBJET : Utilisation des matériaux dragués à Contrecœur par l'Administration portuaire de Montréal

Monsieur,

L'Administration portuaire de Montréal (APM) envisage l'expansion de son terminal portuaire de Contrecœur dans un horizon de 5 à 8 ans. Ce projet pourrait générer une quantité totale de déblais estimée à près de 1 000 000 m³. Nous avons été mandatés par l'APM pour, entre autres, déterminer le mode de gestion des déblais de dragage à privilégier et identifier les opportunités de disposition de ces matériaux.

La démarche que nous entreprenons ici, au nom de l'APM, s'inscrit dans un contexte de développement durable et elle vise la recherche de solutions de réutilisation à des fins bénéfiques des déblais de dragage. Dans cette optique, nous souhaitons savoir si ArcelorMittal, localisée à Contrecoeur, serait apte à recevoir ces déblais de dragage afin de les utiliser comme matériaux de remplissage et/ou de recouvrement dans un processus de réhabilitation ou de fermeture de site.

Le cas échéant, l'étape suivante consistera à établir les modalités d'un partenariat entre l'APM et les futurs bénéficiaires de ces matériaux.

Il faut noter que, dans un tel partenariat, la participation technique et financière de l'APM serait vraisemblablement limitée à la coordination et aux coûts des interventions temporaires (dragage, bassin d'égouttement, aires d'entreposage, etc.).

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<Original signé par>

Marie-Chantale Sauvageau, biol.

Copie :

Mme Lyne Martin, Administration portuaire de Montréal

Étude sectorielle No. 26

Impact économique et fiscal des activités portuaires
de la Phase I du futur terminal à conteneurs de Contrecœur



Administration du Port de Montréal

Impact économique et fiscal des activités portuaires de la Phase I du futur terminal à conteneurs de Contrecœur

Juin 2014

DAA Stratégies
E&B DATA
L'information économique et d'affaires au Canada

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INTRODUCTION

Cette section présente les objectifs de l'étude, le périmètre de l'analyse de même que les principaux concepts associés aux études d'impact économique.

Introduction

OBJECTIFS DE L'ÉTUDE

La mesure des impacts

❑ Cette étude d'impact repose sur une approche d'analyse économique et tente de définir les impacts générés par les dépenses effectuées dans le cadre de la construction et de l'exploitation (activités portuaires) de la Phase I du terminal à conteneurs de Contrecœur.

❑ Les impacts estimés correspondent aux effets directs, indirects et induits générés par ces dépenses d'exploitation et d'immobilisation.

❑ Les effets économiques et industriels *structurants* ne sont pas pris en compte dans la présente étude.

Principaux concepts *

❑ **Effet direct**: Effet économique généré par les dépenses des entreprises à l'étude (ex. : masse salariale, fournitures, services professionnels).

❑ **Effet indirect**: Effet économique généré par les dépenses des premiers fournisseurs des entreprises à l'étude et les fournisseurs de ceux-ci et ainsi de suite.

❑ **Effet induit** : Effet économique généré par les dépenses de consommation des travailleurs au niveau direct et indirect.

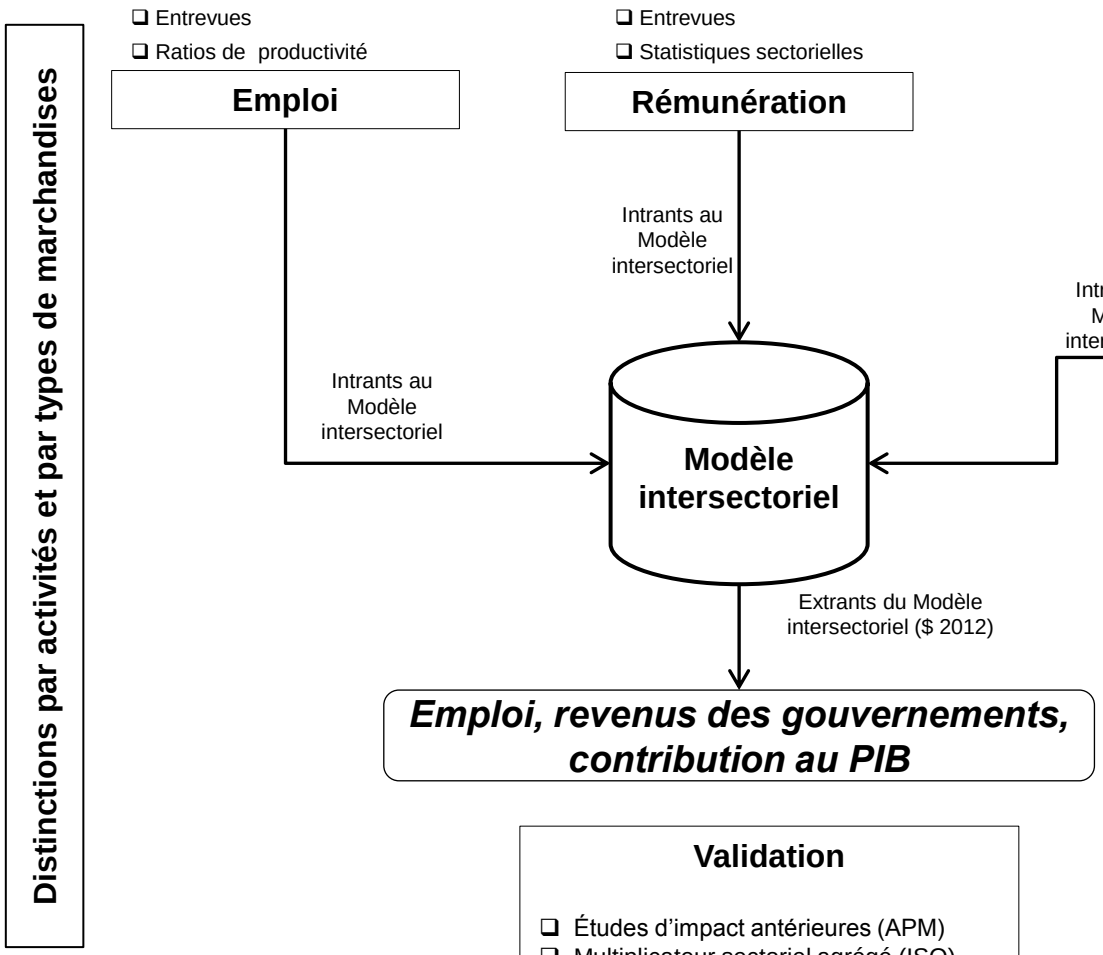
❑ **Effet structurant** : Modification de la structure économique à long terme d'une région (ex. : développement d'un parc industriel) initié par une activité spécifique.

* Voir également le lexique à la fin du document.

1. APPROCHE

Cette section présente la méthodologie employée. Elle présente également le modèle intersectoriel, l'outil de base à la réalisation de telles études ainsi que les sources utilisées. Les dépenses des futures opérations de transport maritime et terrestre, ainsi que les dépenses des activités connexes qui seraient directement reliées à la Phase I du terminal à conteneurs de Contrecœur n'ont pas été prises en compte. Les effets structurants n'ont pas non plus été mesurés, tels que l'implantation d'entreprises dans la zone industrielle prévue à cet effet.

1. Approche
Méthodologie



Le calcul des impacts économiques des dépenses associées aux activités d'exploitation et aux projets d'immobilisation repose sur :

- ***Les structures de dépenses unitaires basé sur les volumes (ex.: coûts par EVP).***
- ***L'estimation la plus précise et la plus conservatrice possible de ces dépenses. Ces dépenses sont ensuite fournies comme intrants au modèle intersectoriel;***
- ***Les simulations réalisées par le modèle, et qui fournissent les extrants désirés (ex.: emplois, rentrées fiscales, contribution au PIB).***

1. Approche
Le modèle intersectoriel

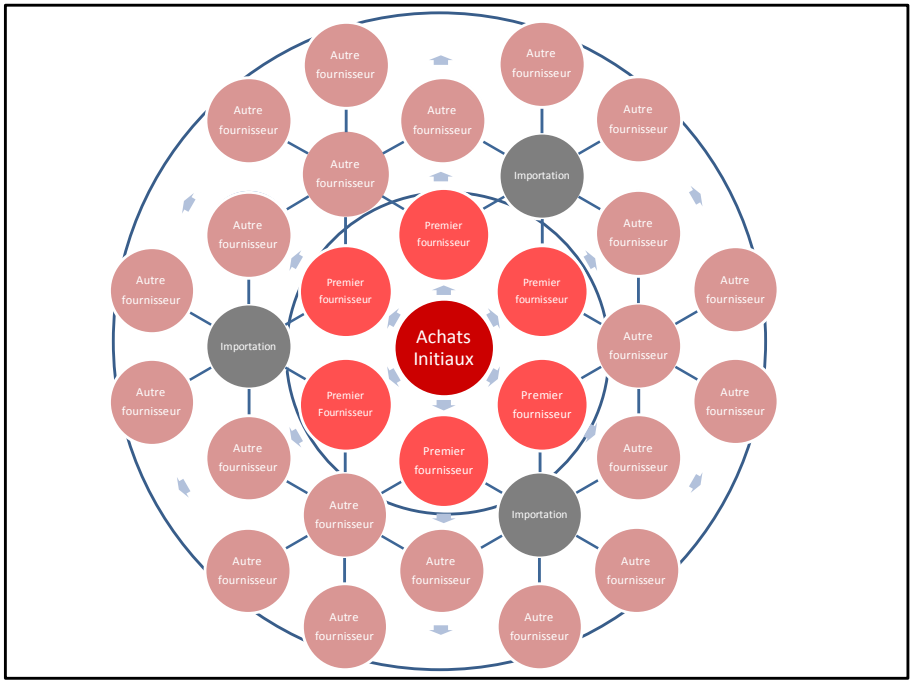
CONCEPT

Une dépense initiale au Québec /Canada fait par une entreprise ou une administration publique génère à son tour un impact économique au niveau direct puis indirect sur tout le réseau de fournisseurs au Québec/Canada. Le modèle intersectoriel du Québec /Canada calcule l'impact de la dépense initiale sur plusieurs indicateurs :

- ❑ **Emploi** : charge de travail à temps plein, mesurée par l'« année-personne »
- ❑ **Rémunération brute de la main-d'œuvre**
- ❑ **Valeur ajoutée** : contribution au PIB
- ❑ **Revenus fiscaux et parafiscaux* :** versés aux administrations publiques au niveau provincial et fédéral

Le modèle s'applique tant pour les dépenses associées aux activités courantes que pour les dépenses d'immobilisation (investissements).

Propagation de la demande captée par le modèle intersectoriel



Limites

- ❑ Modèle linéaire (pas d'économies d'échelle)
- ❑ Atemporel
- ❑ Multiplicateurs basés sur la structure économique de 2009. La fiscalité est celle de l'année fiscale 2013-2014.

* Comprend les revenus d'impôt sur les salaires et traitements des particuliers, les taxes de vente, les taxes sur le carburant, ainsi que les contributions des travailleurs et employeurs aux différents régimes publics (RRQ, FSS, CSST, RQAP, assurance-emploi).

1. Approche
Sources

Données gouvernementales

- Statistiques (Institut de la statistique du Québec, Statistique Canada)
- Rapports (Transport Canada, Ministère des Transports du Québec)

Données de l'Administration portuaire de Montréal

- Données relatives au projet de construction du terminal à conteneurs de Contrecœur
- Informations et données relatives aux ressources humaines

Données privées (domaine public)

- Rapports annuels des entreprises du domaine du transport maritime et portuaire
- Études sur les transports maritimes, Conférence des Nations-Unies sur le Commerce et le Développement
- Autres études d'impact économique reliées aux activités portuaires et au transport maritime
- Containerisation International, Yearbook 2012.

Données confidentielles

- Sondage de *Cargo M* 2012 auprès de 218 entreprises de l'industrie de la logistique et du transport de la grande région de Montréal
- Autres sources (ex.: Association des employeurs maritimes) portant notamment sur les structures de coûts des activités portuaires à l'étude

2. SOMMAIRE

Cette section présente les principales données correspondant à l'impact futur de la construction et de l'exploitation de la Phase I du terminal à conteneurs de Contrecœur.

2. Sommaire

Impacts attribuables au futur terminal à conteneurs de Contrecœur (k$)

Sommaire du terminal à conteneurs de Contrecoeur	Québec		Canada (incluant le Québec)		Revenus du gouvernement du Québec (k$)	Revenus du gouvernement du Canada (k$)
	Main-d'œuvre (années-personnes)	Rémunération brute de la main-d'œuvre (k$)	Main-d'œuvre (années-personnes)	Rémunération brute de la main-d'œuvre (k$)		
Construction du terminal	4 248	210 290	5 236	253 023	65 236	31 088
Exploitation du terminal	948	64 561	1 071	69 703	18 330	9 329

EFFETS PONCTUELS (limités à la période de construction)

EFFETS RÉCURRENTS (annuels)

Source : E&B DATA à partir de simulations et des multiplicateurs de l'Institut de la statistique du Québec et de Statistique Canada.

CONSTRUCTION

La construction de la Phase I (une capacité de 1,1 million d'EVP*) implique un investissement de 650 millions $. Cette activité générera pendant la période de construction :

- ***plus de 5 000 personnes-année dont 80% seront situés au Québec;***
- ***près de 100 millions $ qui seront destinés aux administrations publiques.***

EXPLOITATION

Les futures dépenses d'exploitation associées à la Phase 1 du projet du terminal à conteneurs de Contrecœur généreront :

- ***le maintien de plus de 1 000 emplois pour chaque année d'exploitation***
- ***près de 28 millions $ qui seront annuellement aux administrations publiques.***

Note: les effets présentés ci-haut représentent la somme des effets directs, indirects et induits.
Les effets structurants ne sont pas inclus non plus que les effets générés par les activités de transport terrestre, de transport maritime et les activités connexes qui seraient associées au futur terminal à conteneurs de Contrecœur.

*Équivalent vingt pieds

3. Impact du futur terminal à conteneurs de Contrecœur

Cette section présente l'impact économique de la construction de la Phase I du terminal à conteneurs de Contrecœur ainsi que l'impact économique des activités portuaires qui seront nécessaires à son opération.

3.1 Retombées attribuables au futur terminal à conteneurs de Contrecœur

Dépenses d'immobilisation – Description du projet

1,1 million d'EVP et 650 millions $
dont 450 millions $ seront dépensés pour l'achat de biens et services au Canada

Le projet de terminal à conteneurs de Contrecœur qui a été retenu pour la présente étude aura une capacité de 1,1million d'EVP. Sa construction nécessitera un investissement de près de 650 millions $. Cependant, le montant retenu pour l'évaluation de l'impact économique de sa construction est de 450 millions $. En effet, presque la totalité des équipements sera importée de l'extérieur du Canada et ne peut, dans ce cas, être incluse dans le calcul des impacts économiques au Canada.

Notons également que les impacts présentés ci-après pour la construction du terminal ne sont associés qu'à la période de construction : ces effets ponctuels ne se reproduiront donc plus lorsque la construction sera achevée.

3.1 Retombées attribuables au futur terminal à conteneurs de Contrecœur

Dépenses d'immobilisation – Effets ponctuels

Impact des dépenses d'immobilisation du projet de terminal à conteneurs de Contrecœur

Type d'effet	Québec		Canada (incluant le Québec)		Revenus du gouvernement du Québec (k$)	Revenus du gouvernement du Canada (k$)
	Main-d'œuvre (années-personnes)	Rémunération brute de la main-d'œuvre (k$)	Main-d'œuvre (années-personnes)	Rémunération brute de la main-d'œuvre (k$)		
Effets directs	2 195	116 101	2 304	119 820	33 826	10 985
Effets indirects	1 213	61 415	1 748	86 476	16 550	12 044
Effets induits	841	32 774	1 184	46 727	14 860	8 059
Effets totaux	**4 248**	**210 290**	**5 236**	**253 023**	**65 236**	**31 088**

Source : E&B DATA à partir de simulations et des multiplicateurs de l'Institut de la statistique du Québec et de Statistique Canada.

La première phase du projet d'expansion du Port de Montréal pour le terminal à conteneurs de Contrecœur permettra de créer plus de 4 000 emplois (personnes-année) au Québec (1 000 de plus dans le reste du Canada) pendant la période de construction avec une rémunération correspondante de 210 millions $ (250 millions $) et des revenus pour l'administration publique provinciale de 65 millions $ ainsi que plus de 30 millions $ au niveau fédéral (estimées d'après la structure fiscale de 2013-2014) en $ 2012.

3.2 Retombées attribuables au futur terminal à conteneurs de Contrecœur

Dépenses d'exploitation – Base des calculs

La présente étude n'inclut que l'impact des dépenses associées aux activités portuaires courantes (exploitation) de la Phase I du futur terminal. L'inclusion des autres types d'activités (transport maritime, transport terrestre, activités connexes) viendrait certainement augmenter les impacts estimés dans la présente étude. Dans le même ordre d'idée, la création d'un nouveau terminal à conteneurs à Contrecœur entraînera vraisemblablement l'implantation d'entreprises dans la zone industrielle prévue à cet effet. Ces activités n'ont pas été prises en compte dans la mesure des impacts

L'analyse de ces dépenses d'exploitation a été estimée à partir de prévisions concernant les futurs coûts de manutention. Les estimations ont été effectuées sur la base de dépenses moyennes par conteneur.

Les calculs sont effectués sur la base de l'utilisation du terminal à pleine capacité (Phase I).

3.2 Retombées attribuables au futur terminal à conteneurs de Contrecœur

Dépenses d'exploitation – Effets récurrents

Impact des dépenses d'exploitation du projet de terminal à conteneurs de Contrecœur

Type d'effet	Québec		Canada (incluant le Québec)		Revenus du gouvernement du Québec (k$)	Revenus du gouvernement du Canada (k$)
	Main-d'œuvre (années-personnes)	Rémunération brute de la main-d'œuvre (k$)	Main-d'œuvre (années-personnes)	Rémunération brute de la main-d'œuvre (k$)		
Effets directs	573	47 880	573	47 880	11 183	5 581
Effets indirects	106	6 198	154	8 400	2 395	1 401
Effets induits	269	10 483	344	13 423	4 753	2 347
Effets totaux	**948**	**64 561**	**1 071**	**69 703**	**18 330**	**9 329**

Source : E&B DATA à partir de simulations et des multiplicateurs de l'Institut de la statistique du Québec et de Statistique Canada.

Une fois la première phase opérationnelle opérant au maximum de sa capacité (1,1 million d'EVP), le terminal à conteneurs de Contrecœur :

- ***permettra le maintien de près de 950 emplois annuellement au Québec (plus de 1 000 dans l'ensemble du Canada);***
- ***génèrera des revenus annuels de plus de 18 millions $ pour le gouvernement du Québec ainsi que près de 10 millions $ pour le gouvernement fédéral. Ces estimations sont basées sur la structure fiscale de 2013-2014.***

3.3 Retombées attribuables au futur terminal à conteneurs de Contrecœur

Contribution au PIB

Contribution au PIB attribuable aux dépenses d'exploitation du futur terminal à conteneurs de Contrecœur – (k$)

Type d'effet	Québec		Canada (incluant le Québec)	
	Construction	Exploitation	Construction	Exploitation
Effets directs et indirects	299 886	83 147	360 142	87 537
Effets induits	64 173	20 525	109 589	31 371
Effets totaux	**364 059**	**103 672**	**469 731**	**118 908**

Source : E&B DATA à partir de simulations et des multiplicateurs de l'Institut de la statistique du Québec et de Statistique Canada.
Note : Les calculs étant basés sur les dépenses des entreprises directement reliées aux activités maritimes et portuaires du Port de Montréal et non sur leur chiffre d'affaires, la contribution au PIB associée à leurs profits (excédents bruts d'exploitation) n'a donc pas été prise en compte. La mesure de la contribution présentée dans ce tableau est donc un seuil.

Une fois la Phase 1 de l'expansion du terminal de Contrecœur achevée, celle-ci aura un impact du plus de 100 millions $ sur le PIB du Québec chaque année ainsi qu'un impact de plus de 15 millions $ sur le PIB dans le reste du Canada. De plus, la seule construction aura un impact ponctuel sur le PIB de l'ordre de 365 millions $ (près de 470 millions $ pour l'ensemble du Canada).

Conclusion

Les effets directs, indirects et induits des dépenses associées à la Phase I du terminal à conteneurs de Contrecœur sont les suivants :

- *La construction* générera un impact ponctuel 1) de plus de 5 000 personnes-année dont 80% seront situés au Québec, 2) de près de 100 millions $ de revenus de fiscalité et parafiscalité destinés aux administrations publiques (provinciale et fédérale), et 3) une contribution au PIB de l'ordre de 365 millions $ (près de 470 millions $ pour l'ensemble du Canada).

- *L'exploitation* du terminal générera un impact annuel récurrent 1) de plus de 1 000 emplois, 2) de près de 28 millions $ en revenus pour les administrations publiques, et 3) un impact du plus de 100 millions $ sur le PIB du Québec ainsi qu'un impact de plus de 15 millions $ sur le PIB dans le reste du Canada.

Ces impacts ne couvrent pas ceux associés aux effets structurants (ex.: zone industrielle prévue à proximité immédiate du terminal) non plus que ceux associés aux activités de transport (ferroviaires, routières, maritimes) et aux activités portuaires et autres activités connexes (ex.: administration, douanes, sécurité, transitaires).

Lexique

Activités connexes: Incluent notamment les activités de remorquage, de nettoyage et de pilotage ainsi que les agences gouvernementales et les entreprises responsables de l'approvisionnement en carburant.

Activités portuaires: Incluent l'Administration Portuaire de Montréal et les activités des terminaux portuaires (ex.: conteneurs, vracs liquides et solides).

Effets directs : Effet économique généré par les dépenses initiales des entreprises à l'étude (ex. : masse salariale, fournitures, services professionnels).

Effets indirects : Effet économique généré par les dépenses des premiers fournisseurs des entreprises à l'étude et les fournisseurs de ceux-ci et ainsi de suite.

Effets induits : Effet économique généré par les dépenses de consommation des travailleurs directs et indirects.

Effets structurants: Modification de la structure économique à long terme d'une région (ex. : développement d'un parc industriel) initié par une activité spécifique.

Emploi : Représente la charge de travail utilisée par les différents secteurs de l'économie. L'unité utilisée dans le modèle pour la mesure de l'emploi est l'équivalent temps plein (année-personne).

Équivalent vingt pieds (EVP) : Unité de mesure définissant une longueur normalisée de 20 pieds pour les conteneurs.

Parafiscalité : Versements des employés et des employeurs aux fonds spécialisés des gouvernements : Fonds de services de santé (FSS), Commission de la santé et de la sécurité du travail (CSST), Régie des rentes du (RRQ), Assurance-emploi, Régime québécois d'assurance patronale (RQAP).

Rémunération brute de la main-d'œuvre : Inclut les salaires et traitements avant impôt ainsi que les revenus des travailleurs autonomes. La rémunération brute de la main-d'œuvre exclut les contributions de l'employeur aux divers régimes d'assurance statutaires ou privés.

Taxes : Taxes sur la valeur ajoutée (ex.: TVQ, TPS) et taxes spécifiques (ex.: taxes sur le carburant).

Transport maritime : Inclut les lignes maritimes, les agences maritimes et les transitaires.

Transport terrestre : Inclut le transport routier et ferroviaire.

Étude sectorielle No. 27

Port of Montreal Contrecœur Development
Phase 1 Preliminary Design Report. Final



PORT OF MONTREAL

CONTRECOEUR DEVELOPMENT – PHASE 1
PRELIMINARY DESIGN REPORT

DRAFT REPORT

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1.0 EXECUTIVE SUMMARY

1.1 PURPOSE

The purpose of the preliminary design report is to define "the project" as selected by the Port. The definition includes general descriptions of the specific work elements to be completed by the port and those that will be anticipated by the future tenant, to fully develop Phase 1 of the master plan.

1.2 SUMMARY

The Contrecoeur property offers an excellent opportunity for a high-capacity container terminal near Montreal on the Saint Lawrence River. The existing terminals owned by the Montreal Port Authority (MPA) are extremely constrained between the pier head line, major roadways (e.g. Rue Notre-Dame) and major industrial businesses (e.g. Molson). The trend in container handling facilities is to develop larger terminals with higher density capable of handling multiple carriers and through volume efficiencies, be able to operate at a lower cost per container. Development of this project will help MPA support international trade and remain competitive as a container shipping port.

The Contrecoeur site has the capability to accommodate up to a total of six berths on 286 hectares. The first development phase, Phase 1, will consist of one terminal with two berths and development of about 35% of the upland terminal area. The terminal is anticipated to operate in a semi-automated configuration as follows:

- Containers will be loaded/unloaded from the ship with manned ship-to-shore (STS) gantry cranes, containers will be transferred in the back reach of the crane.
- Manned shuttle carriers will transport the containers between the STS crane back reach and the waterside transfer zone of automated stacking cranes (ASC's). ASC's will store and retrieve containers and manage the container stacks.
- The landside transfer zone will be split between manned remote crane operators delivering to over the road truck chassis and automated delivery to disconnected bombcarts (terminal chassis).
- The bombcarts will be shuttled to the rail intermodal transfer zone by yard hostlers (terminal tractors).
- The rail intermodal operation consists of approximately five manned rail mounted gantry cranes loading and unloading containers on six working tracks. The intermodal yard is supported by support trackage for train building and arrival and departure tracks for interchanging trains with the adjacent Class 1 railway.
- Local cargo will be processed through a modern gate facility equipped with optical character recognition systems (OCR) and cameras with remote clerks to minimize personnel operating in the lanes, and minimize truck processing time.

Support facilities include an Administration Building with the remote gate clerks, trouble resolution, and remote stacking crane operators. The Maintenance Building will be capable of supporting each of the crane types, the horizontal transport system, reefer maintenance, and providing a location for labor reporting and breaks.

The Phase 1 terminal as described is anticipated to accommodate a throughput of approximately 1.14 million TEU's annually. This throughput projection is based on the assumption that 60% of the cargo will be transferred inland by rail, the container yard (CY) will operate with average container dwell time of 6 days, and several other operation assumptions contained in the master plan.

The development is anticipated to require an investment in infrastructure between $440 -$480 million on site, $85 to $90 million near site (road and rail work) and terminal equipment between $220- $250 million. Construction and commissioning is projected to be completed between 42 to 54 months from tendering of design contracts.

2.0 PRELIMINARY DESIGN NARRATIVE / PROJECT DESCRIPTION

The following sections and corresponding drawings describe the preliminary design elements that evolved from the Master Plan, follow on studies, and direction from the Port. The narrative is intended as a guide for preparing final design and construction documents. The project will consist of Phase 1 of the semi-automated container terminal concept as shown in the Master Plan. See Figure 2 in the drawings attached as an appendix.

2.1 BERTH AND DREDGING

The Master Plan outlined several options and considerations for the berth alignment and resulting dredging activities required. Environmental and Geotechnical studies identified feasible equipment and potential dredge disposal locations near the project site. Phase 1 includes two berths along approximately 675m of quay along alignment "D" from the Master Plan.

Berth Characteristics- The berth shall be designed to accommodate two 5,800 TEU vessels and be dredged to a depth of 11.3m below chart datum (-6.88m GSC). The dredge area boundary includes the 675m of quay wall, extends upriver approximately 30 meters then angles at 45deg to meet the channel and extends downriver from the quay wall approximately 30 meters and angles at 45 deg to meet the channel. See Figure 6 in the drawings attached as an appendix.

- The berths will require dredging of approximately 1.1 million cubic meters of mostly stiff clay soils. Dredging will be performed either by mechanical dredge equipment, hydraulic suction cutter dredge or a combination of both. It is feasible to dredge both berths within the environmentally constrained period within two seasons. Dredge spoils may need to be hydraulically offloaded and placed to match the dredge's production rate. Material will likely be disposed of in the unused area between the rail yard and Marie-Victorin Blvd., and on port property south of Marie-Victorin Blvd or at another nearby location identified by the Port.
- Tug basin: The port will work with local pilots and tug operators to determine the need for and extent of near site support facilities (tug dock and buildings) that may be necessary.

2.2 QUAY

- Quay type and general features: The master plan included a detailed assessment of four different quay construction methods. A sheet pile wall system was selected as the preferred option. This option is considered the best combination of robustness and economical construction cost. The preliminary sheet pile wall design determined that a single H-Z pile system could be constructed to satisfy the static and seismic stability requirements for the site.
- The quay will be equipped with a unit fender system, mooring bollards, potable water services to ships and infrastructure for cold-ironing of vessels.

- Cranes: The Phase 1 terminal is anticipated to require up to 8 ship-to-shore cranes (supplied by the tenant). The apron will be designed to accommodate 30.48m (100 ft) gauge cranes at the design loading indicated in the master plan or as otherwise coordinated with the tenant for their anticipated cranes.
- Crane power: Cranes will be supplied medium voltage (12kV) power at vaults located along the quay face. A cable trench will be installed waterside of the waterside crane rail and be covered with a panzer belt type system to protect the cables and reduce tripping hazards.
- Crane rail and support: The crane rails and beams will be supported on pile foundations. Crane beams will be structurally tied together to limit beam spreading under dynamic loading.

2.3 CONTAINER YARD

The container yard will be designed for semi-automated container handling operations. It is anticipated that manned shuttle carriers will move cargo between the ship to shore cranes and the waterside transfer zone of automated stacking cranes (ASC's). Container storage and retrieval will be by end-loaded Automated Stacking Cranes (ASC's) oriented perpendicular to the berth.

- ASC's (Figure 2.1)– The initial terminal will be designed for 16 blocks of 10 wide by (one over) 5 high rail mounted gantry automated stacking cranes. Each block will be 36 TGS (twenty foot ground slots) long of container storage / stacking area plus container transfer zones on each end. Procurement of the ACS's will be the responsibility of the tenant. Close coordination between equipment procurement and civil design is recommended as minor changes to one can significantly impact the design and cost of the other.
- Waterside transfer zone (Figure 4.0)- The waterside transfer zone will be equipped with five lanes for transferring containers to/from manned shuttle carriers and be equipped with indicator lights or other safety system to prevent automated stacking cranes conflicting with the manned shuttle carriers. Containers may be placed up to two high in the water side transfer zone and be stacked two (forty foot) containers deep (when the waterside ASC maintenance bay is not in use). Coordination is required between the tenant and the design team to ensure adequate infrastructure is provided to support the operating system's notification and conflict avoidance between ACS's and shuttle carriers.
- Landside transfer zone (Figure 5.0)– The landside transfer zone in each ASC block will consist of 7 truck lanes. Of these lanes, 3 will be dedicated to over the road trucks, 3 will be dedicated to rail delivery and 1 will be able to be switched between the two operations. Each lane will be separated by a raised concrete island. Each lane serving over the road vehicles will have a booth for the driver to enter during the transfer of containers. The booth will be equipped with heat and data connections for the tenant's operating system. The system must be able to identify the proximity of the driver as well as identify the appropriate transaction associated with the driver. The lanes serving the rail will be able to be operated with automated delivery to waiting bombcarts. Hostlers will not wait in the landside transfer areas.
- General pavement system- Several distinct pavement systems are anticipated throughout the terminal. The transfer zones will be concrete pavement as they will experience repeated

loading on the same path. Asphalt pavement is anticipated for vehicle and equipment circulation areas waterside and landside. Asphalt pavement over cement stabilized base should be considered for the waterside shuttle carrier areas. The Engineer may perform a life cycle cost analysis to determine if pavement systems other than those described are in the best long term interest of the Port. (For instance, in the waterside shuttle carrier area.)

- Container Stack Pavement- For best results with the ASC equipment the containers should be stacked on level pavement. The pavement will also need to shed stormwater. Asphalt with 2 to 3 slot drains (or French drains) running the length of the stack to be the most economical paving system is often the most economical system. Alternatives should be evaluated during final design. Drains should be placed to avoid container corners.
- Refrigerated container storage: Reefer access racks should be installed in approximately 1/3 of the container blocks. These are required to allow reefer mechanics to access the reefer unit end of stacked reefer containers to perform necessary plug and unplug functions. The reefer plugs will accommodate about 6% of the total container storage unless tenant market demand warrants a different capacity. Access racks will be located near the landside transfer zone to minimize operational disruption when accessed by mechanics. The racks may extend over limited portion of the bay (e.g. serve 8 wide of the 10 wide bay) if labor can accommodate containers passing over the non-reefer stacks when working in a reefer bay. Reefer stacks shall be 5 high and have the capacity to connect a full complement of reefers at 480v. A lockout indicator shall be provided at each bay so that the ASC crane cannot operate in a bay where maintenance personnel are present.
- Hazmat: Liquid Hazmat should be stored in landside bays adjacent to the transfer zone that are equipped with an isolation basin. This basin will have a valve that can be closed if a liquid container is observed to be leaking to prevent contamination reaching the stormwater system. The capacity of the basin should be sized to accommodate the full volume of a container plus the volume of a typical storm event.
- Other cargo types: Provisions will be made along the northern boundary of the terminal to store out-of-gauge, general and project cargo that cannot be mixed into the container stacks.

2.4 GATE

The terminal gate (Figure 3.0) will be designed to accommodate at least 50% of the terminal capacity. The gate will use semi-automated data collection and entry systems to minimize the number of individuals having to operate in the lanes. The gate will be designed to accommodate all Transport Canada terminal security requirements.

- Pre-gate process- Trucks entering the terminal will travel through one of two OCR portals. The portal equipment and data systems will be provided by the tenant to ensure compatibility with their gate processing systems. Civil, electrical and communication duct infrastructure to support the equipment will be provided by the Port. Coordination will be required to match infrastructure with the specific OCR vendor's system requirements.

- Receiving gate (in gate, Figure 3.2) – Following the pre-gate, the entry roadway spreads to 6 processing and queue lanes. Additional lanes may be necessary if the tenants anticipated truck volume percentage is more than the 50% planned. Processing lanes will be linked remotely to clerk and security check functions. A clerk in the lanes will not be necessary unless the tenant's agreements with the carriers require manual check of the container seals. Each processing lane will be equipped with a scale, intercom (with printer, card reader, and biometric identification if required by Transport Canada at the time of implementation) and CCTV cameras to allow for remote interaction with the clerks and verification of container numbers. Gate arms may be necessary to meet security requirements, but they are not essential for container transaction operations. Provisions shall be made in the design to allow additional receiving gate lanes for future expansion.
- Trouble resolution area – Trucks that cannot be cleared from the receiving gate to deliver or retrieve a container must proceed to the trouble resolution area. The trouble resolution area will be located approximately 100 meters beyond the receiving gates and will be provided with a conditioned booth equipped with remote access to clerks that can help resolve issues.
- Gate truck holding area: once trucks have cleared the receiving gate trucks may be prompted to proceed to the gate truck holding area. The gate truck holding area will contain 30 holding stalls for trucks to wait in in the event that the 4 landside transfer zone truck lanes at their designated block are occupied. Once a truck's designated block has an open truck lane in the landside transfer zone the truck will be prompted to proceed to the landside transfer zone.
- Delivery gate (out gate, Figure 3.1): once trucks have exchanged containers at the transfer zone, they proceed to the delivery/out gate. The delivery gate process begins with one or more OCR lanes fanning out to (or being in line with each of) 3 exit processing lanes. Provisions will be made for future expansion of additional exit lanes. If all transaction data is confirmed for the exiting truck, it should be able to exit without stopping at the lane pedestal. Pedestals will be equipped with similar equipment (intercom systems and CCTV cameras) as the receiving gate for resolution of any exceptions.
- Booths: HVAC conditioned man booths are anticipated to be required for the following activities. Manual verification of container seals, trouble resolution and guard booths. Coordination with the tenant is required to accommodate these potential structures with their proposed operational procedures. Remote structures may also require restroom facilities. Potential Phase 2 gate location should be considered to allow for additional expansion if necessary.

2.5 INTERMODAL YARD - & SUPPORT TRACK

The intermodal yard has been located southeast of the landside transfer zone and truck circulation space. It has been oriented to avoid property constraints and to allow the working tracks to be straight which is preferred for the RMG's. It has been sized to accommodate approximately 60% of the total terminal throughput. If the tenants planned modal split is significantly different, then the rail facilities and equipment should be reevaluated and scaled accordingly. The intermodal yard has been designed as a manned wide-span RMG yard with perpendicular loading slots.

- Working Track- There will be 6 tracks served by manned RMG cranes. The working track length shall total approximately 8,100m (6 x 1,350m). Provisions shall be made to accommodate future expansion of the working tracks and support tracks to the northeast.
- RMG's – The terminal will require a minimum of 6 rail mounted gantry cranes spanning 6 working tracks to achieve the capacity indicated in the master plan. RMG's shall be supplied by the tenant and be equipped with rotating trolleys to accommodate perpendicular IY transfer zone slots. Coordination is required with the equipment selected to minimize infrastructure to adequately support the cranes to the required tolerances.
- Interchange tracks: - A total of 2 interchange tracks totaling 7,220m (2 x 3,610m) are required to receive and deliver unit trains from/to the CN mainline. Received trains will be moved onto the working or storage tracks by local switch engines. A separate lead track will allow the power set to escape to the mainline. Provisions shall be made in this phase for the future roadway overpass to avoid rail interruption to the Phase 1 terminal operations during construction of the second terminal.
- Storage tracks – The terminal requires a total of approximately 10,230m of storage track to provide sufficient buffer between the working tracks and the interchange tracks. Provisions shall be made to accommodate future expansion of the storage tracts to a total of 30,000m

2.6 BUILDINGS

- Administration building – A detailed program for the administration building will need to be developed in conjunction with the tenant and their operational approach/needs. Where possible functions should be combined into common buildings, as it allows greater opportunity to reorganize floor plans as needs change. The administration building is anticipated to be on the order of 1,500m^2 and include the following functions:
    - Likely functions: Terminal management, terminal planning, vessel planning, gate clerks, remote ASC crane operators, trouble resolution, server rooms and other data systems.
    - Possible other functions: Longshore check in, trucker facilities, carrier staff / sales
- Maintenance and Repair Building: The size and configuration of the maintenance and repair building will depend largely on the specific equipment and operations planned. Some maintenance activities may be served by outside venders and not housed on terminal. Maintenance facilities should be sized to accommodate storage of parts and supplies and repair of items critical to the continued operation of the facility and not readily available. (e.g. crane parts)
- Specialty support Facilities - Additional structures that will likely be necessary to support the operation and maintenance of the facility include:
    - Wash bay – Designated area for steam cleaning terminal equipment. Includes the containment, collection, and treatment of wash water.
    - Reefer wash facilities- It is not the local practice to clean refrigerated containers on terminal, therefore no reefer wash facilities are planned.
    - Compressor building – Building to house compressors, condensate extractors, and pressure tanks to support rail operations.

- Fueling station – A stationary fueling station is planned as a part of this project however, the tenant may elect to use mobile fueling.
- Fire water supply pump house- A structure will be required for the operation and maintenance of the pumps to supply the terminal fire protection system.
- Sanitary treatment facility- A facility shall be provided to house the terminal sanitary sewage treatment system. If cost effective this may consist of a self-contained packaged treatment unit.
- Electrical substations – A life cycle analysis shall be performed to determine if enclosed electrical substation buildings are more cost effective than installing the equipment exposed to the elements.

2.7 UTILITIES

The following are the primary utilities anticipated for the terminal and the generalized design parameters. Refer to the Design Criteria document for detailed design criteria for each system. Preliminary utility layout is shown in Figures 7.1 & 7.2.

- Power – The terminal will have a high electrical power demand. The majority of the container handling equipment is anticipated to be eclectically powered including: ship to shore cranes, End loaded RTG's in the stacks, and side loaded RTGs in the rail yard. Demand for the Phase 1 terminal is anticipated to be between 30MVA and 40MVA depending on the specifics of the equipment provided. Final demand loading should be calculated from the loads of the specific tenant equipment.
  - Supply – Power supply shall be brought to the site by Hydro-Quebec. The engineer shall coordinate with HQ demand, routing and schedule to supply the site. Provisions shall be made to accommodate future demand with the anticipated expansion of the terminal.
  - Substations – one or more substations for each of the following are anticipated throughout the site: ship to shore cranes, ship cold-ironing, reefer power, container stack RMG cranes, terminal lighting, and intermodal yard RMGs (Substations will be located on the site during detailed design.)
- Drainage – The terminal will use a combination of under-drainage in the container stacks and traditional collection and distribution systems in the circulation areas of the container yard. Stormwater treatment (Stormceptor™ or similar) is proposed prior to discharge. Treatment facilities shall be designed consistent with local regulations.
- Fire protection water – The fire protection water system is separated from the domestic water system and consists of a dedicated fire protection pump station drawing water from a river intake, a non-potable water fire protection distribution system and fire hydrants. Hydrants shall be co-located with each light pole, and where required by code in the vicinity of the building structures. Hydrants are not proposed in the container stacks as they would may not be accessible in an emergency. The National Fire Protection Association (NFPA) 307 is commonly used as a basis for terminal fire protection design (hydrant spacing at 100m max). This standard does not strictly apply, nor can it be achieved at a container facility such as the one being

proposed. A standard will need to be adopted requiring input from both the MPA and the jurisdiction having authority.

- Domestic water – Potable water will be distributed to the various buildings proposed on site. Supply will be from the utility main located on Marie-Victorin Blvd. Domestic water connections will also be provided in vaults spaced every 200m along the quay for service to ships.
- Sanitary sewer – Sanitary sewage will be collected and treated on site prior to river discharge. System design shall be in compliance with provincial and local regulations on wastewater treatment. Conveyance system is anticipated to include gravity sewers, manholes and lift stations/force mains as required to economically convey wastewater to the treatment facility.
- Lighting – High mast lighting (30-35m) is required to illuminate the circulation, transfer zones and maintenance areas in the terminal. Smaller (10m) light standards may be used on roadways, in the gate area, and in labour and staff/visitor parking areas. The container stacks will not require supplemental lighting. The stacks will be illuminated by the RMG cranes only, with the exception of the reefer access racks having localized lighting on the racks.
- Communication systems – The buildings and site will be provided with the data systems necessary for the planned activities at those facilities. Coordination will be required with the tenant to define the extent of data infrastructure. An additional 50% capacity (additional conduit, additional fiber strands) is recommended to accommodate future data needs. It is anticipated that all buildings, electrified container handling equipment and reefer access racks will be connected by a redundant fiber-optic ring system and diversely redundant star network. The tenant shall identify locations throughout the terminal for the installation of CCTV cameras for operational observation.
- Security systems – The terminal will require CCTV cameras and other systems for the purpose of maintaining terminal security. It may be necessary to isolate these cameras from the operational observation cameras depending on the terminal security plan. A terminal security plan should be developed between MPA and the tenant to ensure both are in compliance with governing regulations. Infrastructure (conduits and manholes) shall be provided to accommodate future security needs and potential expansion of the terminal security system.
- Compressed air – A compressor building and air distribution system will be required to support building of trains and charging breaks prior to departure on the CN mainline. Air pits should be provided at the head (departure) ends of all working and departure tracks.

2.8 OFFSITE IMPROVEMENTS

Environmental mitigation aside, there is only one significant offsite improvement required for the successful operation of the terminal. The grade separation of Marie-Victorin Blvd. over the proposed receiving tracks is necessary to allow the terminal to meet the required throughput without significant impact to the community.

- Grade separation of Route 132- The grade separation shall comply with CN rail clearance guidelines, and provincial highway design standards.

- Environmental mitigation shall be determined and designed as a part of the environmental review process for the project.

2.9 EQUIPMENT

The previous sections identify several types of equipment that the tenant will be required to supply for the successful operation of the facility. The following table quantifies the equipment and lists several additional supporting vehicles not mentioned previously.

Table 1: Estimates of Container Handling Equipment

	Quantity Anticipated
STS Cranes	6-8
IY RMGs	5
CY ASCs	32
Top-picks	2 (est.)
Shuttle Carriers	3 per STS (est.)
Hostlers	25-35
Bombcarts	120
Fuel Trucks	1
Equip. repair trucks	10
Pick-Up Trucks	22

3.0 CONTRACTING METHOD

The construction work for Phase 1 can be tendered as either Design–Build (DB) or Design-Bid-Build (DBB) contracts. A project as large as the one described can also be broken apart and pieces Tendered under both contracting methods as long as clear separation between the scopes of work is maintained. The preference for the contracting method lies in the construction timeline required and local expertise of the contracting community. Often DB is preferable when the work is commonly performed in the community and a large pool of experienced contractors and designers exist. DB also tends to allow construction work to get underway more quickly, as construction can proceed on completed portions of design and be postponed for work elements later in the construction schedule. DBB is preferred when the work is not common in the local community and greater control is desired to ensure that the end product is going to meet the needs and purpose of the project. Our experience has shown there is typically no economic benefit with one method over the other for container terminal and marine works. The following table represents the primary work elements and our assessment of the method that lends itself to that piece of work.

Table 2: Contracting Method Analysis

Item no.	Work Element	Common in Community	Level of Importance	Preferred Method
1	Dredging	No	Very High	**DBB**
Some dredging is done locally but not on this scale. With short work windows and need to define equipment and potentially apply for a variance to bring in foreign equipment it will be preferable that the design be completed and permitted prior to tendering.				
2	Quay	No	Very High	**DBB**
New quay construction is not common, it will be beneficial to fully design the structure incorporating the specific loading of the tenant supplied cranes to create a cost effective quay and crane rail structure, close coordination with the dredging activities is required. Any special environmental requirements would also be benefitted by the DBB approach.				
3	Terminal Paving	Yes	Moderate	-
While paving work is common and can be tendered as a DB contract it may be simpler to tie it into one of the complementary DBB pieces of work to avoid conflicts of competing contractors in the same area of the job site.				
4	ASC stacks and Transfer zones	No	Very High	**DBB**
Close coordination is required between the tenant and the designer to create the most cost effective design that achieves the specific ASC system's performance requirements. This is very difficult to contractually achieve in a DB project				
5	Buildings	Yes	Moderate	-

	These can definitely be DB, but a need to well define the tenants specific architectural and IT program early is critical. Risk exists that operational needs will evolve during the project that will require changes in the architectural programs. This can lead to change orders if a DB project is tendered prior to solidification of operational parameters.			
6	Gate Systems	Somewhat	High	-
	The components in the gate area are all relatively common to construction activities in the Montreal area. Close coordination is required to ensure that the infrastructure for tenant data collection systems are adequately supported.			
7	Utility systems	Yes	Moderate	**DB**
	The utility systems can be tendered DB if a schedule can be developed that allows the work to proceed without interfering with any adjacent construction packages (if any). The terminal communications infrastructure supporting the tenant's IT systems is critical and must be well-defined.			
8	Intermodal Yard & RMG support	No	High	**DBB**
	Similar to the ASC's close coordination is required to cost effectively provide a rail gantry system that meets the specific equipment criteria. Wheel loads for design of the rail support beams and electrical supply infrastructure must be well-coordinated with the IYRMG specifications.			
9	Rail and support track	Yes	High	**DB**
	The rail track (other than at the IY) is not specialized work. This can be installed on an independent timeframe and is segregated from other terminal work			
10	Grade separation	Yes	Moderate	**DB**
	The grade separation would be best accomplished on an accelerated schedule. This would give the contractor maximum flexibility in rerouting the existing roadway when constructing the grade separation. This makes DB preferable for this piece of work.			

Based on the assessment of the Main construction elements, portions of the work led themselves to both contracting methods. Our recommendations on which method depend on number of contracts to be tendered.

One Tender Package: If the Port elects to issue one tender we strongly recommend that the contracting method used is Design-Bid-Build. The risks of handing off significant portions of the design to a contractor that is outside their expertise and requires significant coordination with the tenant are significant. Designing the project completely under full control of the Port, can ensure that coordination happens and that the tenant's needs are met without every change becoming a construction change order.

Two Tender Packages: If the Port elects to issue two tender packages we recommend that both contracting methods are used. They would be divided as follows:

- **Package 1 DB:** Rail Support Track and Grade Separation. This work is easily separated from the remaining critical terminal work and there is benefit to allowing it to proceed on an accelerated schedule.
- **Package 2 DBB:** All remaining project elements (Dredging, Quay, Paving, ASC stacks, ect.)

Three Tender Packages: If the Port elects to issue three tender packages we recommend that both contracting methods are used. They would be divided as follows:

- **Package 1 DB:** Rail Support Track and Grade Separation. This work is easily separated from the remaining critical terminal work and there is benefit to allowing it to proceed on an accelerated schedule.
- **Package 2 DBB:** Dredging and Quay. This work will require heavy marine equipment to perform and significant coordination between the two construction elements. It is often cost effective to have this work tendered as a package separate from the upland container terminal.
- **Package 3 DBB:** All remaining project elements

Additional tender packages can be created to divide the work further however the costs and risks for coordination and management become increasingly significant the more packages created. The Port should evaluate their comfort level with managing multiple interconnected projects, and determine if more tender packages is warranted. Our recommendation is to issue three packages as described above. This is a good compromise of cost effectiveness, contractor segregation, design/product control, and effective coordination. If additional packages are desired, the next logical scope to become a dedicated tender would be the buildings, refer to table 2 for further potential packages.

4.0 ANTICIPATED COSTS

4.1.1.1 Infrastructure Costs

The anticipated project cost including infrastructure and an allowance for mitigation is on the order of **$440million** dollars. In the absence of detailed engineering design and analysis, estimates for the scope of work and quantity take-offs are based on the concept level drawings. As a result, a contingency allowance generally ranging from 20% to 25% is included for the individual itemized components of work to account for the undefined or indeterminate items due to the limited level of site investigation and engineering analysis completed to date.

The individual unit rates are based on 2014 cost levels in the Montreal area (Canadian dollars) and do not allow for future escalation. The individual unit rates have been developed based on historical and current estimates and contract pricing data using in-house and Port of Montreal sources, discussions with manufacturers and material suppliers, Statistics Canada Construction Cost Indices, BC MOT Construction and Rehabilitation Cost Guide and RS Means Heavy Construction Cost Data. Contract unit rate pricing data is referenced from the following projects: Deltaport Berth 3, Fairview Container Terminal, Port of Montreal Terminal Upgrades, East Blair Two in Tacoma, APL Berth 60-63 in Oakland, Pier E and Pier G in Long Beach.

The estimates include a permitting, engineering and contract administration allowance, which is estimated to be 10% of the total capital construction costs to cover preliminary and detailed engineering design, geotechnical investigations, bathymetric and upland topographic surveys, environmental impact assessment studies and costs associated with obtaining the regulatory and environmental permits, as well as costs associated with onsite construction supervision, environmental monitoring and overall project management services during design, tender and construction stages.

The cost estimate excludes container handling equipment.

All costs exclude applicable federal and provincial taxes, including the GST and QST.

Near terminal infrastructure costs including grade separation and supporting rail tracks are anticipated to require an investment on the order of **$88million**.

4.1.1.2 Equipment Costs

The equipment listed in the table above is anticipated to cost on the order of **$233million** dollars. In the absence of detailed specifications, estimates for the equipment are based on the concept level analysis and recent budget price quotes from recognized manufacturers. As a result, a contingency allowance generally ranging from 5% to 10% is included for the individual units to account for the undefined or indeterminate items due to the limited level of specification completed to date. The estimate is based on typical order quantities (i.e. 2 or 3 gantry cranes per order) and mid-range equipment.

The individual unit rates are based on 2014 cost levels in the Montreal area (Canadian dollars) and do not allow for future escalation. However, container handling equipment is usually purchased in US dollars or Euros and therefore its Canadian dollar cost is dependent on exchange rates at the time of purchase. The exchange rate applied reflects recent rates and for this review are US$0.98 = CDN $1.00 and $0.75 Euros = $CDN 1.00.

The cost estimate includes an allowance for procurement efforts and contract administration associated with the purchase of equipment. This allowance is estimated at 1.5% of the total purchase price.

5.0 SCHEDULE

There are many factors that affect the anticipated construction schedule. Included as an appendix to this report is a baseline schedule that uses a moderately aggressive construction assumptions. Activities such as dredging could potentially be accelerated to complete in one season, but may come at an increased cost to achieve. Permitting or environmental negotiations are not included as a line item in the schedule and are assumed to be able to be accomplished within the timeframe available. The duration from authorizing the engineers to begin design to having the terminal ready for cargo handling operations is 3.5 to 4.5 years. The schedule has numerous constraints that can affect the actual project delivery schedule such as the need to procure assemble and commission the large quantity of cranes required, which is assumed to be under the control of the tenant.

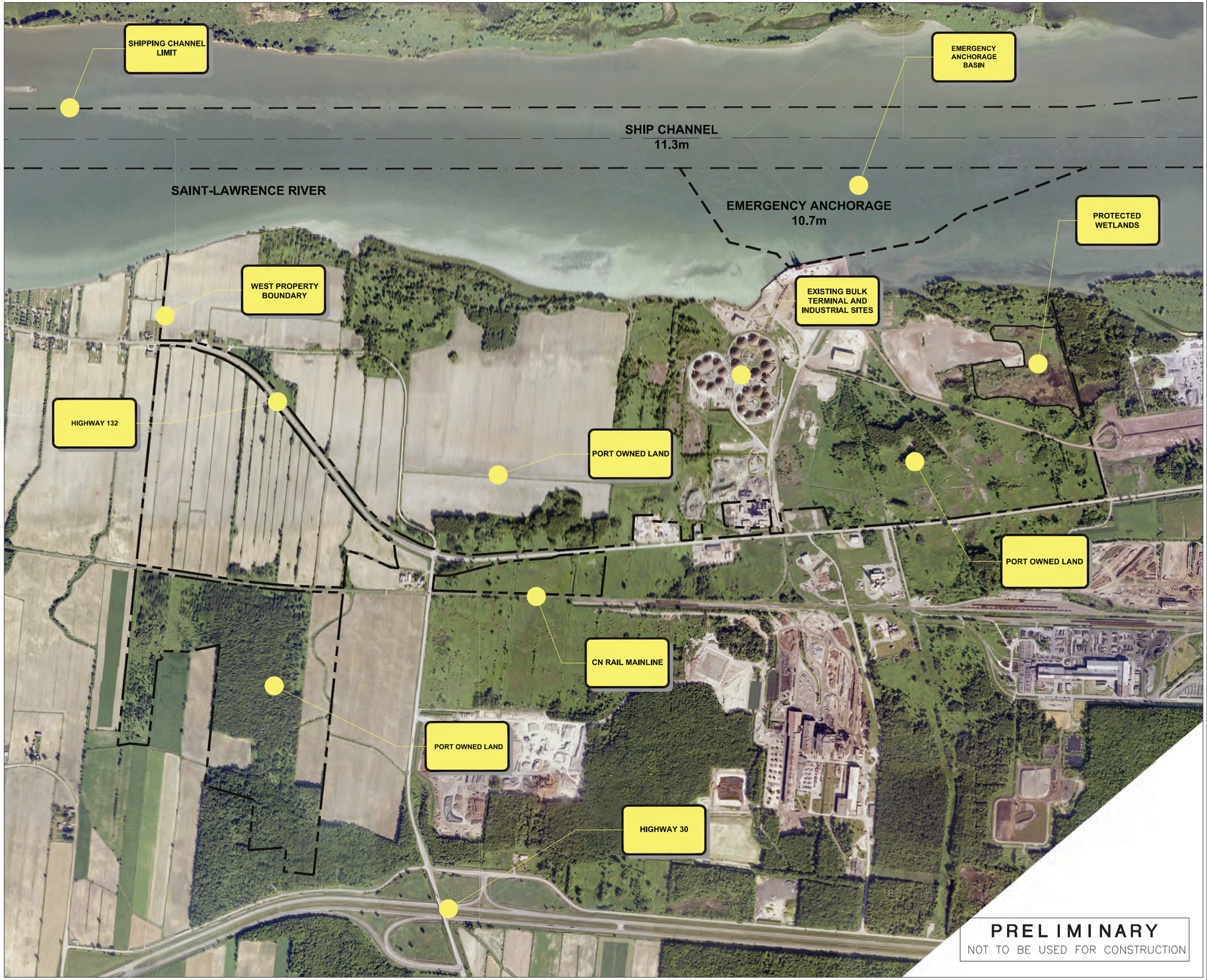
APPENDIX A

DRAWINGS

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NOTES

LEGEND:

CHANNEL LIMIT

PROPERTY BOUNDARY

N

100m 0m 100m 200m

GRAPHICAL SCALE

AUCUN

TITRE-TITLE | No. | MOD.

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
A	JUN 6/13	ISSUED FOR CLIENT REVIEW	SG

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal

Administration portuaire de Montréal
Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT
PRELIMINARY DESIGN

TITRE/TITLE:
PHASE 1 – EXISTING CONDITIONS

SOUS-TITRE/SUB-TITLE:
FIGURE 1.0

CONSULTANTS:

777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

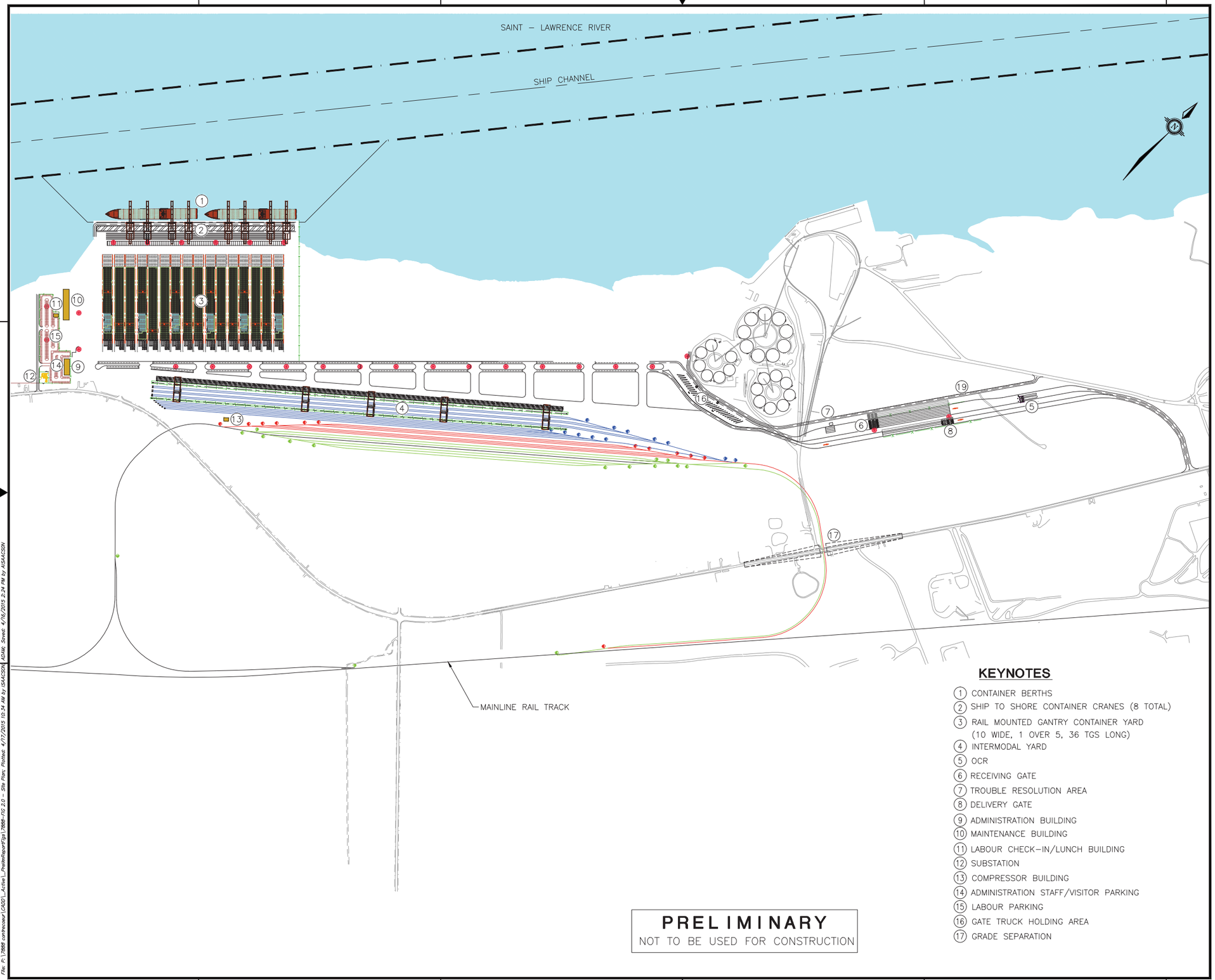
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PROJETÉ/DESIGNED: SG	
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CHEF DE SERVICE/DEPARTMENT HEAD	DATE: APRIL 3, 2015
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE/OF 1

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DESSIN NO. / DRAWING NO. -1718181 MOD.



KEYNOTES

1. CONTAINER BERTHS
2. SHIP TO SHORE CONTAINER CRANES (8 TOTAL)
3. RAIL MOUNTED GANTRY CONTAINER YARD (10 WIDE, 1 OVER 5, 36 TGS LONG)
4. INTERMODAL YARD
5. OCR
6. RECEIVING GATE
7. TROUBLE RESOLUTION AREA
8. DELIVERY GATE
9. ADMINISTRATION BUILDING
10. MAINTENANCE BUILDING
11. LABOUR CHECK-IN/LUNCH BUILDING
12. SUBSTATION
13. COMPRESSOR BUILDING
14. ADMINISTRATION STAFF/VISITOR PARKING
15. LABOUR PARKING
16. GATE TRUCK HOLDING AREA
17. GRADE SEPARATION

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

NOTES

LEGEND

- RAIL MOUNTED GANTRY (RMG) GROUNDED CONTAINERS (5,500 TGS)
- RAIL MOUNTED GANTRY (RMG) GROUNDED REEFERS (400 TGS)
- BUILDINGS
- TRANSFER/STORAGE RAIL TRACK
- ARRIVAL RAIL TRACK
- DEPARTURE RAIL TRACK
- HIGH MAST LIGHT POLE
- VEHICLE OVERPASS STRUCTURE
- TERMINAL FENCE
- MPA PROPERTY LINE

N

80m 0m 80m 160m
GRAPHICAL SCALE

AUCUN

TITRE-TITLE | No. | MOD.

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY

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Port de Montréal Port of Montreal
Administration portuaire de Montréal
Montreal Port Authority
Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT
PRELIMINARY DESIGN

TITRE/TITLE:
PHASE 1 – SITE PLAN

SOUS-TITRE/SUB-TITLE:
FIGURE 2.0

CONSULTANTS:
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

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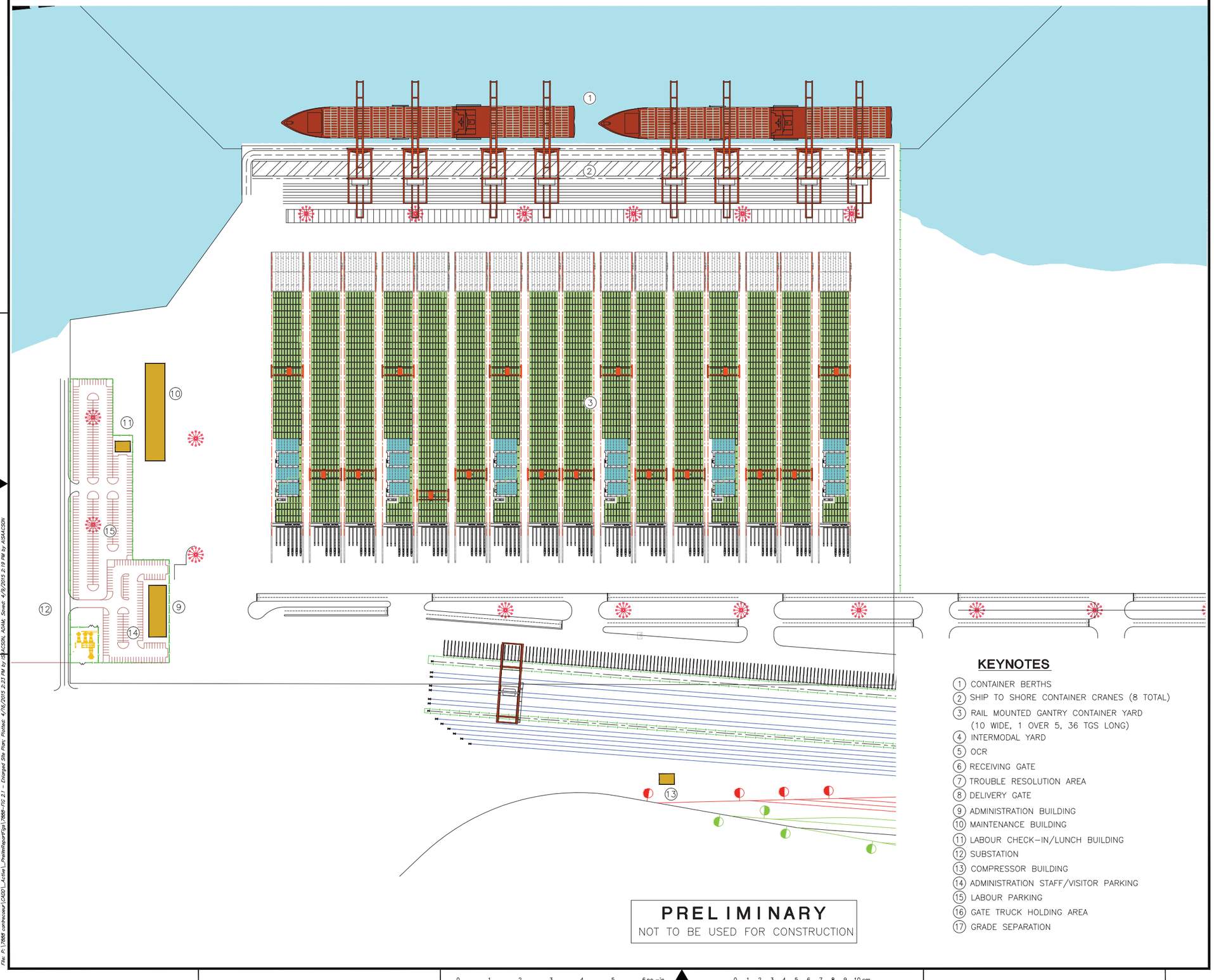
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File: P:\7888 contrecoeur\CAD\1_Active\1_PrelimReport\Fig\7888-FIG 2.0 - Site Plan; Plotted: 4/17/2015 10:34 AM by ISAACSON ADAM; Saved: 4/16/2015 2:24 PM by ALSAACSON

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KEYNOTES

1. CONTAINER BERTHS
2. SHIP TO SHORE CONTAINER CRANES (8 TOTAL)
3. RAIL MOUNTED GANTRY CONTAINER YARD (10 WIDE, 1 OVER 5, 36 TGS LONG)
4. INTERMODAL YARD
5. OCR
6. RECEIVING GATE
7. TROUBLE RESOLUTION AREA
8. DELIVERY GATE
9. ADMINISTRATION BUILDING
10. MAINTENANCE BUILDING
11. LABOUR CHECK-IN/LUNCH BUILDING
12. SUBSTATION
13. COMPRESSOR BUILDING
14. ADMINISTRATION STAFF/VISITOR PARKING
15. LABOUR PARKING
16. GATE TRUCK HOLDING AREA
17. GRADE SEPARATION

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

0 1 2 3 4 5 6 po.-in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND

- RAIL MOUNTED GANTRY (RMG) GROUNDED CONTAINERS (5,500 TGS)
- RAIL MOUNTED GANTRY (RMG) GROUNDED REEFERS (400 TGS)
- BUILDINGS
- TRANSFER/STORAGE RAIL TRACK
- ARRIVAL RAIL TRACK
- DEPARTURE RAIL TRACK
- HIGH MAST LIGHT POLE
- VEHICLE OVERPASS STRUCTURE
- TERMINAL FENCE
- MPA PROPERTY LINE

N

25 0m 25 50
SCALE: 1 : 1250

AUCUN

TITRE-TITLE | No. | MOD.

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No.	DATE	DESCRIPTION	PAR BY

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Administration portuaire de Montréal
Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT
PRELIMINARY DESIGN

TITRE/TITLE:
PHASE 1 – ENLARGED SITE PLAN

SOUS-TITRE/SUB-TITLE:
FIGURE 2.1

CONSULTANTS:
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

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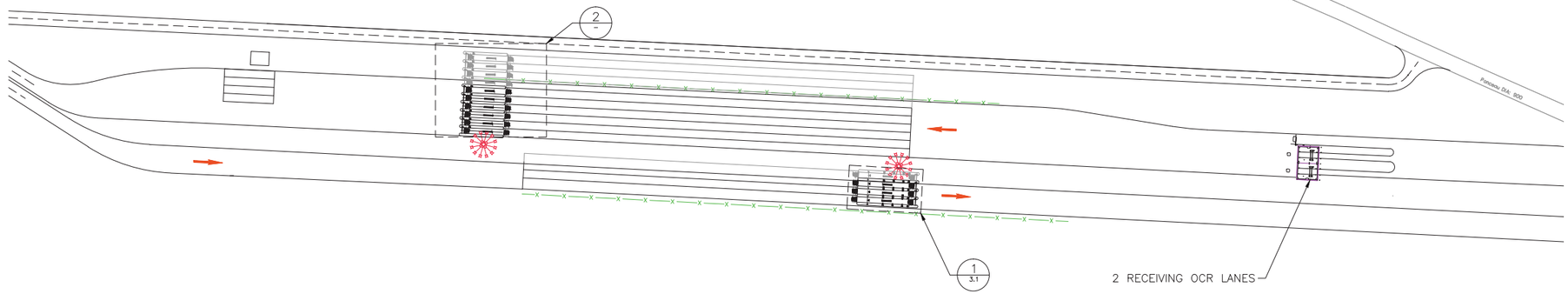
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File: P:\7888 contrecoeur\CAD\1_Active\1_PrelimReport\Fig\7888-FIG 2.1 - Enlarged Site Plan; Plotted: 4/16/2015 2:23 PM by USACOSN; ADAM; Saved: 4/9/2015 2:19 PM by ASSALCSON

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NOTES

LEGEND

- RAIL MOUNTED GANTRY (RMG) GROUNDED CONTAINERS (5,500 TGS)
- RAIL MOUNTED GANTRY (RMG) GROUNDED REEFERS (400 TGS)
- BUILDINGS
- RAIL TRACK
- HIGH MAST LIGHT POLE
- VEHICLE OVERPASS STRUCTURE
- TERMINAL FENCE
- MPA PROPERTY LINE

N

20m 0m 20m 40m
GRAPHICAL SCALE

AUCUN		
TITRE-TITLE	No.	MOD

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Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT
PRELIMINARY DESIGN

TITRE/TITLE:
PHASE 1 – GATE PLAN

SOUS-TITRE/SUB-TITLE:
FIGURE 3.0

CONSULTANTS:

777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

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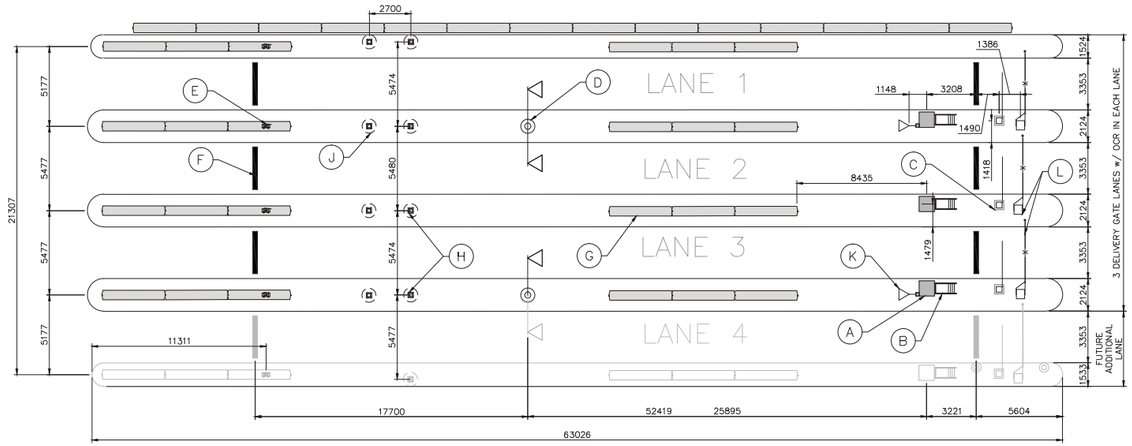
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OUT-GATE: GENERAL FEATURES – 3 LANES – 1 FUTURE

LEGEND KEY

(A) COMMUNICATION PEDESTAL.

(B) PEDESTAL STAIRWAY.

(C) GATE ARM PEDESTAL.

(D) T-POLE AND FOUNDATION.

(E) RED & GREEN LIGHT AND POLE.

(F) ROADWAY MARKING, STOP BAR.

(G) CONCRETE BARRIER. TYPE 2

(H) OCR PORTAL POLE FOUNDATION (RIGHT/LEFT CAMERAS).

(J) OCR PORTAL POLE FOUNDATION (BACKSHOT CAMERA & RADAR).

(K) CAMERA POLE.

(L) GATE ARM WITH FENCE.

1 / 3.0 DELIVERY GATE
SCALE:

NOTES

3m 0m 3m 5m
GRAPHICAL SCALE

AUCUN

TITRE-TITLE | No. | MOD

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

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PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT
PRELIMINARY DESIGN

TITRE/TITLE:
PHASE 1 – DELIVERY GATE DETAIL

SOUS-TITRE/SUB-TITLE:
FIGURE 3.1

CONSULTANTS:
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

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CHEF DE SERVICE/DEPARTMENT HEAD	DATE: APRIL 3, 2015
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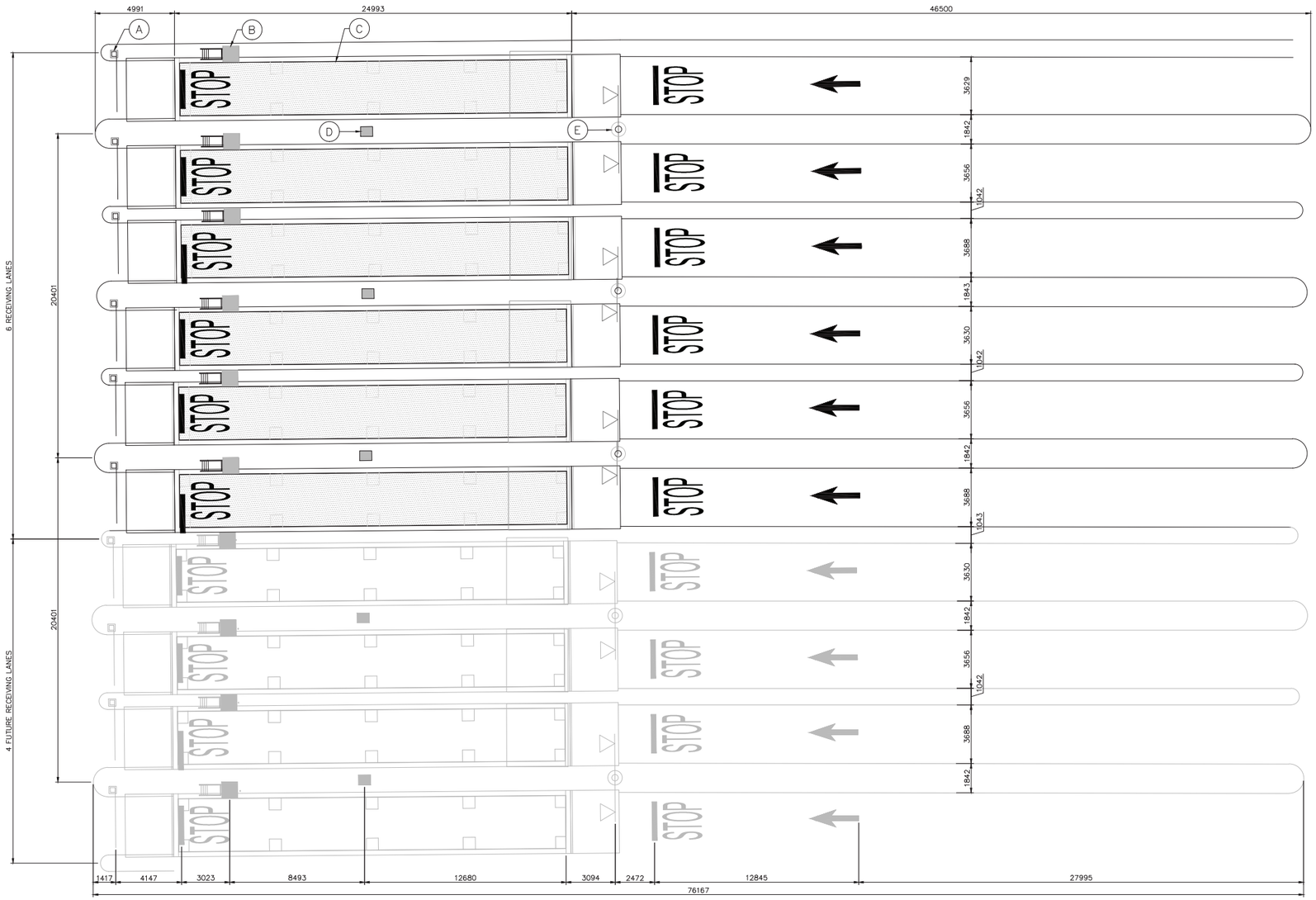
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LEGEND KEY

- (A) GATE ARM
- (B) COMMUNICATION PEDESTAL & STAIRWAY
- (C) TRUCK SCALE
- (D) CHASSES CAMERA PEDESTAL
- (E) T-POLE & FOUNDATION

1 / 3.0 RECEIVING GATE

0 1 2 3 4 5 6 po.-in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

2m 0m 2m 4m
GRAPHICAL SCALE

AUCUN

TITRE-TITLE	No.	MOD
DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS		

No.	DATE	DESCRIPTION	PAR BY
A	JUN 6/13	ISSUED FOR CLIENT REVIEW	SG

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal

Administration portuaire de Montréal
Montreal Port Authority
Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT
PRELIMINARY DESIGN

TITRE/TITLE:
PHASE 1 – RECEIVING GATE DETAIL

SOUS-TITRE/SUB-TITLE:
FIGURE 3.2

CONSULTANTS:
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

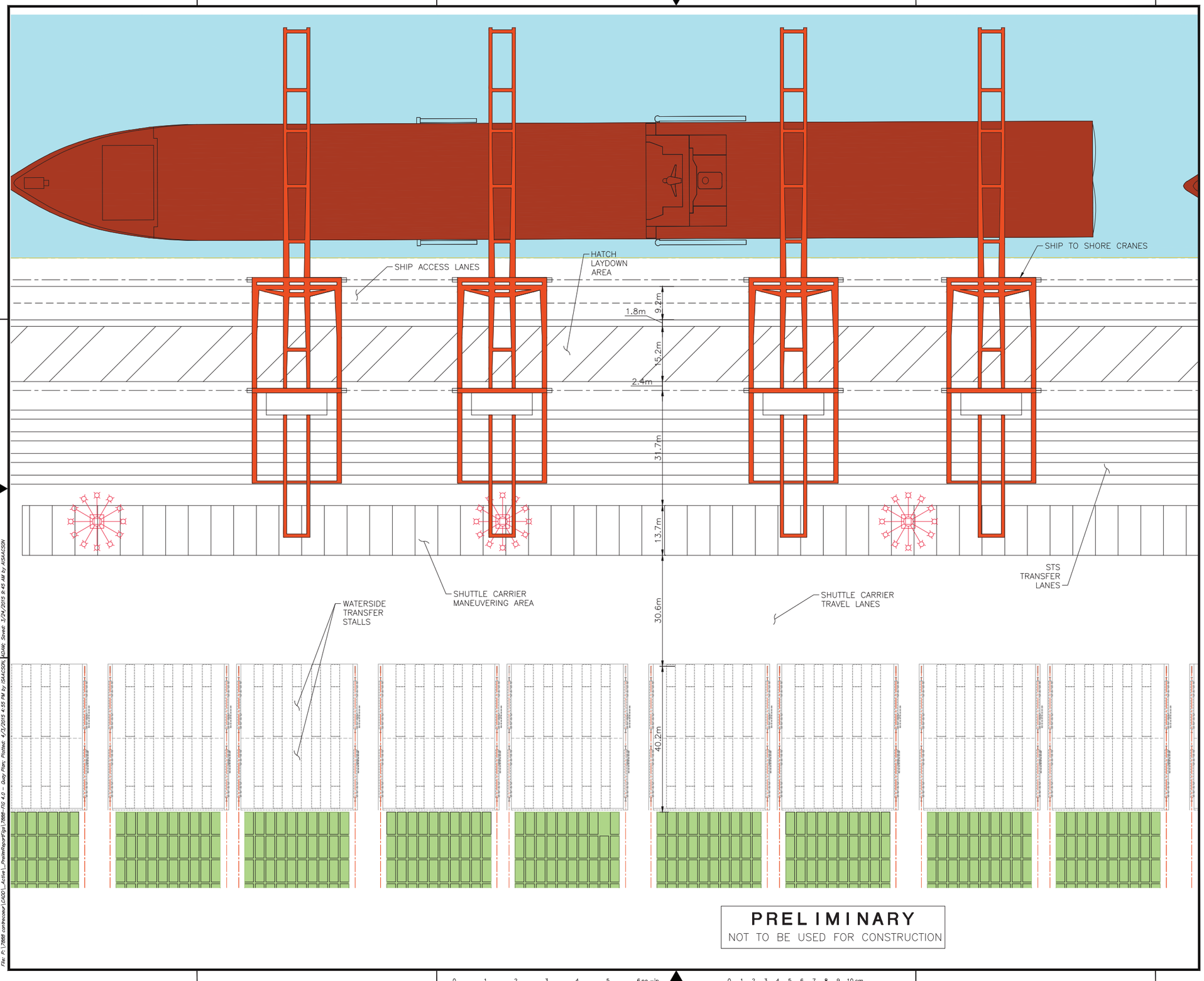
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CG	
PROJETÉ/DESIGNED:	
SG	
VÉRIFIÉ/CHECKED:	
LN	
APPROUVÉ/APPROVED:	
–	
CHEF DE SERVICE/DEPARTMENT HEAD	DATE: APRIL 3, 2015
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE/OF 1

DESSIN No. / DRAWING No. —1718818 1 1F1 1G P D 13.1.2 MOD.

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FORMAT SIZE A-0

DESSIN NO. / DRAWING NO. 1718818 11FIG PD 14.10 MOD.



NOTES

LEGEND

- RAIL MOUNTED GANTRY (RMG) GROUNDED CONTAINERS (5,500 TGS)
- RAIL MOUNTED GANTRY (RMG) GROUNDED REEFERS (400 TGS)
- BUILDINGS
- RAIL TRACK
- HIGH MAST LIGHT POLE
- VEHICLE OVERPASS STRUCTURE
- TERMINAL FENCE
- MPA PROPERTY LINE

N

6m 0m 6m 12m
GRAPHICAL SCALE

AUCUN

TITRE-TITLE | No. | MOD.

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
A	JUN 6/13	ISSUED FOR CLIENT REVIEW	SG

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal

Administration portuaire de Montréal
Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT
PRELIMINARY DESIGN

TITRE/TITLE:
PHASE 1 – QUAY PLAN

SOUS-TITRE/SUB-TITLE:
FIGURE 4.0

CONSULTANTS:

777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

DESSINÉ/DRAWN: CG	SCEAU/SEAL:
PROJETÉ/DESIGNED: SG	
VÉRIFIÉ/CHECKED: LN	
APPROUVÉ/APPROVED: –	
CHEF DE SERVICE/DEPARTMENT HEAD	DATE: APRIL 3, 2015
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE OF 1

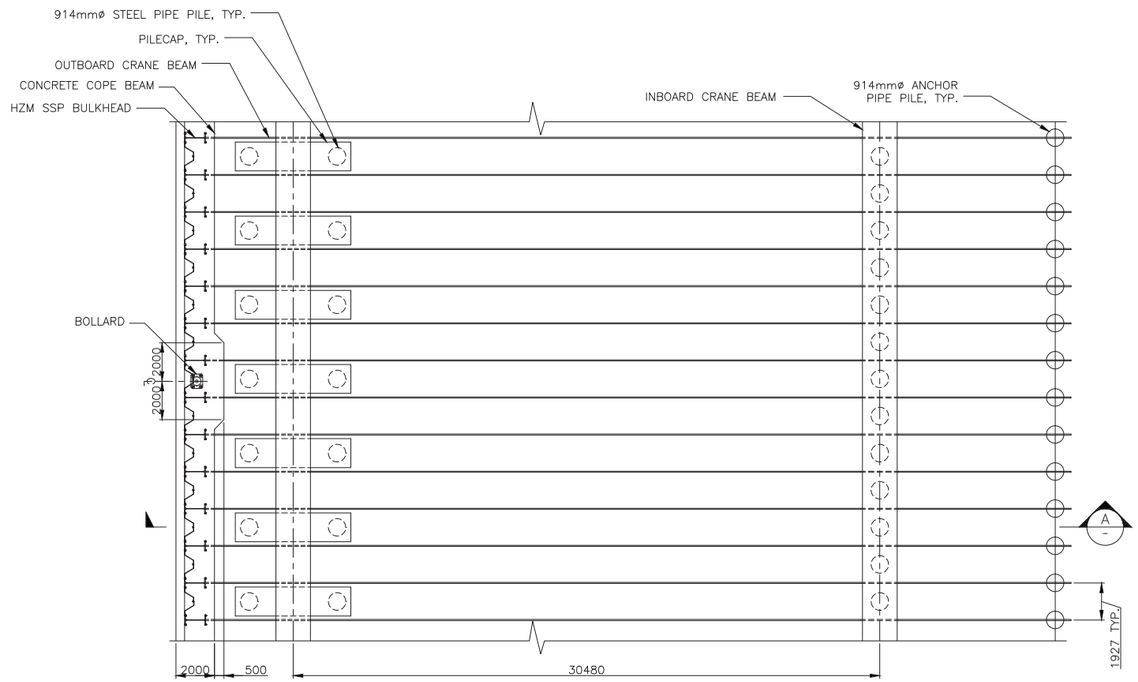
DESSIN No./DRAWING No. 1718818 11FIG PD 14.10 MOD.

File: P:\7888 contrecoeur\CAD_Active_PreliminReport\Figs\7888-FIG 4.0 - Quay Plan, Plotted: 4/3/2015 4:55 PM by ISAACSON, ADAM, Saved: 3/24/2015 9:45 AM by ISAACSON

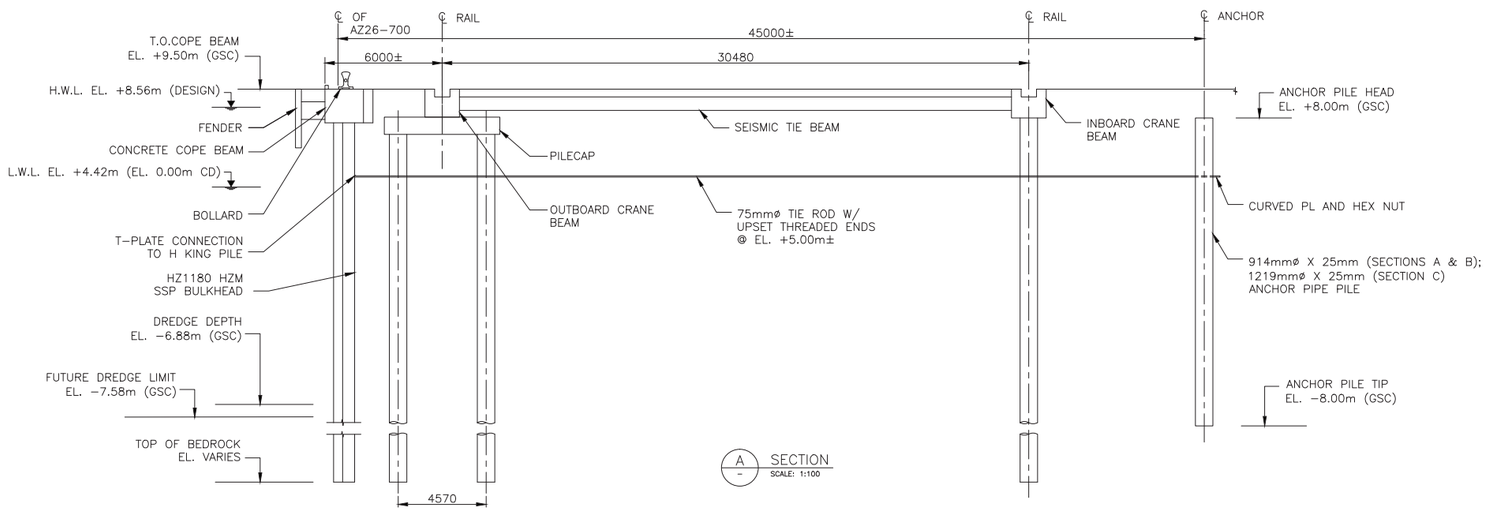
Bande à inclure seulement sur les originaux / Strip to be added on original only

FORMAT SIZE A-0

DESSIN NO. / DRAWING NO. — 1718181 — 1 — FIG 1 — 1 — 0 — 14.1.1 — MOD.



PLAN
SCALE 1:100



A — SECTION
SCALE: 1:100

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

NOTES

2m 0m 2m 4m
GRAPHICAL SCALE

AUCUN
TITRE-TITLE | No. | MOD
DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
A	JUN 6/13	ISSUED FOR CLIENT REVIEW	SG

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal
Administration portuaire de Montréal
Montreal Port Authority
Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT
PRELIMINARY DESIGN

TITRE/TITLE:
PHASE 1 – QUAY DETAIL

SOUS-TITRE/SUB-TITLE:
FIGURE 4.1

CONSULTANTS:
MOFFATT & NICHOL
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

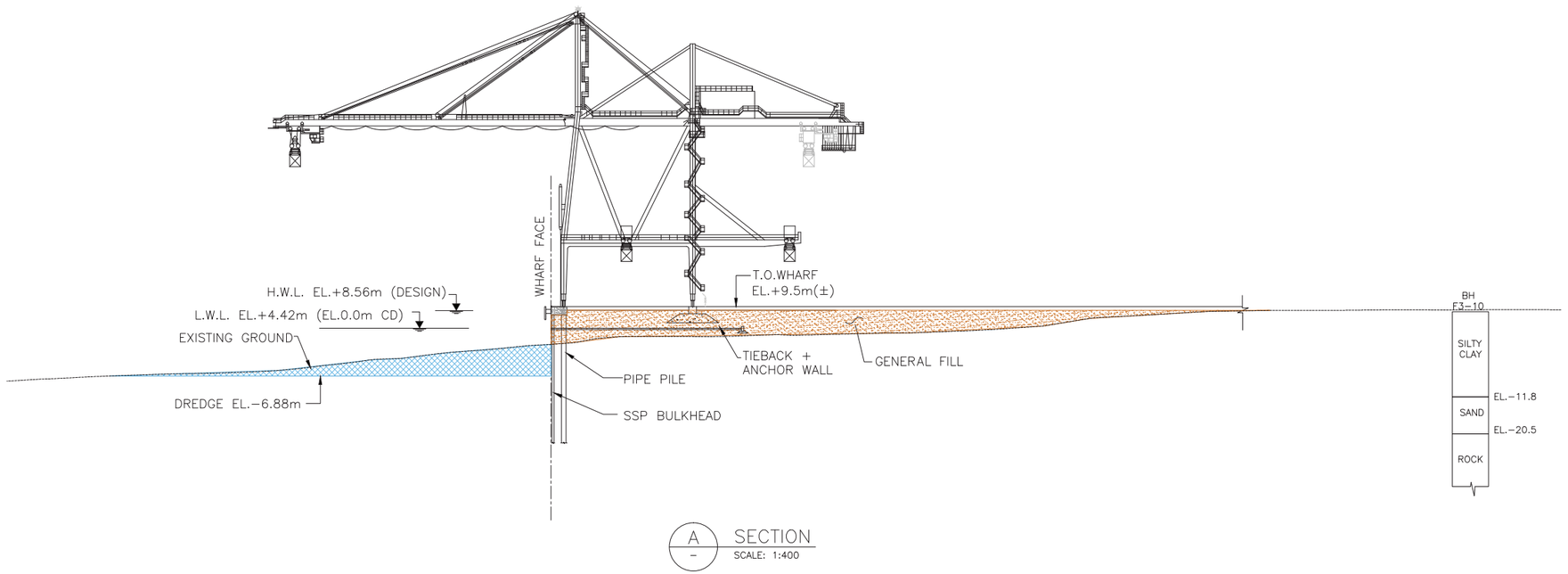
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PROJETÉ/DESIGNED: SG	
VÉRIFIÉ/CHECKED: LN	
APPROUVÉ/APPROVED: –	
CHEF DE SERVICE/DEPARTMENT HEAD	DATE: APRIL 3, 2015
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE OF 1

DESSIN No. / DRAWING No. — 1718181 — 1 — FIG 1 — 0 — 14.1.1 — MOD.

0 1 2 3 4 5 6 po.-in.
0 1 2 3 4 5 6 7 8 9 10 cm.

FORMAT SIZE A-0

DESSIN NO. DRAWING NO. 7181R1-MPI-1R10 | MOD. B



A – SECTION
SCALE: 1:400

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

NOTES

LEGEND:

DREDGE CUT

GENERAL FILL

VERTICAL DATUM:

ALL ELEVATIONS ARE PROVIDED IN GEODETIC DATUM

0.0m CHART DATUM (CD) = 4.42m GEODETIC DATUM (GEO.)

8m 0m 8m 16m
SCALE: 1:400

AUCUN		
TITRE-TITLE	No.	MOD.

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal
Administration portuaire de Montréal
Montreal Port Authority
Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT
PRELIMINARY DESIGN

TITRE/TITLE:
PHASE 1 – BULKHEAD WHARF SECTION

SOUS-TITRE/SUB-TITLE:
WHARF ALIGNMENT A

CONSULTANTS:
MOFFATT & NICHOL
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

DESSINÉ/DRAWN: JL	SCEAU/SEAL:
PROJETÉ/DESIGNED: MC	
VÉRIFIÉ/CHECKED: HW	
APPROUVÉ/APPROVED: –	
CHEF DE SERVICE/DEPARTMENT HEAD	DATE: MAY 1, 2015
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE/OF 1

DESSIN No. DRAWING No. 7181R1-EN-1412 | MOD.

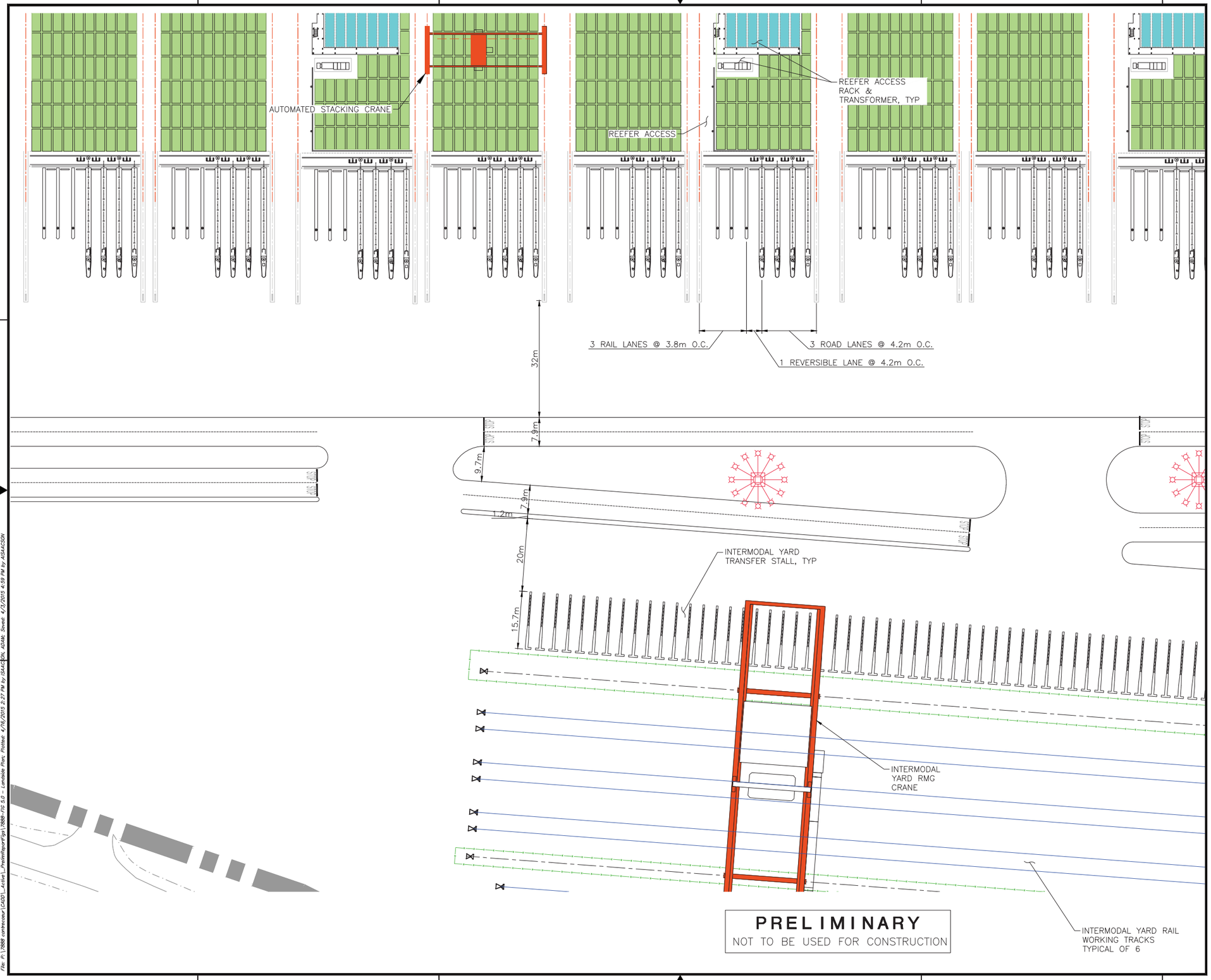
0 1 2 3 4 5 6 po.-in.

0 1 2 3 4 5 6 7 8 9 10 cm.

Bande à inclure seulement sur les originaux / Strip to be added on original only

FORMAT SIZE A-0

DESSIN NO. / DRAWING NO. -171818 1 1F1 16 P D 15.10 MOD.



PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

NOTES

LEGEND

- RAIL MOUNTED GANTRY (RMG) GROUNDED CONTAINERS (5,500 TGS)
- RAIL MOUNTED GANTRY (RMG) GROUNDED REEFERS (400 TGS)
- BUILDINGS
- RAIL TRACK
- HIGH MAST LIGHT POLE
- VEHICLE OVERPASS STRUCTURE
- TERMINAL FENCE
- MPA PROPERTY LINE

N

6m 0m 6m 12m
GRAPHICAL SCALE

AUCUN		
TITRE-TITLE	No.	MOD

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
A	JUN 6/13	ISSUED FOR CLIENT REVIEW	SG

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal

Administration portuaire de Montréal
Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT
PRELIMINARY DESIGN

TITRE/TITLE:
PHASE 1 – LANDSIDE PLAN

SOUS-TITRE/SUB-TITLE:
FIGURE 5.0

CONSULTANTS:
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

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PROJETÉ/DESIGNED: SG	
VÉRIFIÉ/CHECKED: LN	
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CHEF DE SERVICE/DEPARTMENT HEAD	DATE: APRIL 3, 2015
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE OF 1
DESSIN No./DRAWING No. -171818 1 1F1 16 P D	15.10 MOD.

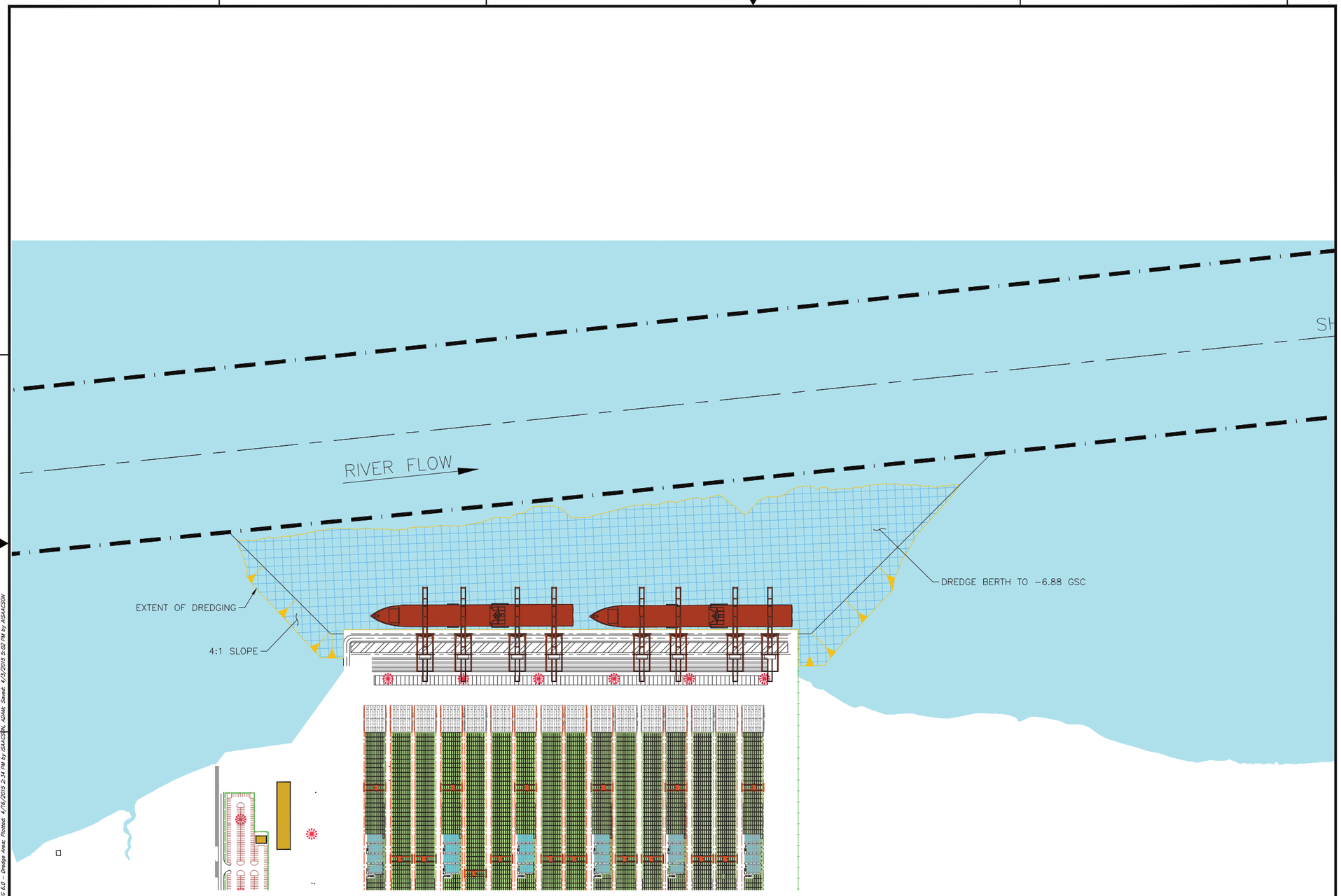
0 1 2 3 4 5 6 po.-in.
0 1 2 3 4 5 6 7 8 9 10 cm.

File: P:\7888 contrecoeur\CAD_Active_PrelimReport\fig\7888-Fig 5.0 - Landside Plan; Plotted: 4/16/2015 2:27 PM by SSAACSON, ADMIN; Saved: 4/3/2015 4:59 PM by ASSAACSON

Bande à inclure seulement sur les originaux / Strip to be added on original only

FORMAT SIZE A-0

DESSIN NO. / DRAWING NO. -1718818 1 1 FILING P D 16.10 MOD.



PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

NOTES

LEGEND:

CHANNEL LIMIT

PROPERTY BOUNDARY

DREDGE LIMIT EL. -6.88m

VERTICAL DATUM:

ALL ELEVATIONS ARE PROVIDED IN GEODETIC DATUM

0.0m CHART DATUM (CD) = 4.42m GEODETIC DATUM (GEO.)

N

40m 0m 40m 80m

GRAPHICAL SCALE

AUCUN			
	TITRE-TITLE	No.	MOD

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

A	JUN 6/13	ISSUED FOR CLIENT REVIEW	SG
No.	DATE	DESCRIPTION	PAR BY

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal

Administration portuaire de Montréal
Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT
PRELIMINARY DESIGN

TITRE/TITLE:
PHASE 1 – DREDGE PLAN

SOUS-TITRE/SUB-TITLE:
FIGURE 6.0

CONSULTANTS:

777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

DESSINÉ/DRAWN: CG
PROJETÉ/DESIGNED: SG
VÉRIFIÉ/CHECKED: LN
APPROUVÉ/APPROVED: –
CHEF DE SERVICE/DEPARTMENT HEAD

SCEAU/SEAL:

DATE: APRIL 3, 2015
ÉCHELLE/SCALE: AS SHOWN
FEUILLE/SHEET: 1 DE 1 OF

DESSIN No./DRAWING No. -1718818 1 1 FILING P D 16.10 MOD.

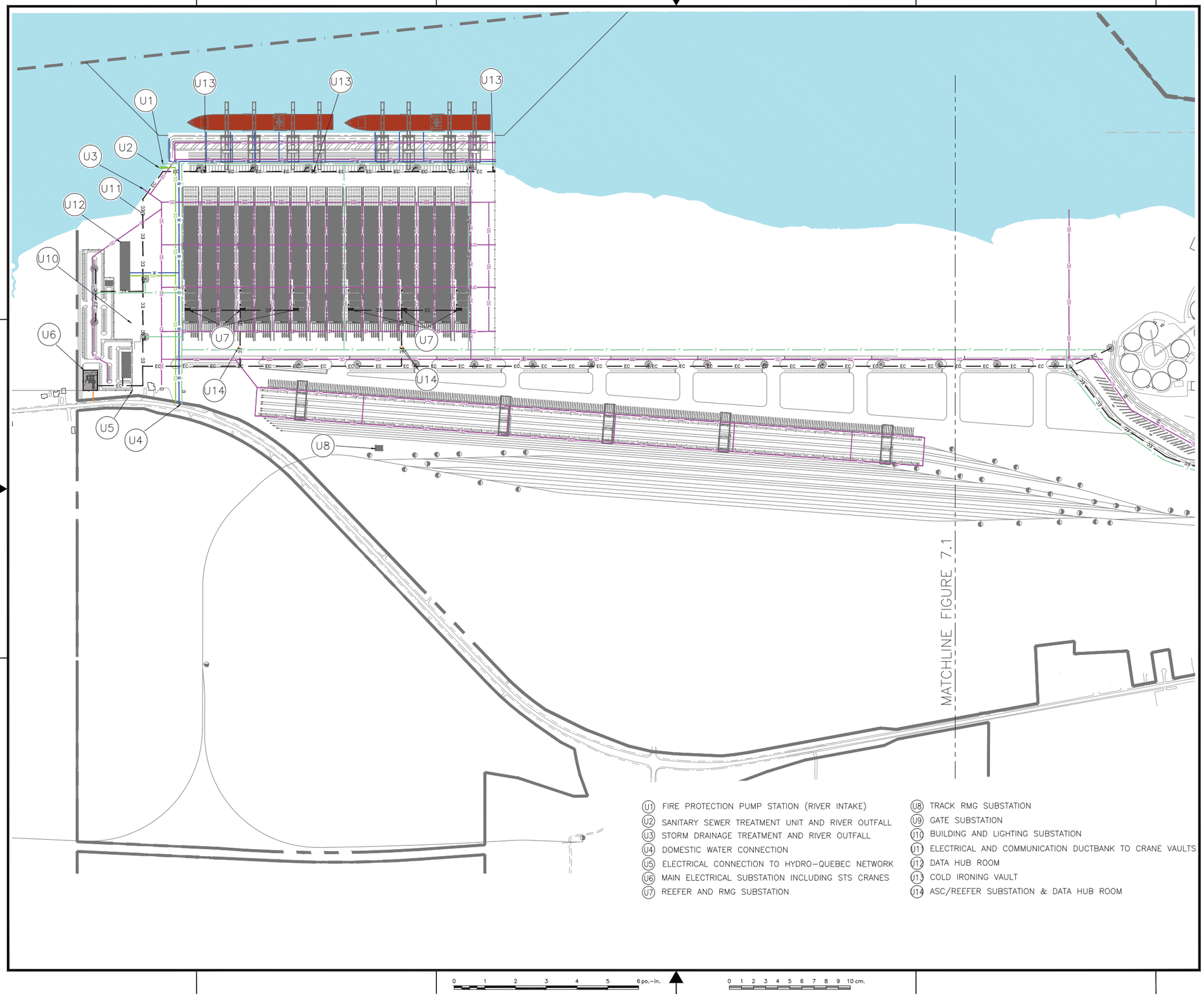
0 1 2 3 4 5 6 po.-in.

0 1 2 3 4 5 6 7 8 9 10 cm.

File: P:\7888 contrecoeur\CAD\...Active\...PrelimReportFigs\7888-FIG 6.0 - Dredge Areas; Plotted: 4/16/2015 2:34 PM by ISAACSON, ADAM; Saved: 4/3/2015 5:02 PM by ADAACSON

FORMAT SIZE A-0

DESSIN NO. DRAWING NO. 7181818 - FIGR - 7.01 MOD. C



(U1) FIRE PROTECTION PUMP STATION (RIVER INTAKE)
(U2) SANITARY SEWER TREATMENT UNIT AND RIVER OUTFALL
(U3) STORM DRAINAGE TREATMENT AND RIVER OUTFALL
(U4) DOMESTIC WATER CONNECTION
(U5) ELECTRICAL CONNECTION TO HYDRO-QUEBEC NETWORK
(U6) MAIN ELECTRICAL SUBSTATION INCLUDING STS CRANES
(U7) REEFER AND RMG SUBSTATION
(U8) TRACK RMG SUBSTATION
(U9) GATE SUBSTATION
(U10) BUILDING AND LIGHTING SUBSTATION
(U11) ELECTRICAL AND COMMUNICATION DUCTBANK TO CRANE VAULTS
(U12) DATA HUB ROOM
(U13) COLD IRONING VAULT
(U14) ASC/REEFER SUBSTATION & DATA HUB ROOM

0 1 2 3 4 5 6 po.-in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND

- W — DOMESTIC WATER MAIN
- F — FIRE PROTECTION WATER MAIN
- SD — STORM DRAINAGE MAIN
- UD — STORM TRENCH/UNDER DRAIN
- SS — SANITARY SEWER MAIN
- UE — ELECTRICAL SUPPLY
- EC — ELECTRICAL AND COMMUNICATION DUCTBANK
- HIGH MAST LIGHT POLE

50m 0m 50m 100m
SCALE: 1 : 2500

AUCUN		
TITRE-TITLE	No.	MOD.

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
C	JAN 18/11	ISSUED FOR FINAL REPORT	AT
B	SEPT 17/10	ISSUED FOR CLIENT REVIEW	AT
A	AUG 17/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal
Administration portuaire de Montréal Montreal Port Authority
Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
PHASE 1 – UTILITY PLAN (1 OF 2)

SOUS-TITRE/SUB-TITLE:
FIGURE 7.0

CONSULTANTS:
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

DESSINÉ/DRAWN:	SCEAU/SEAL:
JL	
PROJETÉ/DESIGNED: MC	
VÉRIFIÉ/CHECKED: HW	
APPROUVÉ/APPROVED: –	
CHEF DE SERVICE/DEPARTMENT HEAD	DATE: APRIL 3, 2015
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE 1 OF

DESSIN No. DRAWING No. 7181818 – FIGURE 7.01 MOD. C

FORMAT SIZE A-0

DESSIN NO. DRAWING NO. 7 1888 + FIG- 7.1 | | |

APPENDIX B

ANTICIPATED PROBABLE COST BREAKDOWNS

MONTREAL PORT AUTHORITY
Order of Magnitude Cost Estimate for Contrecoeur Development Preliminary Design

Date: 16-Apr-15
Prepared By: AI
Project No.: 7888

DRAFT-

10228-4861

1. ENTRANCE COSTS - SEMI AUTOMATED PHASE 1 - 2 BERTHS
(2 Berths, 1,140,000 TEU's/annum)

ITEM		DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT RATE	ITEM COST	AREA COST	CONTINGENCY %	CONTINGENCY $
1		**ENTRANCE COSTS**							
1.1		Mobilization/Demobilization	L.S.	1	$2,550,000	$2,550,000		20	$510,000
1.2		Hwy 132 Overpass Structure (2-Lane Hwy.132 over New Rail)	sq.m.	4,500	$4,393	$19,769,944		25	$4,942,486
1.3		Storage Tracks							
	a	Storage, Runaround and Interchange Rail Track	lin.m.	28,028	$724	$20,305,600		20	$4,061,120
	b	No.8 Turnout Assembly with Switch (Relay), Incl. Ballast, Subballast, Ties, Rail	ea.	28	$111,590	$3,124,520		20	$624,904
	c	Gravel Surfacing Access Roads	Allowance	1	$54,917	$54,917		25	$13,729
1.4		Environmental Habitat Compensation (5% of Capital Construction Cost, Ph.2)	L.S.	1	$20,400,000	$20,400,000		25	$5,100,000
						SUB-TOTAL FOR ENTRANCE COSTS	$66,204,981		$15,252,239
						TOTAL FOR CAPITAL CONSTRUCTION	**$66,204,981**	**23%**	**$15,252,239**
						TOTAL FOR CAPITAL CONSTRUCTION, INCL. CONTINGENCY		**$81,000,000**	
2		**PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION**							
2.1		Allowance 10% of Construction Costs	L.S.	1	$6,620,000	$6,620,000			
						SUB-TOTAL FOR PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION	$6,620,000		$0
						TOTAL FOR PROJECT	**$72,824,981**	**21%**	**$15,252,239**
						TOTAL FOR CONSTRUCTION, INCL. CONTINGENCY		**$88,000,000**	

MONTREAL PORT AUTHORITY
Order of Magnitude Cost Estimate for Contrecoeur Development Preliminary Design

Date: 16-Apr-15
Prepared By: AI
Project No.: 7888

DRAFT-

2. Contrecoeur Container Terminal 1 - Phase 1 - Semi Automated
(2-Berth,1,140,000 TEU's/annum)

ITEM		DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT RATE	ITEM COST	AREA COST	CONTINGENCY %	CONTINGENCY $
1		**MOBILIZATION/DEMOBILIZATION**							
1.1		Mobilization/Demobilization	L.S.	1	$12,330,000	$12,330,000		20	$2,466,000
						SUB-TOTAL FOR MOBILIZATION / DEMOBILIZATION	$12,330,000		$2,466,000
2		**DREDGING AND LAND RECLAMATION**							
		Total Dredge Volume (Ship Basin + Tug Basin)	**cu.m.**	**1,100,000**					
		Total General Fill Volume Required (Upland)	**cu.m.**	**317,000**					
2.1		Dredging & Disposal							
	a	Excavator Dredge and Upland Disposal (Incl. Marine and Land Based Works)	cu.m.	1,100,000	$31	$34,221,288		50	$17,110,644
	b	Upland Disposal Environmental Mitigation (Berms, Ditching, Hydroseed, etc.)	Allowance	1	$200,000	$200,000		50	$100,000
		Land Reclamation & Import Material							
	a	Import Fill (Sand) for Land Reclamation to El.+8.5m± (Subgrade Elevation)	cu.m.	317,000	$36	$11,412,000		25	$2,853,000
	d	Slope & Scour Protection (SSP Wall Toe + Wall Returns)	cu.m.	11,000	$89	$982,017		25	$245,504
						SUB-TOTAL FOR DREDGING AND LAND RECLAMATION	$46,815,305		$20,309,148
3		**REMOVALS AND SITE PREPARATION**							
3.1		Clear and Grub	Allowance	1	$150,000	$150,000		20	$30,000
						SUB-TOTAL FOR REMOVALS AND SITE PREPARATION	$150,000		$30,000
4		**WHARF STRUCTURAL**							
4.1		Steel Sheet Pile Wall System (Arcelor HZ King Pile c/w AZ Sheet Pile)							
		Total Length of Wall	**m**	**760**					
		Number of Container Berths	**ea.**	**2**					
	a	Supply HZ Sheet Piling (Arcelor HZ 1180 + AZ26-700)	kg	8,850,000	$2.70	$23,895,000		25	$5,973,750
	b	Supply Tie Rods	ea.	394	$4,295	$1,693,970		25	$423,492
	c	Supply T-Plates and Curved Plates	ea.	394	$207	$81,637		25	$20,409
	d	Drive H Sheet Piles	ea.	394	$1,552	$612,278		25	$153,070
	e	Drive Z Pair Sheet Piles	ea.	394	$673	$265,321		25	$66,330
	f	Supply and Install Concrete Cope Wall & Bullrail	cu.m.	3,100	$621	$1,925,035		25	$481,259
	g	Install Tie Rods	ea.	394	$517	$204,093		25	$51,023
	h	Install T-Plates and Curved Plates	ea.	394	$517	$204,093		25	$51,023
	i	Supply Anchor Pile (914mm dia.)	lin.m.	6,300	$983	$6,194,266		25	$1,548,566
	j	Drive Anchor Pile	ea.	394	$776	$306,139		25	$76,535
4.2		Crane Rail System (Crane Rail, Crane Beam, Support Piles and Pile Cap)							
		Length of Crane Beam	**m**	**650**					
	a	CIP Concrete Crane Beam and Pile Cap	cu.m.	7,200	$659	$4,744,787		25	$1,186,197
	b	CIP Concrete Seismic Tie Beam	cu.m.	15,200	$659	$10,016,772		25	$2,504,193
	c	Supply Support Piles (914mm)	lin.m.	22,300	$1,180	$26,314,000		25	$6,578,500
	d	Drive Support Piles	ea.	670	$776	$520,070			
	e	Crane Rail & Fixation	lin.m.	1,300	$549	$713,915		25	$178,479
	f	Crane Rail Stops	ea.	4	$19,770	$79,080		25	$19,770
	g	Stowage Pins	ea.	19	$20,699	$384,416		25	$96,104
4.3		Miscellaneous Wharf Elements							
	a	Mooring System (Bollards)	ea.	28	$10,350	$292,490		25	$73,123
	b	Crane Power Vault	ea.	10	$20,699	$206,993		25	$51,748
	c	Ship Service Pit	ea.	4	$10,350	$44,848		25	$11,212
	d	Fenders	ea.	50	$32,950	$1,647,495		25	$411,874
						SUB-TOTAL FOR WHARF STRUCTURAL	$80,346,696		$19,956,657
5		**CIVIL & STRUCTURAL TERMINAL INFRASTRUCTURE**							
5.1		Civil Utilities							
	a	Fire Protection Water Distribution System (Pipes, Valves)	lin.m.	5,910	$330	$1,950,300		25	$487,575
	b	Fire Hydrants	ea.	30	$4,300	$129,000		25	$32,250
	c	River Intake Pump Station for Fire Protection (Pumps & Motors, Valves)	Allowance	1	$226,256	$226,256		25	$56,564
	d	Domestic Water Distribution System (Pipes, Valves)	lin.m.	2,150	$165	$354,750		25	$88,688
	e	Sanitary Sewer Collection System (Pipes, MHs)	lin.m.	1,050	$220	$231,000		25	$57,750
	f	Sanitary Treatment Unit and River Disposal (Anaerobic/Aerobic/UV Treatment)	Allowance	1	$113,128	$113,128		25	$28,282
	g	Storm Drainage Collection System (Pipes, MHs)	lin.m.	7,125	$320	$2,280,000		25	$570,000
	h	Storm Drainage Trench Drains	lin.m.	650	$600	$390,000		25	$97,500
	i	Storm Drainage Under Drains (French Drains for Semi-Automated)	lin.m.	9,110	$283	$2,576,495		25	$644,124
	j	Storm Drainage Treatment and River Disposal	ea.	2	$113,128	$226,256		25	$56,564
	k	Utility Services (Buildings & Ship Service Pits)	ea.	7	$5,492	$40,272		25	$10,068
5.2		Civil Pavement Structures (Asphalt/Concrete, Base and Subbase Gravel)							
	a	Heavy Duty Pavement For Container Yard, Access Roads and Gate Area	sq.m.	440,000	$125	$55,000,000		25	$13,750,000
	c	Light/Medium Duty Pavement for POV/Equipment Parking Area	sq.m.	50,000	$93	$4,650,000		25	$1,162,500
	d	RMG Concrete Runways (Container Yard)	lin.m.	16,360	$2,130	$34,854,772		25	$8,713,693
	e	Misc. Concrete Slabs (RTG Repair Pad, Fueling Station, Washdown Area)	sq.m.	400	$165	$65,900		25	$16,475
	f	Misc. Concrete Strips for Container Castings (for Semi-Automated only)	cu.m.	20,000	$659	$13,179,963		25	$3,294,991
5.3		Miscellaneous Civil and Structural							
	a	Fencing and Gates	lin.m.	6,450	$136	$875,612		25	$218,903
	b	Pavement Markings	Allowance	1	$200,000	$200,000		25	$50,000
	c	Reefer Tower Structures	ea.	20	$465,734	$9,314,685		25	$2,328,671
	d	Fueling Facility (Single 45,000 Gallon Diesel and Gasoline Tank)	L.S.	1	$200,000	$200,000		25	$50,000
	e	Customs portal radiation monitors (RPM)	ea.	4	$200,000	$800,000		25	$200,000
						SUB-TOTAL FOR CIVIL TERMINAL INFRASTRUCTURE	$127,658,391		$31,914,598
6		**OFFSITE IMPROVEMENTS**							
	a	Existing Drainage Channel Relocations	Allowance	1	$100,000	$100,000		25	$25,000
	b	Tug Basin (Mooring Piles and Access Gangway)	Allowance	1	$400,000	$400,000		25	$100,000
						SUB-TOTAL FOR OFFSITE IMPROVEMENTS	$500,000		$25,000
7		**RAIL WORKS**							
7.1		Intermodal Yard							
	a	Working Rail Track, Incl. Ballast, Subballast, Ties	lin.m.	9,396	$724	$6,807,172		20	$1,361,434
	b	No.8 Turnout Assembly with Switch (Relay), Incl. Ballast, Subballast, Ties, Rail	ea.	5	$111,590	$557,950		20	$111,590
	c	RMG Concrete Runways	lin.m.	2,736	$2,130	$5,829,013		25	$1,457,253
	d	Asphalt Pavement	sq.m.	75,000	$93	$6,975,000		25	$1,743,750
						SUB-TOTAL FOR RAIL WORKS	$20,169,135		$4,674,028

MONTREAL PORT AUTHORITY
Order of Magnitude Cost Estimate for Contrecoeur Development Preliminary Design

Date: 16-Apr-15
Prepared By: AI
Project No.: 7888

DRAFT-

2. Contrecoeur Container Terminal 1 - Phase 1 - Semi Automated
(2-Berth,1,140,000 TEU's/annum)

ITEM		DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT RATE	ITEM COST	AREA COST	CONTINGENCY %	CONTINGENCY $
8		**GATE COMPLEX**							
	a	Pre-Gate OCR (Gate Arms, OCR, Cameras, Communication, Bollards, Electrical)	lane	2	$339,385	$678,769		25	$169,692
	b	In-Gate (Gate Arms, Cameras, Communication, Bollards, Electrical)	lane	6	$226,256	$1,357,539		25	$339,385
	c	Out-Gate OCR (Gate Arms, OCR, Cameras, Communication, Bollards, Electrical)	lane	3	$395,949	$1,187,846		25	$296,962
	d	Roadside Barriers	lin.m.	500	$170	$84,846		25	$21,212
	e	Misc. Structures	sq.m.	2,800	$730	$2,044,000		25	$511,000
						SUB-TOTAL FOR GATE COMPLEX	$5,353,001		$1,338,250
9		**BUILDINGS**							
	a	Administration building (2 floors)	sq.m.	1,500	$1,950	$2,925,000		20	$585,000
	b	Maintenance Building	sq.m.	2,000	$1,890	$3,780,000		20	$756,000
	c	Labour Check In/Lunch Building	sq.m.	1,000	$1,950	$1,950,000		20	$390,000
	d	LEED Certification (5%)	Allowance	1	$430,000	$430,000		20	$86,000
	e	Guard House	L.S.	1	$100,000	$100,000		20	$20,000
	f	Trouble Building	L.S.	1	$100,000	$100,000		20	$20,000
	g	Compressor Building	L.S.	1	$45,251	$45,251		20	$9,050
						SUB-TOTAL FOR BUILDINGS	$9,330,251		$1,866,050
10		**ELECTRICAL TERMINAL INFRASTRUCTURE**							
	a	Power Supply to Site	L.S.	1	$100,000	$100,000		25	$25,000
	b	Main Substation	ea.	2	$1,000,000	$2,000,000		25	$500,000
	c	Reefer Substations	ea.	3	$400,000	$1,200,000		25	$300,000
	d	ASC Crane Substations	ea.	3	$400,000	$1,200,000		25	$300,000
	e	IY Crane Substations	ea.	2	$750,000	$1,500,000		25	$375,000
	f	Quay Crane Substation	L.S.	1	$1,800,000	$1,800,000		25	$450,000
	g	Gate Electrical	L.S.	1	$600,000	$600,000		25	$150,000
	h	High Mast Lighting Complete (Foundation, Pole, Fixture, Conduit)	ea.	24	$150,000	$3,600,000		25	$900,000
	i	Power and Communication Distribution	L.S.	1	$6,000,000	$6,000,000		25	$1,500,000
						SUB-TOTAL FOR ELECTRICAL TERMINAL INFRASTRUCTURE	$18,000,000		$4,500,000
						TOTAL FOR CAPITAL CONSTRUCTION	**$320,652,780**	**27%**	**$87,079,731**
						TOTAL FOR CAPITAL CONSTRUCTION, INCL. CONTINGENCY	**$408,000,000**		
11		**PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION**							
11.1		Allowance 10% of construction costs	L.S.	1	$32,100,000	$32,100,000			$0
						SUB-TOTAL FOR PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION	$32,100,000		$0
						TOTAL FOR PROJECT	**$352,752,780**	**25%**	**$87,079,731**
						TOTAL FOR CONSTRUCTION, INCL. CONTINGENCY	**$440,000,000**		

MONTREAL PORT AUTHORITY
Contrecoeur Development Preliminary Design

Date: 16-Apr-15
Prepared By: MN (M&N)
Project No.: 7888

CONTRECOUER PHASE 1 - SEMI AUTOMATED

ITEM	DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT RATE	ITEM COST	AREA COST	CONTINGENCY %	CONTINGENCY $
1	**CONTRECOEUR EQUIPMENT PURCHASE**							
1.1	Ship-to-Shore Cranes	ea.	8	$9,200,000	$73,600,000		5	$3,680,000
1.2	Spare STS Crane Spreaders	ea.	2	$170,000	$340,000		5	$17,000
1.3	IY RMGs	ea.	5	$2,500,000	$12,500,000		10	$1,250,000
1.4	CY ASCs	ea.	32	$3,000,000	$96,000,000		10	$9,600,000
1.5	Shuttle Carriers	ea.	24	$600,000	$14,400,000		5	$720,000
1.6	Top Picks	ea.	2	$505,000	$1,010,000		5	$50,500
1.7	MT Handlers	ea.	0	$265,000	$0		5	$0
1.8	Hostlers	ea.	30	$70,000	$2,100,000		5	$105,000
1.9	Trailers (Bombcarts)	ea.	120	$90,000	$10,800,000		5	$540,000
1.10	Fuel Trucks	ea.	1	$110,000	$110,000		5	$5,500
1.11	Repair Trucks	ea.	10	$120,000	$1,200,000		5	$60,000
1.12	Pick-up Trucks	ea.	22	$40,000	$880,000		5	$44,000
					SUB-TOTAL	$212,940,000		$16,072,000
					TOTAL FOR EQUIPMENT	**$212,940,000**		$16,072,000
					TOTAL FOR EQUIPMENT, INCL. CONTINGENCY	*$229,012,000*		
2	**PROCUREMENT & CONTRACT ADMINISTRATION**							
2.1	***P & C at 1.5% of Purchase Price***	ea.	1	$3,194,100	$3,194,100		10	$319,410
					SUB-TOTAL FOR PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION	$3,194,100		$319,410
					TOTAL FOR EQUIPMENT	$216,100,000		$16,400,000
					TOTAL FOR EQUIPMENT , INCL. CONTINGENCY	**$232,500,000**	**(rounded)**	

The cost estimate for the 30.48 m gauge ship to shore cranes includes the crane design, supply, delivery, erection and testing costs (the estimate does not include applicable taxes, duties and tariffs). One spreader is included for each crane.

The estimate is based on Canadian (CDN) Dollars. Container handling equipment is usually purchased in US dollars or Euros and therefore its Canadian dollar cost is dependant on exchange rates at the time of purchase. The exchange rate applied to the crane estimate in this review is US$0.98 = CDN $1.00 and $0.75 Euros = $CDN 1.00

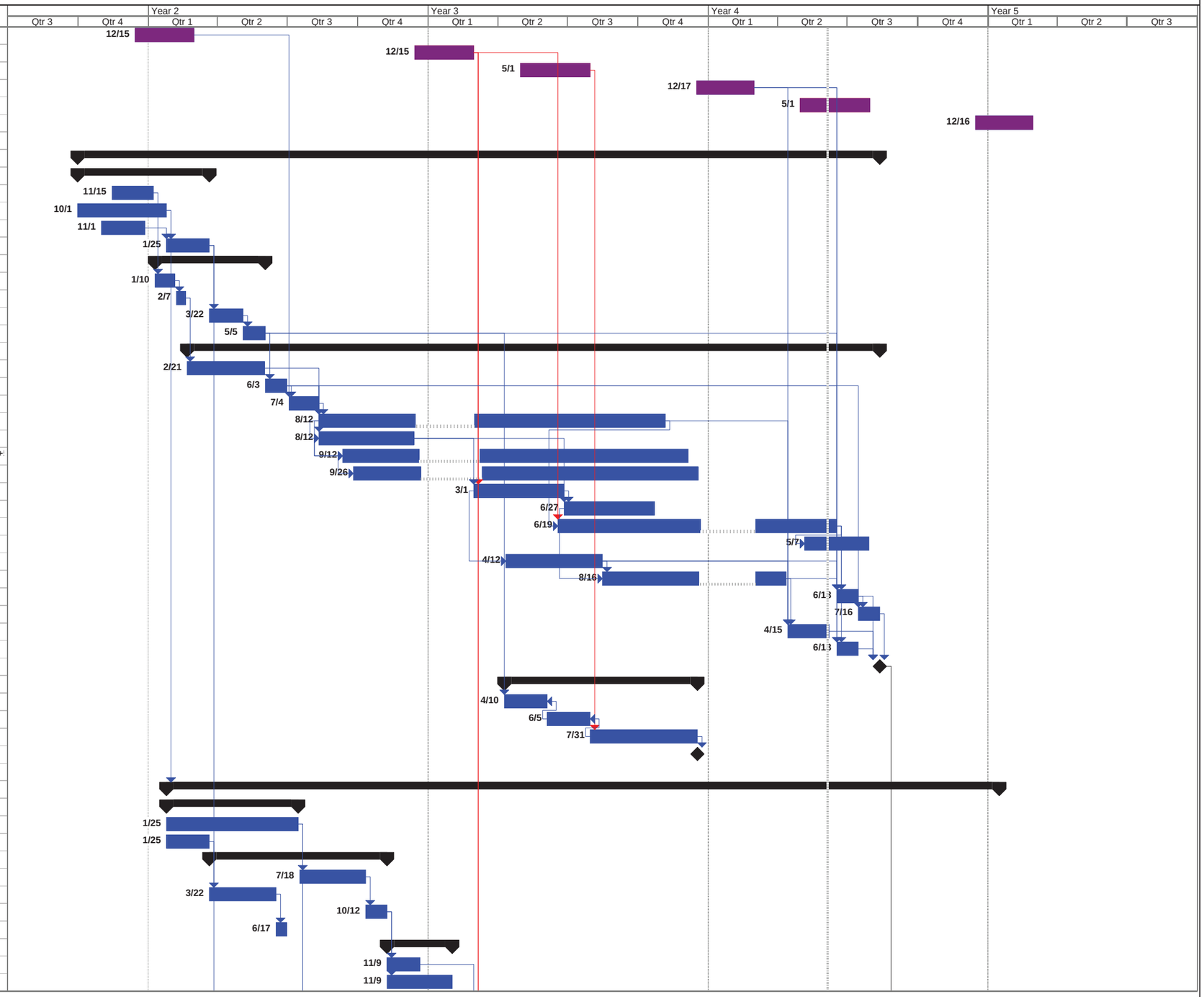
The estimate is based on typical order quantities (i.e. 3 gantry cranes per order) and mid-range equipment

APPENDIX C

SCHEDULES

CONTRECOEUR DEVELOPMENT
PRELIMINARY DESIGN
PHASE 1CONSTRUCTION SCHEDULE (DRAFT)

ID	Task Name	Duration	Predecessors
1	No Winter Excavation -Season 1	55 days	
2	No Winter Excavation - Season 2	55 days	
3	No Dredging (environmental)	65 days	
4	No Winter Excavation -Season 3	55 days	
5	No Dredging (environmental)	65 days	
6	No Winter Excavation - Season 4	55 days	
7			
8	**PHASE 1 MARINE WORKS PACKAGE**	**738 days**	
9	**Construction Documents**	**120 days**	
10	Prepare Pile Supply Specification	2 mons	
11	Prepare SSP Wharf Plans & Specifications	4 mons	
12	Prepare Dredging Plans & Specifications	2 mons	
13	Prepare Construction Documents	2 mons	11,12
14	**Tendering**	**101 days**	
15	Tender SSP & Pipe Pile Supply	1 mon	10
16	Award SSP & Pipe Pile Supply	0.5 mons	15
17	Tender Marine Works	1.5 mons	13
18	Award Marine Works	1 mon	17
19	**Wharf Material Supply & Construction**	**639 days**	
20	Supply SSP & Pipe Piles	3.5 mons	16
21	Shoreline Preparation & Mobilization	1 mon	18
22	Supply and Place Initial Shoreline Fill	28 days	21,1
23	Pitch and Drive SSP	53 wks	20,21FS+5 days,22
24	Pitch and Drive Anchor Wall Piles	86 days	21,23SS
25	Install Tie Rods	53 wks	23SS+20 days,24SS+
26	Backfill Wharf	53 wks	25SS+10 days
27	Pitch and Drive Backside Crane Rail Piles	84 days	24,2
28	Pitch and Drive Frontside Crane Rail Piles	84 days	24,27
29	Cast Cope Beam	42 wks	23FS-100 days,2
30	Cast Cold Iron Pits, Cable Pits, Etc.	3 mons	29FS-30 days
31	Cast Backside Crane Rail	18 wks	27SS+30 days
32	Cast Frontside Crane Rail & Seismic Tie	24 wks	31,28SS+30 days
33	Backfill to Grade	1 mon	18,29,31,32,4
34	Install Wharf Utilities	1 mon	21,33
35	Install Crane Rails	2 mons	31,32,23,4
36	Install Fenders, Bollards, Stops, Ladders, Etc.	1 mon	21,29,4
37	Substantial Completion Wharf	0 days	33,34,35,36
38	**Ship Basin Dredging and Disposal**	**180 days**	
39	Prepare Upland Disposal Area	2 mons	40SF,18
40	Mobilize Dredge	2 mons	41SF
41	Dredge Ship Basin	20 wks	3
42	Substantial Completion Dredging	0 days	41
43			
44	**PHASE 1 BACKLAND SITE IMPROVEMENTS PACKAGE**	**770 days**	**11**
45	**Construction Documents**	**120 days**	
46	Prepare Site Work Plans & Specifications	6 mons	
47	Prepare Buildings Plans & Specifications	2 mons	
48	**Tendering**	**160 days**	
49	Tender Site Work	60 days	46
50	Tender Building	60 days	47
51	Award Site Work	1 mon	49
52	Award Building	0.5 mons	50
53	**Notice to Proceed**	**60 days**	
54	Mobilization - Site Work	30 days	51
55	Submittals	60 days	51

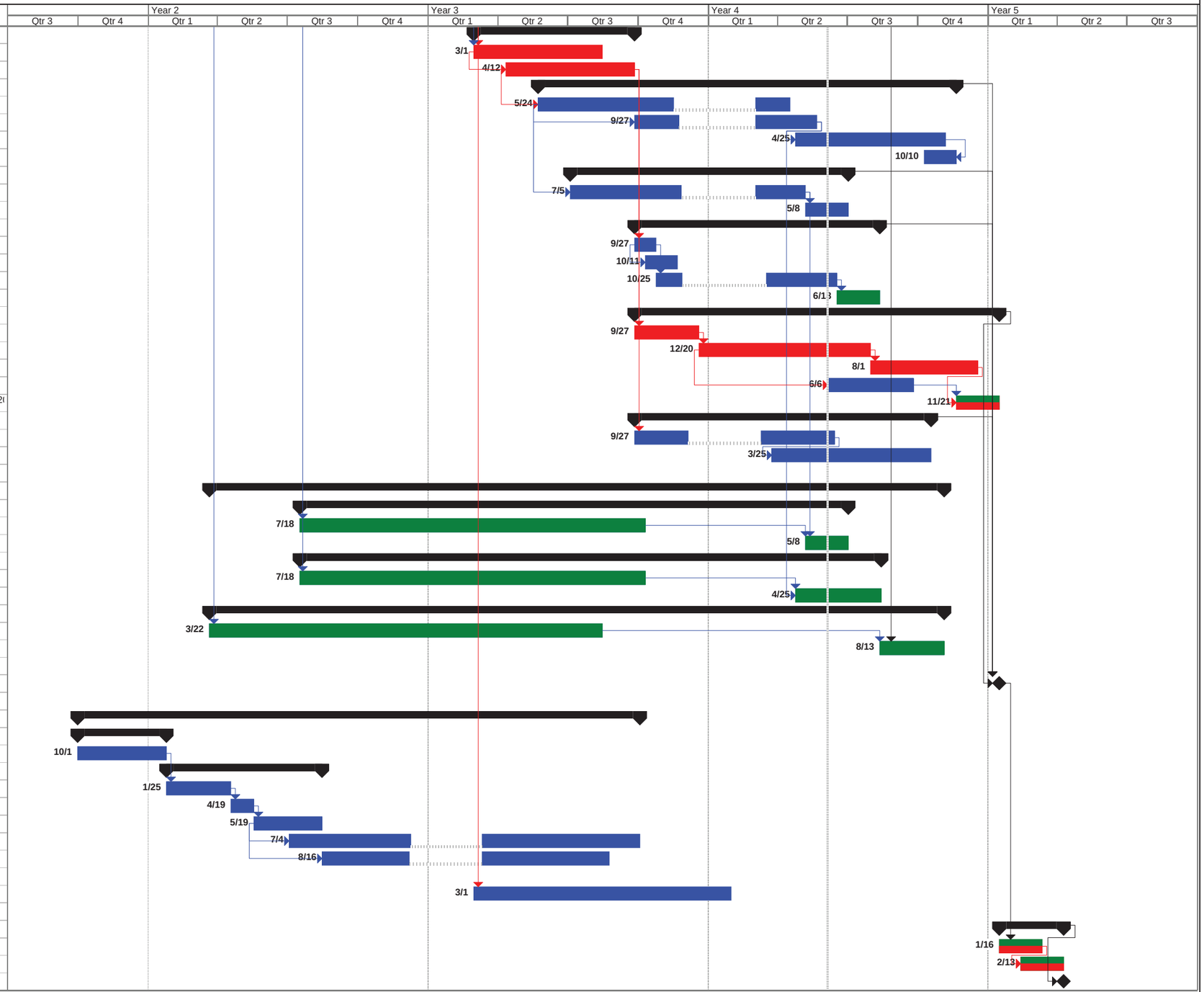


Project: phase 1 terminal
Date: 6/5/13

Task | Critical Task | Tenant Task | Env. Constraint | Critical Tenant | Progress | Milestone | Summary | Split

CONTRECOEUR DEVELOPMENT
PRELIMINARY DESIGN
PHASE 1CONSTRUCTION SCHEDULE (DRAFT)

ID	Task Name	Duration	Predecessors
56	**Removals and Site Preparation**	**150 days**	
57	Clear & Grub	120 days	54,2
58	Rough Grading/Import Fill	120 days	57SS+30 days
59	**Civil & Misc Struc Terminal Infrastructure**	**390 days**	
60	Civil Utilities	8 mons	58SS+30 days
61	RMG Concrete Runways	100 days	60SS+90 days
62	Paving & Pavement Markings	140 days	61FS-20 days
63	Misc Site Work (fencing, gates)	30 days	62FF+10 days
64	**Intermodal Yard**	**259 days**	
65	Rail work	150 days	60SS+30 days
66	Paving & Pavement Marking	40 days	65
67	**Gate Complex**	**228 days**	
68	Grading & Drainage	20 days	58
69	Paving & Pavement Marking	30 days	68SS+10 days
70	Utilities (Incl OCR, Comm)	90 days	68
71	Tenant gate operating systems and equipment	2 mons	70
72	**Buildings**	**340 days**	
73	Foundation	3 mons	58
74	Building Structures	8 mons	73
75	Interior Construction	5 mons	74
76	Building Utility Systems	4 mons	74SS+120 days
77	Tenant Data Systems	2 mons	75FS-20 days,76FS-2(
78	**Electrical Terminal Infrastructure**	**277 days**	
79	Primary infrastructure	120 days	58
80	Distribution	150 days	79FS-60 days
81			
82	**Major Equipment Procurement**	**678 days**	
83	**RMG IY, order, fabricate, assemble commission**	**509 days**	
84	Order Fabricate Assemble Transport	16 mons	46
85	Assemble Commission	2 mons	84,65
86	**ASC CY, order, fabricate, assemble commission**	**540 days**	
87	Order Fabricate Assemble Transport	16 mons	46
88	Assemble Commission	4 mons	87,61FS-20 days
89	**Ship to Shore Crane Procurement**	**678 days**	
90	Order, Fabricate, Transport & Commission Cranes	18 mons	13
91	Assemble and Commission	3 mons	90,37
92			
93	Construction Substantial Completion - Phase 1	0 days	78,72,67,64,59
94			
95	**PHASE 1 ENTRY IMPROVEMENTS**	**515 days**	
96	**Construction Documents**	**80 days**	
97	Prepare D-B Plans & Specifications	4 mons	
98	**Tendering**	**140 days**	
99	Tender Design Build	60 days	97
100	Award Site Work	1 mon	99
101	Design and Plan approval	3 mons	100
102	Storage, A&D and Runaround Track	260 days	101SS+30 days
103	Hwy 132 Overpass	10 mons	101SS+60 days
104			
105	Environmental habitat compensation	12 mons	2
106			
107	**Tenant Operational Commissioning**	**60 days**	
108	Field test and resolve system integration issues	2 mons	93
109	Labor training	2 mons	108FS-20 days
110	terminal operational	0 days	107



Project: phase 1 terminal
Date: 6/5/13

Task | Critical Task | Tenant Task | Env. Constraint | Critical Tenant | Progress | Milestone | Summary | Split

Étude sectorielle No. 28

Port of Montreal Contrecœur Development Master Plan, Revised



PORT OF MONTREAL

CONTRECOEUR DEVELOPMENT MASTER PLAN

FINAL REPORT

Prepared for:

Montreal Port Authority
2100 Pierre-Dupuy Ave., Wing No. 1
Montreal Quebec
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REV	DESCRIPTION	DATE ISSUED	PREPARED BY	REVIEWED BY	APPROVED BY
2	Revised to incorporate Additional Dredging & Geotechnical Reports	March 19, 2013	LWN		LWN
1	Final Report	January 19, 2011	HW	MC	LN
0	Final Report (Draft)	December 03, 2010	HW		

M&N Project No. 7146/7888

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APPENDIX G – SCHEDULES

1.0 EXECUTIVE SUMMARY

MPA is looking forward to long term expansion of container handling capacity once current facilities reach their full potential. Fortunately, the MPA owns a large land bank near the town of Contrecoeur; some 30 km downstream from the current port container facilities. The Contrecoeur land bank is located on the banks of St. Lawrence River adjacent to the existing main shipping channel. Most of the 486 hectares of land is flat and undeveloped with excellent road and rail connections nearby including a CN Rail main line and Highway 30. Existing facilities include a one berth dry bulk terminal primarily used for the import and storage of iron ore for nearby industrial facilities. As a result, the site offers tremendous potential for port development with few constraints, mostly the site boundaries themselves and a few sensitive habitat areas (See Drawing 7146-MP-2 in Appendix A).

The length of undeveloped foreshore downstream of the existing dry bulk terminal is about 800 metres in length while upstream it is roughly 2500 metres. As a result, at the upstream side of the land bank one new dry bulk berth and six new container berths able to accommodate 300 m LOA container vessels can be constructed. As an undeveloped foreshore, a new wharf and dredging for a ship mooring basin adjacent the nearby shipping channel is needed (see Drawing 7146-MP-4 in Appendix A).

Three types of wharf structure have been reviewed including a steel sheet pile bulkhead, pile supported concrete deck and concrete box caissons. The presence of a thick layer of sensitive clays that can lose up to 30 or 50% of their strength is a key issue for the design of the new wharf. For each alternative the foundations should be extended deep to an underlying layer of till and bedrock. For the steel sheet piles or concrete deck piles this means driving and seating the piles into the hard till layer. For the caissons their heavy mass dictates that the clay layer under the caissons be excavated and the resulting trench filled with rock onto which the caissons can rest (see Drawing 7146-MP-10 in Appendix A). As a result the caisson wharf is from a technical perspective the most reliable and robust of the three options. The sensitive clays also dictate the excavation of a relatively flat 4H:1V slope under the pile supported concrete deck wharf (see Drawing 7146-MP-9 in Appendix A). The many piles required for the deck structure will be most disruptive to the clays and thus leave the structure most vulnerable to lateral failure during an earthquake. The steel sheet pile bulkhead, like the caisson, offers a robust gravity based structure with the least amount of excavation required and less disturbance of the clay layer (see Drawing 7146-MP-8 in Appendix A). Although the height of the bulkhead at 16.38 metres from deck to base of dredge cut will require a heavy steel pile section, this option is the preferred choice pending final geotechnical investigations and analysis.

As seen above, each wharf option will require a different quantity of dredging and fill placement. Accounting for the cost of the structure themselves, the volumes of dredging at a quoted rate and the cost of fill, also at a quoted rate, a comparison of total cost was made between each wharf type and along four varying wharf alignments (see Drawing 7146-MP-3 in Appendix A). The result is that the caisson wharf along any alignment was up to 50% more costly than the steel sheet pile bulkhead and pile supported deck options along any alignment. The cost of the pile supported deck was only 5 to 10% above that of the steel sheet pile bulkhead. For all wharf types the cost differential between alignments is less than 5 to 10% with Alignment A the least costly followed closely by Alignment D. As a result, Alignment D is preferred by the MPA as it permits the longest possible wharf across the available land bank foreshore.

Extensive river hydraulic computer modeling of water levels and currents under existing and post-construction conditions were conducted by Environment Canada for most of the wharf types and

alignments. The results indicate minimal impact to river water levels in the order of 0.5 to 1 cm at most under low, medium and high flow conditions. Similarly, river current changes are minimal.

Dredging of the ship basin in front of a steel sheet pile bulkhead along wharf Alignment D requires in the long term approximately 2 million cubic meters of clay removal. Dredge depths will not reach the hard till layers. As the in situ strength of the clay is high, barge mounted excavators or rotating cutter suction dredges are likely to be the preferred choice by contractors. Both methods will disturb the sensitive clay to the point where it will lose strength and become unsuitable as structural fill. As deep water disposal is not available within reasonable distances of the site, upland disposal is considered the only viable option although some material could, pending regulatory discussions, be used for river foreshore habitat creation. The logical location for upland disposal is the Contrecoeur land bank itself in an area that will not be needed for development as it will be years or require treatment/ mixing until the material is suitable for even simple fill needs. The return water for a pipeline/cutterhead dredge operation would also require the creation of containment basins and return water conduits.

With six container berths, the MPA is considering in the long term two 3 berth terminals. Three modes of operation were considered for which six options in total were investigated. The three modes of operation include:

1) **Conventional:** Includes manned berth operations including ship to shore gantry cranes and terminal tractors with bombcarts for transport between the berth and container yard (CY). Container yard is operated using manned rubber tired gantries (RTGs). Intermodal yard (IY) utilizes manned RTGs or rail mounted gantries (RMGs) with horizontal transport between IY and CY with manned terminal tractors and bombcarts.

2) **Semi-Automated:** Includes manned berth operations including ship to shore gantry cranes and shuttle carriers for transport between the berth and container yard (CY). Container yard is operated using automated rail mounted stacking cranes (ASCs). Intermodal yard (IY) utilizes manned RTGs or RMGs with horizontal transport between IY and CY with manned terminal tractors and bombcarts or shuttle carriers.

3) **Automated:** Includes automated berth operations including double trolley ship to shore gantry cranes where primary trolley is manned and second portal trolley is automated with automated guided vehicles (AGVs) or automated shuttle carriers for transport between the berth and container yard (CY). Container yard is operated using automated rail mounted gantries (RMGs) or automated stacking cranes (ASCs). Intermodal yard (IY) utilizes automated RMGs or ASCs with horizontal transport between IY and CY with AGVs or automated shuttle carriers.

For all options the terminals will have a similar truck gate operation utilizing proximity ID cards, optical character recognition (OCR) cameras and remote inspections and clerk interaction.

Each ultimate plan for each mode of operation includes a container storage yard adjacent the berths sized to match the handling capacity of the expected 22 berth cranes; 11 per terminal. For the Conventional terminal rows of 6 wide, 5 high container storage blocks parallel to the berths will provide for the longest and most efficient runs for rubber tired gantries (RTGs). For the Semi-Automated and Fully Automated modes the container yard will consist of 10 wide, 5 high rows of container storage blocks perpendicular to the berths. The number and length of the rows varies depending on the matching handling capacity of the berth. For the Fully Automated operation where unmanned vehicles will transfer containers from the berth to the storage stacks the set back from the berth is greater to accommodate the automated vehicle traffic and holding lanes needed.

Further inland adjacent to the container yard will be a rail intermodal yard for the discharge and loading of containers from railcars. Possible modes of operation include RTG's with groups of 4 tracks under the RTG's or wide-span RMG's where up to 10 tracks can be accommodated under the RMG's. Again, the intermodal yard will be sized to match the capacity of the berths and as a result will require 30,000 to 40,000 feet of working track based on preliminary modeling. The length of the land bank allows for tracks on the order of 5,000 feet long so 6 to 8 working tracks are required.

To support the intermodal operation additional rail car storage tracks and tracks for the arrival and departure of trains is needed. Trains up to 12,000 feet long are expected to arrive and depart the facility. As a result, exiting from the CN main line to the south three arrival/departure interchange tracks are provided that are over 12,000 feet in length. To accommodate this train length within the land bank the track must begin at one end of the site and wrap back around across the site twice. Three tracks are provided in total assuming only one rail carrier will arrive and depart trains. This is one track for arrival, one for departure and one for the power set to run around. A second rail carrier may require two more tracks as they can share the run around. These interchange tracks will cross Marie-Victorin Blvd. to the west where as a result of the high volume and slow speed of rail traffic an overpass will be needed for the roadway.

Once trains are arrived they will be cut into working lengths and stored on the storage tracks or if space is free placed directly into the intermodal yard. Once unloaded and reloaded, the trains will be pulled from the intermodal yard and stored on storage tracks until ready to be part of an outbound train on the departure tracks. Based upon an average car dwell time of 36 hours a total of about 100,000 feet of storage track is required based on the expected volume of rail traffic generated by the berth capacity.

The final major terminal component is the truck gate where arriving and departing trucks are processed. Each terminal will have its own stand alone truck gate. The inbound gates will include OCR (optical character recognition) portals where containers are first identified followed by a process area where truckers link with remotely located clerks to process their transactions. The outbound gates will include an OCR to confirm the truck and container match. The number of lanes for each is based on the truck volumes generated by the berth throughput capacity.

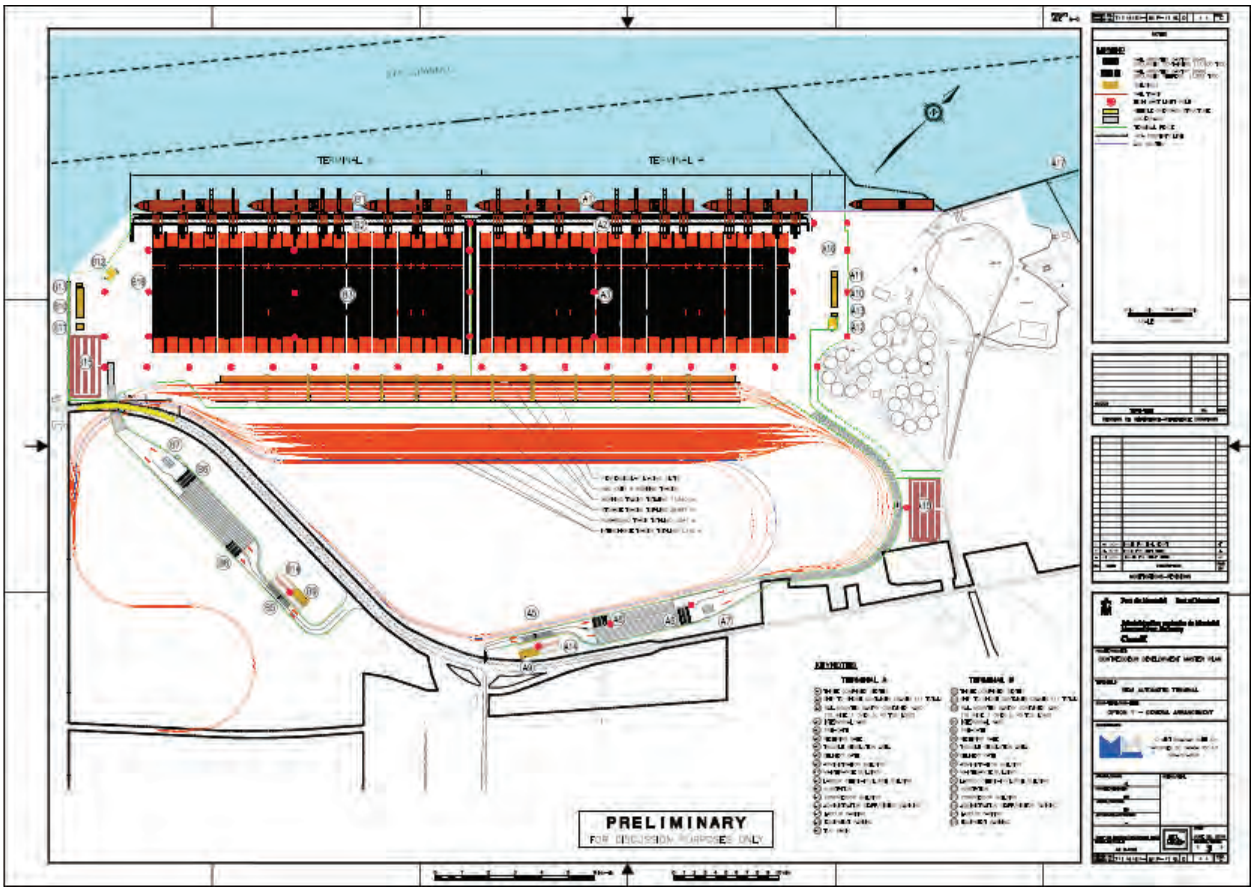
Once trucks pass the in gate for the Conventional operation they will enter the container yard and go directly to the stack where they will receive or drop off their container. In the yard, trucks and yard equipment will mix. For the Semi-Automated operations trucks go to the inland end of the perpendicular stacks and back in. There the automated RMGs will deliver the container with final load or discharge executed by a remote operator who will only perform that task before setting the machine on automatic again. For the Fully Automated operation the same applies but as the inland end of the container stack will also have automated vehicles transferring containers to and from the intermodal yard so the trucks can't go there either. As a result, a truck interchange area is needed at the end of each terminal. This area will consist of buffer container stacks fed by automated vehicles on one side and trucks on the other with RMGs moving containers between vehicles and the stack.

For the downstream terminal the truck gates can be located near the dry bulk terminal or adjacent Marie-Victorin Blvd. For the upstream terminal the truck gates have been located adjacent Marie-Victorin Blvd. but south of the roadway since to the north there is not sufficient space due to the proposed rail yards. Thus an underpass below Marie-Victorin Blvd. is required.

Through review of the options the preferred terminal plans included a Conventional and Semi-Automated operation as shown on Drawings 7149-MP-14 and 7146-MP-16 enclosed in Appendix A.

MPA has selected the semi-automated option, as depicted in Figure 1-1 below and appended drawing 7146-MP-16, for advanced engineering and cost studies.

Figure 1-1: Preferred Semi-Automated Terminal Option



Conceptual locations and footprints of the features described above are shown on the preferred full build out plans along with ancillary facilities for each terminal including administration buildings, maintenance shops, electrical substations, staff and labour parking and areas for equipment parking.

Based on computer models that reflect the expected physical, market and productivity parameters of the terminals the estimated practical capacity of the Conventional and Semi-Automated terminals shown on the preferred plans that include 22 berth cranes will be 3,420,000 TEUs per annum and 3,690,000 TEUs per annum, respectively. The Semi-Automated terminal attains a higher capacity through the use of the automated operations and a manned shuttle carrier operation at the berth as opposed to terminal tractors and bombcarts.

Clearly, these container throughput volumes of over 3 million TEUs per year will provide sufficient capacity for the near-term future and as a result it is expected that berths and associated upland facilities will be constructed in phases to meet market demands. As a result, initial phase plans, and their estimated capacities, have been developed as follows:

- Phase A: One berth with 4 berth cranes and annual throughput capacity of 430,000 TEUs per annum for a Conventional operation and 470,000 TEUs per annum for a Semi-Automated operation.

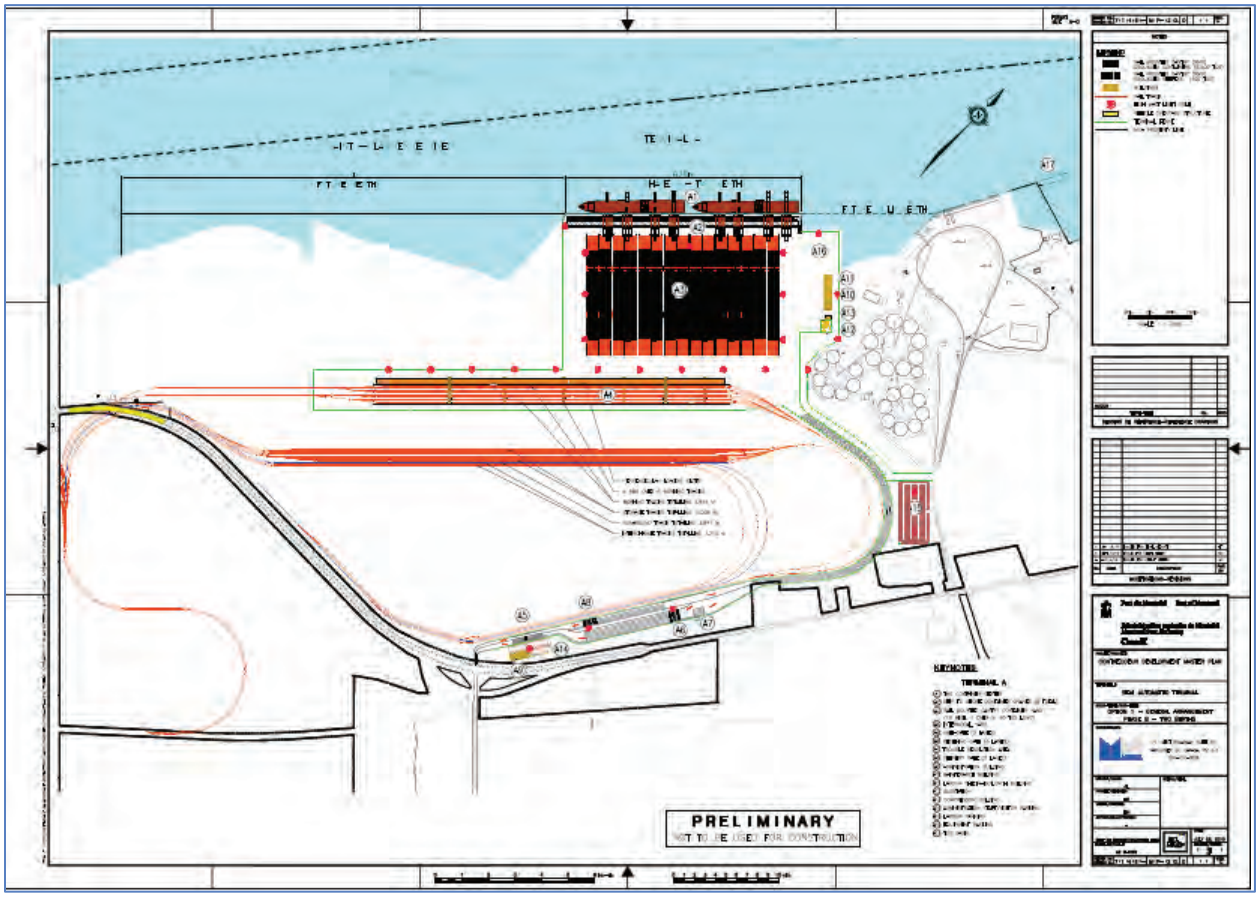
- Phase A-2: Two berths with 5 berth cranes and annual throughput capacity of 430,000 TEUs per annum for a Conventional operation and 470,000 TEUs per annum for a Semi-Automated operation. As such the terminal infrastructure works include only the second berth extension and backlands fill.
- Phase B: Two berths with 8 berth cranes and annual throughput capacity of 1,050,000 TEUs per annum for a Conventional operation and 1,140,000 TEUs per annum for a Semi-Automated operation. As such the terminal infrastructure works include the CY, IY and gate improvements related to the second berth extension from Phase A-2.

The following drawings in Appendix A show the initial phases of development for the Conventional and Semi-Automated terminal options at Contrecoeur:

- Drawing 7146-MP-20: Conventional Terminal Phase A;
- Drawing 7146-MP-20B: Conventional Terminal Phase A2;
- Drawing 7146-MP-21: Conventional Terminal Phase B;
- Drawing 7146-MP-22: Semi Automated Terminal Phase A;
- Drawing 7146-MP-22B: Semi Automated Terminal Phase A2; and,
- Drawing 7146-MP-23: Semi Automated Terminal Phase B.

Since MPA has selected the Semi-Automated terminal option, and to build a two-berth initial development, Figure 1-2 below and Appended Drawing 7146-MP-23 depict the preferred initial construction project.

Figure 1-2: Semi-Automated Terminal Initial Phase 1A



All of the above noted plans consist of sub-sets of full build out plans beginning at the downstream end of the development as if they were infrastructure modules where one berth module can be added when market demand dictates additional capacity is needed. This minimizes costs associated with relocation or throw-away of facilities.

Since these phases are expected to be constructed first, and provide substantial capacity to the port their initial capital construction costs and container handling equipment procurement costs have been estimated and are summarized in the following tables.

Table 1-1: Terminal Infrastructure Cost Estimate Summary

ESTIMATED COST				
Scenario	**Conventional Terminal**	**Conventional Terminal Entry**	**Semi-Automated Terminal**	**Semi-Automated Terminal Entry**
Phase A	$233,000,000		$226,000,000	
Phase A-2	$85,000,000		$85,000,000	
Phase B	$70,000,000		$71,000,000	
TOTAL	**$388,000,000**	**$67,000,000**	**$382,000,000**	**$68,000,000**
	$455,000,000		**$450,000,000**	

Separate Entry Costs are provided for each terminal operation since these costs are not within the terminal boundary and thus are not considered directly attributable to terminal development. These include offsite road and rail improvements, as well an allowance for environmental habitat compensation.

Table 1-2: Summary of Equipment Cost Estimates

Conventional Terminal A – Phase A	$69,500,000
Conventional Terminal A – Phase B (Phase A + B, Total)	$71,700,000 ($141,200,000)
Semi-Automated Terminal A – Phase A	$92,400,000
Semi-Automated Terminal A – Phase B (Phase A + B, Total)	$107,900,000 ($200,300,000)

It is estimated that following environmental studies and the securing of necessary regulatory permits the engineering design and construction of Phase A and A2 will be approximately 40 months. The construction of the Phase B back lands that are expected to follow some years later will require an estimated 13 months to construct.

As with any major construction project there are inherent risks although if properly identified, steps can be taken to mitigate the risk. Some of the major risks for the Contrecoeur development include:

- The need for substantial environmental permits to disrupt a relatively green field natural site. Lengthy permits can delay schedules and add project cost;
- The site is currently serviced by only one Class I railway (CN rail). This may deter shipping lines who prefer that at least two railways to be able serve their traffic in order to add in reliability and reduce cost through competition;
- Opposition from the local community to a new larger port complex with associated truck and rail track is likely. This in turn can delay schedules and add cost through the permitting process;

- Quotes for the extensive dredging had a broad range as local fleet is limited. Final prices may be substantially higher than anticipated adding cost to the project;
- The cost of container handling equipment and the steel sheet piling for the wharf are dependent on steel prices as a result of their high steel content and exchange rates as these items are generally priced in US dollars or Euros. Rising steel prices and a lower Canadian dollar will add cost; and,
- To date only limited geotechnical investigations have been undertaken. As the project infrastructure design is highly dependent on the existing ground conditions, varying conditions can add time and cost to the project.

Recommended next steps for the project should include:

- A detailed financial assessment of the project to confirm financial feasibility to both the MPA and potential operators;
- Additional discussions with dredge industry to confirm the planning budgets, particularly in regard to use of foreign equipment.
- Preliminary discussions with regulators to set the framework for environmental studies and permits;
- Discussions with the Class 1 railways to review and develop the rail service to the facility; and
- Continue to review through simulation, financial modeling and discussions with operators the preferred mode of terminal operation.

2.0 INTRODUCTION

This report was originally submitted to the Montreal Port Authority (MPA) in January 2011. Subsequent to this, additional site investigations were commissioned by MPA, specifically addressing dredging and disposal of dredged material. The reports associated with these new investigations are appended hereto. This updated report incorporates the findings of the new reports.

In 2007 the Montreal Port Authority (MPA) completed its ten year master plan that included a series of upgrades to their existing international container terminals at Racine, Maisonneuve and Cast in order to provide 2,000,000 TEUs per annum of throughput capacity. In addition, the master plan reviewed alternatives for accommodating growth beyond this threshold. This included a conceptual review of new container handling facilities at the Port's land bank and existing port facilities at Contrecoeur; some 30 kilometres upstream from the current container terminals.

With a rebound in container volumes following the global financial crisis of 2008 and 2009, in 2010 the Montreal Port Authority retained port consultants, Moffatt & Nichol, to prepare a comprehensive development master plan for further development at Contrecoeur. The primary mandate given included:

- Prepare development master plans for two 3 berth container terminals and one additional dry bulk terminal berth;
- Review alternative container handling modes of operation;
- Select a preferred wharf alignment for the 7 berths;
- Review river dredge requirements and dredgeate disposal options;
- Examine alternative wharf construction methodologies;
- Review river water level and current impacts resulting from new construction;
- Prepare off-site road and rail operating and infrastructure requirements;
- Develop initial phase plans for 1 berth and 2 berth container terminal facilities;
- Prepare preliminary infrastructure plans and associated capital cost estimates;
- Estimate container handling equipment needs and associated procurement costs;
- Develop project design and construction schedules; and,
- Review project risks and mitigation recommendations.

The Contrecoeur land bank is a large area bounded to the north by the St. Lawrence River. It is located in a relatively rural setting but there does presently exist nearby large heavy industrial facilities. Current port facilities at Contrecoeur include two dry bulk berths and associated storage areas used primarily for the import of iron ore for a nearby steel plant along with aggregate production facilities. Despite these port facilities, the vast majority of the Contrecoeur land bank is farm land or forest.

3.0 OPPORTUNITIES AND CONSTRAINTS

Provided in Appendix A is M&N Drawing No. 7146-MP-2 that provides an Opportunities and Constraints Map for the land bank at Contrecoeur as well as an overall aerial view of the region.

In preparing this map an analysis was prepared of major attributes of the land bank that present opportunities for port development with a focus on container handling along with a review of constraints, or boundaries, that may limit or direct the course of development. This important analysis allows planners and stakeholders the opportunity to clearly understand the key issues impacting development of new port terminals at an early enough stage so that issues can be mitigated, or possibly eliminated, through careful planning and conceptual design. The opportunities and constraints primarily focus of physical or legal features of the site such as property boundaries, major roadway or rail lines, shipping channels, large physical obstructions, etc. Minor attributes which may simply impact costs but not the development plan itself, are not highlighted. On this basis, the map provided has key opportunities presented in blue while constraints are highlighted in yellow.

The area under review is the Port's land bank at Contrecoeur which at present provides more than 468 hectares of relatively flat land for port development. As a result it was seen that there are few constraints to development with the exception of legal and physical boundaries to the east, west and south. However, between these limits there are large flat tracts of land available.

As a result, the key site opportunities include:

- Location along the banks of the St. Lawrence River and its deep water shipping channel;
- Availability of large tracts of undeveloped flat land owned by the MPA;
- A nearby rail main line; and,
- A major highway less than 1 km away with direct access to the land bank.

As stated earlier the property boundaries to the east, west and south will limit the size of port development along with the location of the existing dry bulk terminal. In addition, the alignment of Marie-Victorin Blvd., especially at the west end of the site, can impact terminal depth and layout, but roadway re-alignment may be an option. Remaining constraints noted in the river are a matter of dredging which is a function of cost, although these could be significant so they were noted.

As a result, it is the conclusion that the opportunities presented by the Contrecoeur land bank far outweigh the constraints to development.

4.0 WHARF ALIGNMENT AND CONFIGURATION

4.1 WHARF STRUCTURAL TYPES

4.1.1 Introduction

Before proceeding with the selection of the preferred wharf alignment several factors required consideration including wharf structural type, wharf length, dredging requirements and river impacts. Various structural alternatives for construction of the proposed wharf at the Contrecoeur terminal site can be considered. For this exercise three were selected for review including steel sheet pile bulkheads, concrete box caissons and pile supported concrete deck. These three wharf structure types are described and compared regarding their advantages and disadvantages in terms of structural efficiency, constructability, etc. It is recognized that preferences for one concept over another are somewhat subjective, involving a wide range of criteria including initial cost, ease of construction, risk, reliability, availability of equipment and materials, environmental footprint, long term operational, maintenance and repair costs, and others. In this case the focus was to identify three solutions offering the best combination of proven technology, robust design, risk mitigation, and cost.

As noted, the three common structural configurations considered for the proposed wharf at Contrecoeur include:

- Steel Sheet Pile (SSP) Bulkheads;
- Pile and Deck; and,
- Concrete Caissons.

4.1.2 Soil Conditions

When comparing the various structures, consideration of the local geotechnical conditions is critical, as these soil conditions fundamentally influence the configurations for each structure type. For the Contrecoeur site, the upper layers of soil consist of a stiff silty clay (Leda Clay) extending from the surface to a depth of approximately -14.5 m GSC datum. Although the Leda clays are very stiff in their natural undisturbed state, they are highly sensitive and can experience large reductions in strength when disturbed. The clay is underlain by a sandy till layer approximately 13 m thick which extends down to an elevation of approximately -28 m GSC datum. Bedrock lies below the till layer. A detailed report outlining the preliminary soil investigation as reviewed by Golder Associates is provided in Appendix B.

4.1.3 Design Criteria

Some of the fundamental design criteria that affect the design of the various wharf alternatives are provided below for reference. This data has been taken from the M&N Design Criteria document prepared for the Contrecoeur Development Master Plan dated June 1, 2010 and is enclosed in Appendix C.

The daily average river water levels as measured from Geodetic Datum are given in Table 4-1below:

Table 4-1: River Water levels

Max. Water Level (flow of 20,500 cu.m./s)	8.57 metres (200 yr. event)
Mean Water Level (flow of 9500 cu.m/s)	5.17 metres
Min. Water Level (flow of 6650 cu.m/s)	3.88 metres

The necessary deck elevation for the wharf has been set at approximately 5 m above chart datum (+9.5 m GSC). The minimum water depth of the container vessel berths shall be 11.3 meters below Chart Datum (-6.88 meters GSC) with provision for future deepening to 12.0 meters below Chart Datum (-7.58 m GSC). The minimum water depth of the extended bulk berth shall be 10.7 meters below Chart Datum (-6.28 m GSC) or 11.3 m with provision for 12.0 m.

The governing deck loads include the following:

- Uniform Distributed Storage Load (UDL) on the Container Wharf Apron when Simultaneous Container Crane Wheel loads are applied: 60 kPa. (Under this loading scenario, the uniformly distributed storage load need not be applied within 1.5 meters of either side of the landside or waterside crane rails.)
- Container wharf UDL outboard of the waterside crane rail: 24 kPa
- Container Wharf UDL for Long Term Settlement: 10 kPa

Preliminary data for an 80 t “Tandem 40” Container Crane, is as follows:

- Dead weight = 1,870 long tons (1,900 tonnes);
- Rail gauge = 30.48 m (100 ft);
- Lifting capacity = 80 tonnes;
- Truck arrangement = 4 trucks, 8 wheels per truck;
- Distance between wheels at each truck = 1.375 m for Design Case I (minimum), or 1.500 m for Design Case II (maximum);
- Distance between the load centres of the two corners on a rail = 13.3 m for Case I (i.e. 3.675 m gap between centre wheels), or 14.1 m for Case II (i.e. 3.60 m gap between centre wheels);
- Overall length of crane (bumper to bumper) = 27.0 m (Note: this exceeds the commonly used value of 86’6” by about 24”);

Location of stowage pin slot:

- Offset from rail centerline = 415 mm.

Normal Operating Condition:

- Waterside Wheel Load = 115 tonnes (254 kips) per wheel.
- Landside Wheel Load = 90 tonnes (199 kips) per wheel.

Extreme Operating Condition:

- Waterside Wheel Load = 130 tonnes (287 kips) per wheel; and,
- Landside Wheel Load = 105 tonnes (232 kips) per wheel;

Earthquake Condition:

- Waterside Wheel Load = 135 tonnes (298 kips) per wheel; and,
- Landside Wheel Load = 120 tonnes (265 kips) per wheel;

Stowed (Storm Wind) Condition:

- Waterside Wheel Load = 130 tonnes (287 kips) per wheel;
- Landside Wheel Load = 110 tonnes (243 kips) per wheel; and,
- Max. Lateral Load (applied at top of rail) = 18.6 tonnes per wheel.

All of the above loads are unfactored.

In addition to the primary vertical loading given above, the primary lateral loading including vessel berthing and mooring forces for a 5,800 TEU container ship and the seismic loading for the 3 design levels of seismic events can be found in the M&N Design Criteria document.

4.1.4 SSP Bulkhead Alternative

Steel Sheet Pile bulkheads are a form of flexible bulkhead commonly used for wharf construction. The current Contrecoeur bulk terminal consists of a SSP bulkhead. For a bulkhead wall with a large height requirement, H-Z type steel sheet piling is commonly used due to its relatively large bending resistance per tonne of steel. The H-Z pile system consists of a series of specially designed H-piles alternating with standard Z-section pairs. The H-piles are the main supporting members and are typically designed to resist most, if not all, of the expected bending stresses. The intermediate Z-sections act as diaphragms which transmit loads laterally to the H-piles. Since the Z-sections are not used to develop appreciable resistance to bending, they can typically be terminated at a shallower depth than the H-piles. The section modulus of the composite section can be easily optimized by varying the size of either the H-piles and/or the Z-sections.

Despite the large bending resistances provided by the H-Z pile system, tall walls subjected to large lateral forces will also likely need to be anchored. The elevation of the anchors is typically optimized to reduce the bending requirements of the wall while balancing the tension requirements of the anchor system. For waterfront structures, the anchor elevations are typically selected to be as low as possible to reduce bending requirements in the wall, but still allow the anchor system to be constructed above water. Multiple levels of anchors can also be used to decrease wall bending stresses even further, but can be impractical to construct if the lower level of anchors is below the waterline.

Although there are several types of anchor systems, generally the most economical is the deadman anchor system. Deadman anchors may consist of a series of concrete blocks, a continuous concrete wall, pipe piles or another SSP wall, all of which utilize passive earth pressure to resist applied tensile anchor forces. The anchor forces are transmitted through anchor rods which are used to span between the wall and deadman anchors. For the H-Z pile system, the anchor rods are connected through special T-plate connections which are slotted though the inboard flange of the H-pile and bear directly on the internal

flange-to-web interfaces. The distance between the deadman anchors and the main wall is also very important, since the deadman anchors must be located outside the active soil wedge of the main wall in order to provide adequate tensile resistance.

Once the piles have been driven or cut-off at their final elevation, a concrete cope beam is typically cast on top of the piles along the length of the bulkhead. The cope beam is wide enough to accommodate moderate pile misalignment and is used to tie the tops of the piles together, help with load sharing between piles, and provide a smooth berth face to accommodate mooring and berthing hardware.

Construction Sequence

The SSP bulkhead can be constructed before any dredging takes place. Typically a driving frame or template is temporarily erected in the water to align a section of sheet piles for driving. Once the first section of sheet piles have been set, the driving frame can be advanced to install the next section of wall. The soil conditions at the Contrecoeur site should allow for the sheet piles to be vibrated relatively easily. If obstructions are encountered, the H-piles are durable enough to handle large impact forces from an impact hammer and can usually be driven “around” or through an obstruction.

When the SSP bulkhead has been set, the anchor rods and deadman anchors can be installed and backfilled. The cope beam and associated hardware is installed afterwards completing the structure.

Concept Configuration (Drawing No. 7146 – MP – 13)

As indicated from the Design Criteria for the required height of bulkhead wall and the magnitude of the anticipated surcharge loading an Arcelor Mittal HZ1180 HZM type steel sheet piling, or equivalent, will likely be required and the bulkhead wall will need to be tied back with at least one row of deadman anchors. Deadman anchors using driven pipe piles are proposed, since these piles are easily installed and will mobilize the entire passive soil wedge. The deadman piles will be spaced at the same spacing as the bulkhead H-piles. To avoid the active soil zone, the deadman anchors are located approximately 45 to 50 m from the bulkhead.

Due to the relatively weak marine deposits, the H-piles will likely need to be driven down to bedrock to provide both vertical and lateral capacity. To achieve the depth of bedrock the required length of the H-piles will be approximately 36 m. At the top of H-piles, the concrete cope beam accommodates the anchorage of the berthing and mooring hardware along the face of the wharf.

To avoid loading the bulkhead with the crane rail loads, the outboard crane rail will be supported on a pile supported grade beam built in the same fashion as Pile and Deck construction. The inboard rail may be supported on a grade beam designed as a beam on an elastic foundation. However, if the soil settlement under the inboard rail is determined to be too great, the inboard rail will likely need to be pile supported as well in order to reduce settlements and avoid placing displacement loading on the underlying anchor rods which extend past the inboard rail. To reduce differential lateral movement of the crane rails, cast-in place seismic tie beams are used to connect the two rail beams together.

Advantages

- Can be installed more easily relative to the other structure types.
- Median robust construction which is more resistant to ice damage or vessel impacts than Pile and Deck structures.
- Easily repaired.

- Requires the least amount of dredging compared to the other structure types.
- Requires only minimal revetment protection at the dredge line to reduce scour and erosion potential.
- Flexible under seismic events.

Disadvantages

- Flexible SSP walls have less capacity than caissons to resist very large lateral loads and thus the level of safety against massive slope failures will be less.
- Pile installation methods may initiate soil failure in the highly sensitive Leda clay layer.
- Piles will likely need to be driven to bedrock due to the local soil conditions.

4.1.5 Pile and Deck Alternative

The Pile and Deck alternative for the terminal wharf would consist of individual piles supporting a concrete deck superstructure consisting of pile caps, crane rail beams, deck panels and a composite topping slab. The most commonly used pile types for this type of structure are either steel pipe piles, which can be fully or partially filled with concrete; or solid or hollow precast prestressed concrete piles. Traditionally a combination of vertical and batter piles have been used to resist the vertical and horizontal forces applied to the wharf structure. However under seismic loading, batter piles can produce significant shear forces in the pilecaps which can be onerous. To avoid excessively large pilecaps, it is a general practice, especially on the NA West Coast to avoid batter piles and exclusively use vertical piles to resist both vertical and horizontal loads.

To account for the larger construction tolerances for individual piles, the pile caps and crane rail beams typically consist of cast-in-place concrete. The deck panels are usually fabricated as precast prestressed concrete slabs, double-T sections, or box girders. The deck panels usually span perpendicular to the pilecaps and bear on ledges formed on either side of the pilecap. A space is provided between the ends of the deck panels to allow steel reinforcement extending from the precast deck panels and the lower half of the pilecap to be cast in a second pour which forms the top portion of concrete pilecap. Once cured, the deck and pilecaps behave monolithically. The cast-in-place topping slab can be cast either simultaneously with or after the second pilecap pour. The cast-in-place topping slab ties the entire deck structure together as a diaphragm and also can allow for composite bending action between the deck slab and the precast deck panels to help resist vertical loads.

In a pile and deck configuration, the vertical loads are resisted via bending in the crane rail beams and deck slabs which in turn transfer the loads to the pilecaps and then directly into the piles. Horizontal loads acting at the deck level are resisted by frame action resulting from the continuity among the deck, pilecap and piles. Horizontal loads acting directly on the piles such as wave, current or ice loading are resisted by pile bending.

The tips of the piles are typically driven into a competent soil stratum. If bedrock is close to the dredge surface, as is the case with the Contrecoeur site, the piles can be driven down to bedrock and designed as end-bearing. Pending the results of a final geotechnical investigation, it may also be necessary to anchor the piles into the rock to provide sufficient lateral capacity although this is not expected based on preliminary review. Piles can be anchored as either a rock dowel or rock socket. A rock dowel is a steel pile which extends deep into a slightly oversized hole drilled into the bedrock. The annulus

between the pile and hole is fully grouted, thereby providing full anchorage fixity. A rock socket is similar to a rock dowel, but in lieu of extending the steel pile into the drilled hole, a rock socket uses a cast-in-place reinforced concrete core which extends through the steel pipe pile and into the hole thereby providing full anchorage fixity.

Construction Sequence

Any dredging required underneath the wharf footprint will be completed before pile installation. Piles that are driven into soil or set slightly into bedrock are installed with either standard vibration or impact hammers operated from a barge derrick. Piles that are either doweled or socketed into the bedrock will require the use of a drill derrick. Once the piles are set or anchored, placement of the slope protection under the wharf structure may commence.

Once the revetment works are complete, construction of the deck superstructure may begin. Concrete top plugs with extended reinforcement cages will be cast in the heads of each pile. Formwork will be set up to form and pour the concrete pilecaps and crane rail beams around the pile heads. The pilecaps are typically cast in two separate pours. The first pour, includes casting the lower half of the pilecap around the individual pile heads. This not only forms the bottom half of the pilecap, but also provides a bearing surface for seating the precast deck panels. The precast deck panels can then be efficiently erected with barge cranes onto the bottom half of the pile caps. The pilecaps are completed with a second pour which is cast on top of the first pour between the ends of the precast deck panels. The second pour allows the deck and pilecap to act monolithically and achieve the frame action necessary to resist lateral loads. Finally the topping slab is poured tying the entire deck structure together.

Concept Configuration (Drawing No. 7146 – MP – 11)

The sensitivity of the in-situ clay dictates that the majority of the piles should be spaced approximately 5 pile-diameters apart and should be driven open-ended in order to reduce the potential for soil failure caused by disturbances from pile installation.

The preliminary geotechnical review indicates the upper half of the underlying till layer is also relatively weak. Due to the relatively weak marine deposits, the piles will likely need to be designed as end-bearing and driven down to bedrock, but not dowelled or socketed. Preliminary results indicate that 0.914 m diameter steel pipe piles will be required. The piles will be completely filled with reinforced concrete to increase capacity and maintain optimum spacing. The steel pipe will also act as a layer of armour to protect the piles from ice loading and other impacts.

Due to the sensitive nature of the upper clay layer, the finished slopes of the embankment will need to be fairly shallow for stability purposes, in the order of 4H:1V. This implies that the Pile and Deck structure will need to extend well beyond the inboard crane rail beam. Alternatively as shown in Drawing No. 7146-MP-11 of Appendix A, the Pile and Deck structure can be terminated at the inboard crane rail beam and still accommodate a shallow sloped embankment, if a bulkhead wall is used behind the wharf apron to retain the fill in the back-reach area of the yard.

For the Pile and Deck option shown in Drawing No. 7146-MP-11, the main pilecaps span laterally from the wharf face to the inboard crane rail beam and are spaced at 6.096 m (20’) on center. The main pilecaps in turn are supported on piles spaced at 4.7 m (15’-6”).

Outboard and inboard crane rail beams run longitudinally along the length of the container wharf with a rail gauge of 30.48 m (100’). To provide additional support to the outboard crane rail beam, intermediate pilecaps are located along the beam at the midpoint between the main pilecaps. The

outboard crane rail beam is supported on two rows of piles spaced at 4.57 m (15') apart located at each of the main and intermediate pilecaps. The inboard crane rail beam is supported by a single row of piles spaced at 3.048 m (10').

The precast deck panels shown on Drawing No. 7146-MP-11 are approximately 2 m (6') wide and consist of a haunched slab which has a larger thickness at the end support points and a reduced thickness in the middle. T-sections or box girders would also work equally well for the precast deck panels. The deck panels will be fabricated with extended stirrups to allow for composite action with the cast-in-place concrete deck slab.

Advantages

- Pile and Deck configurations require less dredging below the structure than caissons and require less fill behind the structure than SSP Bulkheads.
- Open nature of Pile and Deck structures requires less habitat loss than either caissons or Bulkhead structures.

Disadvantages

- Pile installation methods may initiate soil failure in the highly sensitive Leda clay layer.
- Piles are susceptible to deflections and bending stresses caused by lateral soil movements. Preliminary geotechnical results indicate these soil movements can be very pronounced under the 475-yr and 2475-yr seismic events.
- Less resistant to ice damage or vessel impacts compared to caissons or bulkhead structures.
- The Pile and Deck structure requires full revetment slope protection underneath the deck structure to prevent scour and erosion of the river embankment.
- If piles are required to be anchored to the bedrock to provide lateral stability, associated costs and construction times will increase.
- Pile and Deck structures generally require more maintenance than either caisson or bulkhead structures.
- A short steel sheet pile bulkhead wall behind the inboard crane rail beam is required to accommodate stable embankment slopes under the pile and deck structure.
- Median alternative with respect to the amount of dredging required.

4.1.6 Concrete Caisson Alternative

Precast concrete caissons are a form of gravity-base structure that is well suited for massive waterfront construction. Caissons can be built to heights of 24 m or more; they typically range in length from 30 m to 45 m, and can have widths up to 24 m. They are also typically fabricated with internal compartments, or cells, for purposes of strength and ballast control.

Caissons are placed side-by-side to form the wharf face and provide direct vertical support of the wharf apron. The caissons also act as a large bulkhead structure retaining the backfill behind them and are typically filled with rock material to provide additional stability. The large size and weight of these

structures allows them to inherently resist overturning and sliding. In the past this type of structure was widely used along the St. Lawrence Seaway as well as other parts of Canada and has most recently been used in British Columbia at the Deltaport terminal.

Construction Sequence

Caissons can either be fabricated on site on a barge, or off site in a dry dock. Caissons fabricated in dry docks are generally transported to site by floating and towing the caisson itself or delivering it on a barge.

To provide adequate bearing capacity and reduce soil settlements, a mattress of gravel or crushed rock base material is typically required to help distribute the caisson's large bearing stresses. Depending on the depth to competent soil, this mattress may vary from 1 m to several meters in thickness. The purpose of the mattress is to replace the low strength in-situ material with higher strength engineered materials. Typically excavation and placement of the caisson mattress materials are conducted while the caissons are being fabricated. As the design thickness of the mattress increases, the size of excavation required to accommodate the mattress footprint can become fairly large.

Once the caisson is ready for placement, it is typically floated into position, and seated onto the base mattress. Afterwards the caisson is backfilled (ballasted) with rock material. Due to the difficulties of placing such large structures within a tight tolerance, caissons are typically placed side by side at a certain distance apart to allow for a precast concrete keyway to accommodate imprecise alignment and differential settlement. The panel keyways between the caissons may or may not be subsequently sealed with grout or concrete to prevent washout of the backfill. To finish the overall wharf structure, a cope beam and crane rail beam on top of the caissons are typically cast in place thereby allowing for some additional adjustment for any caisson misalignment.

Concept Configuration (Drawing No. 7146 – MP – 12)

For the Contrecoeur site, the in-situ clay material is too sensitive to be relied upon as a bearing medium for the caissons due to its potential for dramatic loss of strength when disturbed. As a result, the clay material will be required to be excavated down to the till layer and be replaced with engineered fill material. The material will be placed and densified on top of the till layer to provide a 6 m thick mattress upon which the caissons will bear.

The typical caisson dimensions estimated at this early project stage are 14 m high (from the top of base slab to the underside of cope beam) by 40 m long by 17 m wide as indicated on Drawing No. 7146-MP-12 enclosed in Appendix A. Based on the results of the preliminary geotechnical investigation the global stability of the caisson structure under static loading indicates a Factor of Safety (FOS) = 1.8, which is satisfactory. Under the 100-yr and 475-yr seismic events, the anticipated global deformations are relatively small, in the order of 10 mm of less. Under the 2475-yr seismic event, the global deformations are around 50 mm and the FOS for global slope stability is less than 1.0 at 0.5 to 0.7 indicating failure. As a result, extensive ground improvement as discussed earlier is required.

The results of the local stability analysis of the caisson structure indicates the FOS for overturning are equal to 5.0 for static conditions, 3.0 under the 100-yr seismic event, 2.3 under the 475-yr seismic event, and 1.2 for the 2475-yr seismic event. The FOS for sliding failure is equal to 2.7 for static conditions. The anticipated lateral movements of the caissons for the 100-yr and 475-yr seismic events are less than 25 mm. For the 2475-yr seismic event, the lateral movement is estimated to be 100 to 125 mm. These lateral sliding movements are within tolerable limits for this type of structure.

As previously discussed the caissons will be constructed with interior walls, or bulkheads, to provide several internal compartments. A continuous cast-in-place cope beam has been included to help tie adjacent caissons together, retain the layers of fill underlying the asphalt deck surface and provide a smooth berth face to accommodate mooring and berthing hardware. Likewise a cast-in-place crane rail beam has been included to better accommodate the tighter alignment requirements of the crane rails. To reduce differential lateral movement of the crane rails, cast-in place seismic tie beams are used to connect the two rail beams together.

Advantages

- Caissons have the capacity to resist very large lateral and vertical loads. Caissons are the most robust structure type for resisting slope instability and provide a higher level of safety against massive slope failures.
- Robust construction that is more resistant to ice damage or vessel impacts.
- Well suited for areas where bedrock exists fairly close to the dredge surface.
- Only requires minimal toe protection to reduce scour and erosion potential.
- Requires less maintenance than Pile and Deck or Bulkhead structures.
- Easy accommodation of wharf apron services including cold ironing, power pits, etc.

Disadvantages

- If the in-situ soils are of a poor quality as is the case with the Leda clays at the Contrecoeur site, caissons may require a fairly large and deep excavation to prepare a proper mattress sub-base.
- The caisson alternative has the largest dredging requirements of the 3 structure types studied.
- Require adequate land staging areas and/or nearby dry dock facilities.
- For caissons fabricated in a dry dock, the size of the caissons may be limited by the capacity of the dry dock.

4.1.7 Preferred Wharf Structure

A review of the various structural types for the proposed Contrecoeur terminal wharf indicates that all three alternatives are structurally viable. Although each has its advantages and disadvantages, from a structural/geotechnical viewpoint, the preferential order of the various alternatives is as follows:

- SSP Bulkhead;
- Concrete Caissons; and,
- Pile and Deck.

Due to the advantages afforded by the SSP Bulkhead option, it is currently the preferred alternative. Although corrosion is always a consideration for this type of structure, it is less of an issue in fresh water and therefore should be of less concern for the Contrecoeur site.

The caisson alternative represents the most robust structure of the various alternatives; however it also requires the most amount of dredging and fill which will increase initial construction costs. Consideration should be given to a resulting benefit of this extensive dredging which is the removal of the problematic in-situ clays. This will reduce the potential for geotechnical issues such as slope instability and clay sensitivity thereby further enhancing the robust nature of this alternative. Depending on the results of the geotechnical investigations, this alternative has potential and is considered a close runner-up to the preferred SSP Bulkhead alternative.

The Pile and Deck alternative has several disadvantages that make it the least preferable option. As previously discussed some of the more critical disadvantages include susceptibility to ice and impact loads, the need for permanent slopes to remain relatively flat for stability reasons, susceptibility to lateral soil movements in a large seismic event, and the additional requirements for a secondary bulkhead wall structure to retain the fill behind the wharf apron.

4.1.8 Steel Sheet Pile Bulkhead Preliminary Design

As discussed above three structural alternatives have been considered for the proposed Contrecoeur terminal wharf including; a Steel Sheet Pile (SSP) Bulkhead option, a Pile and Deck option and a Concrete Caisson option. The SSP Bulkhead option is preferred due to its advantages as cited in the aforementioned section. As such the objective of this section is to further advance the Steel Sheet Pile (SSP) Bulkhead structural option and verify preliminary sizes based on the preliminary lateral earth pressures derived by the project's geotechnical engineer; Golder Associates.

4.1.8.1 Additional Soil Data

A preliminary geotechnical investigation was conducted by Qualitas, including a borehole and sampling program, to give a general description of soil stratigraphy and develop preliminary soil design parameters. As the project progresses, further borehole and geotechnical analysis will be required to better define the soil profiles and parameters for final design purposes.

As noted earlier for the Contrecoeur site, the existing soils consist of an upper Leda clay layer overlying a sandy till layer which in turn overlies bedrock. Above the Leda clay, an upper layer of granular fill will be placed and compacted to bring the site to finished grade.

The Leda clay layer consists of silty clay which is very stiff in its natural state, but is highly sensitive to disturbances. Under seismic conditions the Leda clay will undergo strain softening and can experience noticeable reductions in strength.

For the till layer, the standard penetration test 'N-values" obtained from the preliminary borehole program were somewhat variable and therefore the lower bound was used to conservatively determine the friction angle.

The unit weights and preliminary shear strength parameters for each soil type as provided by Golder Associates are given in Table 4-2.

Table 4-2: Soil Shear Strength Parameters

Soil Layers	Unit Weight (kN/m^3)	Friction Angle (degrees)	Peak Shear Strength (kPa)
Upper Granular Fill	19	38	--
Leda Clay	17	--	50 to 90 (Static) 25 to 40 (Seismic)
Till	19	36	--

4.1.8.2 Soil Profiles

Several boreholes were drilled to identify the depths of each soil layer along the length of the proposed wharf, and within the terminal backlands. Three of these boreholes are in the vicinity of the wharf structure and are represented by Sections A through C as shown on Drawing No. 7146-MP-7 in Appendix A. Section A is representative of the western end of the overall proposed wharf structure, Section B the middle portion and Section C the eastern end of the wharf (where it meets the existing bulk terminal berth).

Soil profiles for each borehole are given for the SSP Bulkhead option in Sections A through C on Drawing No. 7146-MP-8 of Appendix A. Although the boreholes indicate that for the "green field" site the clay layer exists at the surface, for purposes of the SSP bulkhead analysis, it was assumed the final site grade would be achieved by placing an upper granular fill layer which would extend from the surface down to elevation +2.3 m (Geodetic). The variability of the soil stratigraphy is indicated in Table 4-3 which gives the bottom elevation of each soil layer for Sections A through C.

Table 4-3: Site Soil Profiles

Soil Layer	Section A Geo. Elevation (m)	Section B Geo. Elevation (m)	Section C Geo. Elevation (m)
Upper Granular Fill	+2.3	+2.3	+2.3
Leda Clay	-11.8	-13	-14.5
Till	-20.5	-24	-27.9

In general the clay and till layers become thicker from west to east. The clay thickness varies from near surface to -11.8 m GSC on the west side of the site to -14.5 m GSC on the east side. The till layer thickness varies from 8.7 m in the west to 13.4 m in the east. Correspondingly the till layer and the bedrock are at greater depths on the eastern side of the site than the western side.

4.1.8.3 Sheet Pile Loading Conditions

The preliminary geotechnical investigation by Golder Associates provided lateral earth pressure plots for both static and seismic loading conditions. The seismic load levels considered include the 1/100 year, 1/475 year and 1/2475 year events.

The lateral pressure distributions were computed assuming "undrained" conditions in the clay. Thus the lateral earth pressures in the clay layer were derived using the total stress method (hydrostatic water pressure included in the soil pressure). The clay layer is relatively weak compared to the till and only contributes limited passive resistance in front of the SSP bulkhead wall.

For the granular fill and till layers, the "drained" or effective stress method was used (hydrostatic water pressure calculated separately and added to the lateral earth pressures). Most of the passive resistance in front of the wall is provided by the till layer.

The lateral earth pressure plots were developed assuming the following:

- A surface surcharge load of 60 kPa was used on the deck apron for the static load condition. A surface surcharge load of 24 kPa was used for the three levels of seismic loading.
- The container crane loads will be supported by an independent pile and crane beam structure and will not impart loads to the SSP Bulkhead wall.
- A low water level of +4.42 m was used under static loading conditions and the mean water level of +6.49 m was used under seismic loading.
- Both hydrostatic and seismic hydrodynamic water pressures were given separately and are additive to the given soil pressures (except for the clay layer where it is already included in the earth pressures).
- A factor of safety (FOS) = 2 was included in the passive soil lateral pressures at the toe for the resisting side of the bulkhead wall to account for strain compatibility.
- The sheet piles will be driven some distance into the till layer or to the top of bedrock.
- A 50% degradation of clay strength was assumed under seismic loading (subsequent testing indicates that this could be reduced to 30%).

4.1.8.4 Reduced Water Levels Due To Global Warming

It is estimated that water levels in the St. Lawrence River may drop by as much as 1.0 m, including 0.43m at Contrecoeur, in the coming years due to global warming. Since normal water fluctuations in the St. Lawrence are seasonal, the water levels typically rise and fall over relatively long periods of time. As a result, hydrostatic pressures on either side of the SSP Bulkhead have time to equilibrate. Differential hydrostatic pressures acting on the wall will be minimal. As such, long term water level reduction should have little to no effect on the SSP Bulkhead. Seismically, long term reduction in water levels will be beneficial as this will reduce the hydrodynamic pressures which may act on the wall during a seismic event.

4.1.8.5 SSP Bulkhead Analysis

A preliminary SSP bulkhead analysis was conducted using PROSHEET Version 2. The lateral earth pressures for the static condition and the three levels of seismic loading conditions were analyzed for Sections A, B and C.

In addition to the lateral earth pressures, the sheet pile analysis included a concentrated force of 40 kN/m applied to the top of the bulkhead wall for the static loading condition. This equivalent line

load conservatively represents a mooring load of 1000 kN applied on bollards spaced at 25 m. The top of piles (deck elevation) was taken as +9.5 m geodetic and the dredge line was taken as -7.58 m geodetic.

The following factors of safety were used in the sheet pile analysis:

- Sheet Pile Modulus (Static): 1.5
- Sheet Pile Modulus (Seismic): 1.0
- Tie Rod Yielding (Static): 1.3
- Tie Rod Yielding (Seismic): 1.0

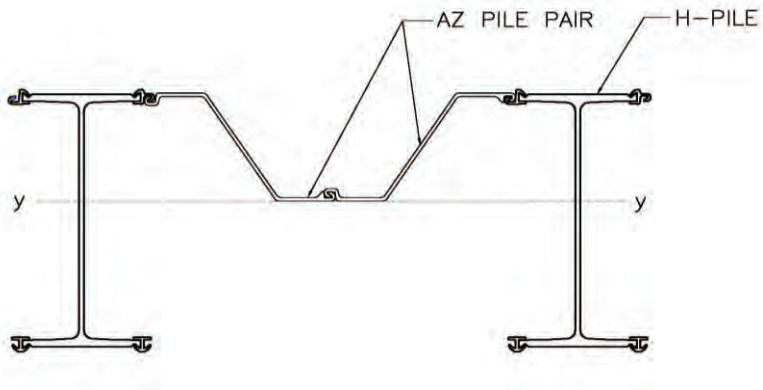
4.1.8.6 Analysis Results

Based on the preliminary geotechnical investigation and structural analysis, the greater depth of the till layer on the eastern side of the site increases the structural requirements of the SSP wall for both the static and seismic loading conditions. The analysis indicates the lower depth of the competent till strata on the east side of the site causes increased shear and moment loads in the wall section, deeper embedment requirements and an increase in tie rod forces as compared to the western side of the site.

Overall, the analysis indicates that the higher seismic events are more critical than the static condition resulting in larger SSP profiles, embedment depths and anchorage requirements for each correspondingly larger seismic event level. These structural premiums are further exacerbated on the eastern side of the site (Section C) due to the effects of the deep competent till layer.

Due to the large height requirements of the Contrecoeur terminal, an H-Z type steel sheet piling system is proposed. Figure 4-1 illustrates a typical H-Z pile system. The H-piles are the main supporting members and are typically designed to resist most, if not all, of the expected bending stresses. The intermediate Z-piles act as diaphragms which transmit loads laterally to the H-piles. Since the Z-piles are not used to develop appreciable resistance to bending, they can typically be terminated at a shallower depth than the H-piles. The H-Z pile system is more structurally efficient than other SSP systems due to its relatively large bending resistance per tonne of steel.

Figure 4-1: "Single" HZ Pile System



For more extreme loading conditions a “double” H-Z pile system can be used as illustrated in Figure 4-2. In this system H-piles are placed in pairs which are alternated with standard Z-pile pairs. Since the principal load bearing H-piles are doubled-up, the capacity of the SSP Bulkhead is increased substantially when this system is used. However this system is also more difficult to install than the “single” HZ system and requires more complicated tie-rod connection details.

Figure 4-2: “Double” HZ Pile System

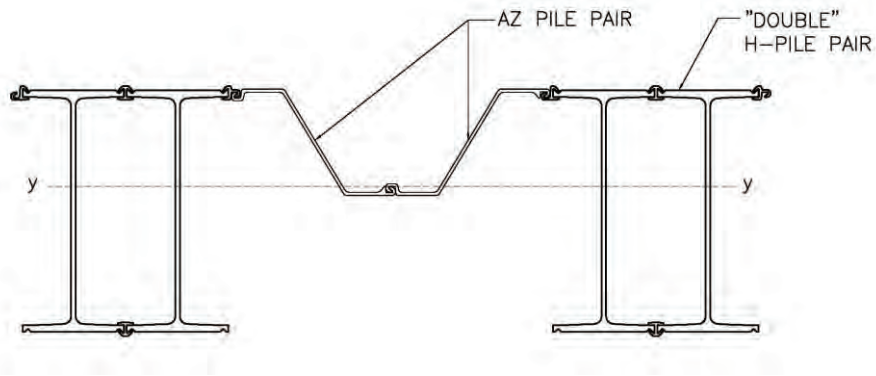


Table 4-4 lists the required H-Z pile sizes for the various soil profile sections and loading conditions. The efficiency of the H-Z pile system can be demonstrated by comparing the weights of the various H-Z piles in the table below to the weight of the basic AZ50 pile section (252.9 kg/m2), which is the heaviest conventional Z-pile available. The weight of the H-Z piles are approximately the same as the AZ50 pile, yet the moment of inertias of the H-Z piles are in the order of 5 to 6 times greater than the AZ50 pile (121,060 cm4/m). The H-Z system provides a much stronger and stiffer section for approximately the same amount of steel.

Table 4-4: Required HZ Sections

Section	Required HZ Section	Required Modulus (cm^3/m)	Weight of Section (kg/m^2)	Moment of Inertia of Section (cm^4/m)
Static Loading Conditions (60 kPa Surcharge)				
A	HZ 1080M / A26-700	10,207	288.2	590,125
B	HZ 1180M / A26-700	11,717	312.8	658,960
C	HZ 1180M / A26-700	11,979	319.4	683,056
1/100 Seismic Loading Conditions (24 kPa Surcharge)				
A & B	HZ 1080M / A26-700	9,498	271.4	549,987
C	HZ 1180M / A26-700	12,114	319.4	683,056
1/475 Seismic Loading Conditions (24 kPa Surcharge)				
A & B	HZ 1180M / A26-700	12,696	335.9	736,273
C	Double HZ 1180M / A26-700	15,336	415.4	928,786
1/2475 Seismic Loading Conditions (24 kPa Surcharge)				
A & B	HZ 1180M / A26-700	13,740	345.6	762,104
C	Double HZ 1180M / A26-700	18,105	448.8	1,035,302

Details of the SSP bulkhead wall for the two extreme loading conditions (static and the 1/2475 yr seismic event) are summarized below. The elevations are given with respect to Geodetic datum. The requirements for the 1/100 yr and 1/475 yr seismic event levels will be intermediate of the ones given.

Static Loading Conditions (60 kPa UDL) (Sections A, B and C)

- Required SSP Section Mod: 11,979 cm^3/m (223 in^3/ft)
- SSP Profile: Arcelor Mittal HZ 1180 with AZ 26-700
- SSP Embedment Elev.:-24 m
- Tie Rod Diameter: 63.5 mm
- Tie Rod / Anchor Spacing: 1.927 m
- Tie Rod Elevation: +7.0 m (Sec. A & B); +5.0 m (Sec. C)
- Anchor Pile: 914x25 mm Pipe (Sec. A & B); 1219x25 mm Pipe (Sec. C)
- Anchor Pile Tip Elev.: -5.0 m (Sec. A & B); -7.0 m (Sec. C)

Seismic Conditions (1/2475 yr event) (Sections A and B)

- Required SSP Section Mod: 13,740 cm^3/m (256 in^3/ft)
- SSP Profile: Arcelor Mittal HZ 1180 with AZ 26-700

- SSP Embedment Elev.: -24 m (Top of Bedrock)
- Tie Rod Diameter: 75 mm
- Tie Rod / Anchor Spacing: 1.927 m
- Tie Rod Elevation: +5.0 m
- Anchor Pile: 914 mm X 25 mm Pipe
- Anchor Pile Tip Elev.: -8.0 m

Seismic Conditions (1/2475 yr event) (Section C)

- Required SSP Section Mod: 18,105 cm^3/m (337 in^3/ft)
- SSP Profile: Arcelor Mittal "Double" HZ 1180 with AZ 26-700
- SSP Embedment Elev.:-28 m (Top of Bedrock)
- Tie Rod Diameter: 88.9 mm
- Tie Rod / Anchor Spacing: 2.398 m
- Tie Rod Elevation: +5.0 m
- Anchor Pile: 1219 mm X 28 mm Pipe
- Anchor Pile Tip Elev.: -10.0 m

Common to all the above configurations, the concrete cope beam cast on the pile tops will be approximately 1.75 m high and 2.0 m wide to allow for pile placement tolerances. At the bollard locations the cope beam can be made wider (approximately 2.5 m in width) to accommodate the bollards themselves as well as the higher torsion forces in the beam from the mooring line pull.

Deadman anchors using either 914 mm or 1219 mm diameter driven steel pipe piles are proposed since they are relatively easy to install and can be readily aligned with the H-piles in the bulkhead to facilitate the tie-rod connections. The top of the anchor piles was taken as +8.0 m geodetic. To avoid the active soil zone, the anchor piles are located approximately 45 to 50 m from the bulkhead. For the H-Z pile system, the anchor rods are connected through special T-plate connections which are slotted though the inboard flange of the H-pile and bear directly on the internal flange-to-web interfaces.

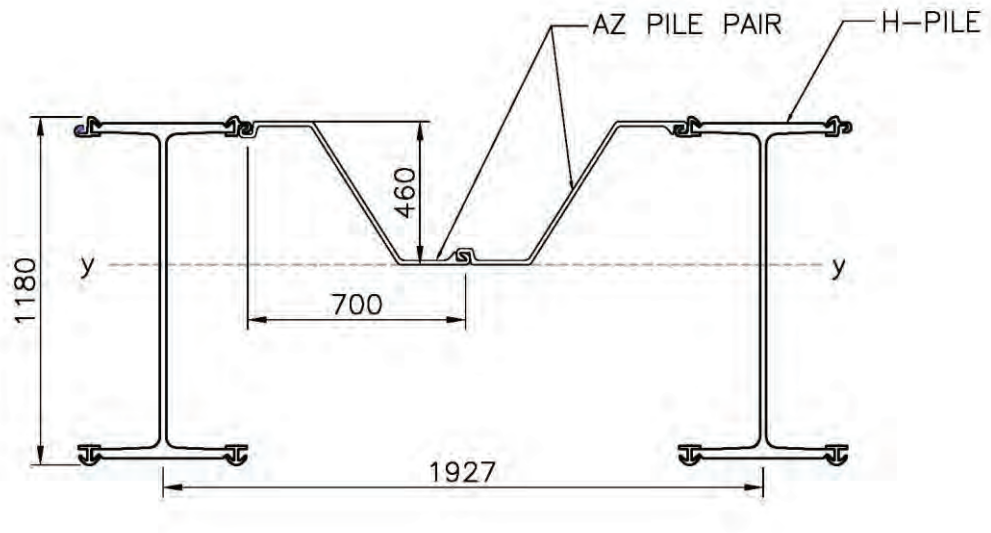
4.1.8.7 Conclusions

A comparison between the bulkhead configurations for static and seismic conditions gives an indication of the structural premium needed to meet seismic requirements. For the majority of the proposed bulkhead structure, as represented by Sections A and B, a "single" H-Z pile system will meet the requirements for both static and seismic loading conditions. However, the seismic conditions do require a 75 mm diameter tie rod located at an elevation of +5.0 m geodetic while the static condition requires only a 63.5 mm diameter tie rod which can be located at an elevation of +7.0 m along most of the SSP wall (Sections A and B). There is a corresponding increase in the size and depth of the pipe pile anchors as well. The elevation of the tie-rods was lowered for the seismic conditions to better optimize the stresses in the sheet piles and keep the profile size to a minimum. However, installation of the tie rods to this depth will be more difficult, as it will require additional excavation and will need to be scheduled during low water conditions.

For the eastern end of the proposed bulkhead structure, represented by Section C, the preliminary analysis indicates that there is a more substantial difference between static and seismic requirements for the bulkhead wall. This is partly due to the effects of the greater depths of the competent till layer in this area. The analysis indicates that for this portion of the wharf structure, a “single” H-Z pile system would not be sufficient for the 1/475 yr and 1/2475 yr seismic events, and that a “double” H-Z pile system may be required. However, it must be emphasized that this analysis is based on preliminary geotechnical data only and is somewhat conservative, since it assumes the SSP bulkhead remains elastic even under the larger seismic loading conditions.

Under the 1/475 yr and 1/2475 yr seismic events, significant damage can be tolerated as long as collapse does not occur. Therefore under these more severe seismic load levels, larger deflections are acceptable and local yielding and plastic behaviour is to be expected. To model the soil-structure interaction and account for the large deflections and yielding of the bulkhead wall under seismic conditions, a preliminary FLAC (Fast Lagrangian Analysis of Continua) analysis was conducted by Golder Associates (see Soil and Steel Sheet Pile Wall Interaction Analysis memorandum by Golder Associates enclosed in Appendix B). The results indicate that the required size of the SSP profile can potentially be reduced by up to 30% for the larger seismic events, since the FLAC analysis can properly characterize the plastic-behaviour of the SSP bulkhead and the potential reduction in lateral pressures due to the correspondingly larger displacements. This implies that a single H-Z pile system will be sufficient for the entire bulkhead structure including Section C even for the higher seismic loading conditions. Based on these observations, the preferred system would consist of “single” H-Z 1180 piles alternating with AZ26-700 piles as manufactured by Arcelor Mital and shown in Figure 4-3. The overall SSP Bulkhead configuration is given in Drawing 7146-MP-13. This configuration is adequate for static load conditions for all three soil profile sections as well as seismic conditions for Sections A and B. This configuration will also likely be adequate for seismic conditions for Section C as confirmed by early FLAC analysis.

Figure 4-3: HZ 1180 with AZ 26-700 Pile Configuration



In summary, the results of this analysis indicate that a SSP Bulkhead structure using the H-Z pile system is viable. For the proposed wharf structure a single H-Z pile system would be adequate to resist both static and seismic loading conditions up to the 1/2475 yr event. It should be noted however, the results of this analysis are based on preliminary geotechnical data. Through more rigorous evaluation and further FLAC analysis the required SSP pile sizes may be able to be reduced even further.

4.2 WHARF LENGTH

The Montreal Port Authority Terms of Reference for the project called for one new dry bulk berth providing for a total dry bulk wharf length of maximum 600 metres long, and roughly 2000 metres of new container wharf providing for 6 new container berths. The planning criteria for the project enclosed in Appendix D notes the following maximum vessel sizes for dry bulk and container vessels respectively:

- Dry Bulk Ship: Maximum LOA – 244 m
- Container Ship: Maximum LOA – 300 m

Table 2-6 of the Handbook of Port and Harbour Engineering by G.P. Tsinker provides recommended spaces between ships and between end of ships and end of mooring structures.

For ships greater than 200 m LOA, Table 2-6 recommends the following for D1, D2 and D3 as indicated below.

- D1 (distance between vessels on straight alignment): 25 metres
- D2 (distance at berth ends): 15 metres
- D3 (distance at berth ends with adjacent angled berth): 20 metres

If these space dimensions are adopted the total new wharf length would be as follows:

1 x 244 m	=	244 m
6 x 300 m	=	1800 m
1 x 15 m (D2)	=	15 m
6 x 25 m (D1)	=	150 m
1 x 20 m (D3)	=	20 m
Total Wharf Length	=	2229 m

As a result, if in a straight line alignment from the existing dry bulk berth 1, the new wharf with one new dry bulk berth and 6 container berths should have a wharf length of 2229 metres. Other lengths maybe required if non-linear alignments are required.

4.3 WHARF ALIGNMENT ALTERNATIVES

4.3.1 Introduction

With data in hand with respect to wharf type and length it is possible to review a variety of wharf alignments. For the master plan a total of four (4) possible wharf alignments for the new Contrecoeur dry bulk terminal wharf extension and new container terminals are examined here. A preferred wharf alignment is then determined based primarily on a review of estimated construction costs. Issues with respect to dredging and river hydraulic impacts are subsequently reviewed to confirm the determination of the final preferred alignment. In order to fairly and comprehensively compare the wharf construction

costs the review includes the costs for three alternative wharf structure configurations (SSP Bulkhead, Pile and Deck and Concrete Caisson), along with related dredging and land reclamation costs.

4.3.2 Description of Wharf Alignment Alternatives

The Contrecoeur development includes a total of approximately 2229 meters of new wharf that will provide about 280 additional meters for a bulk products berth and approximately 1950 meters for six container handling berths. The new bulk berth will start immediately west of the existing dry bulk berth and the six container berths will carry on westward (upstream).

The four wharf alignments reviewed are shown on M&N Drawing No. 7146-MP-3 enclosed in Appendix A.

Wharf Alignment A is positioned so as to be closest to the existing shipping channel and thus represents the in-river limit. The east end of the wharf starts at the existing dry bulk berth and is continuous along its entire length, but with a bend of ±18º at the junction with the existing bulk berth. The west end of the wharf is positioned to provide a minimum clearance of two vessel beam widths between the wharf face and shipping channel. The wharf has a total length of 2229 meters. Wharf Alignment A minimizes the volume of dredging but it has the highest potential hydraulic impact on the river. A summary of the river hydraulic analysis for the different alignments is provided in Section 6.0.

Wharf Alignment B is positioned closer to the foreshore but provides a straight continuous wharf alignment for the two bulk berths. The west end of the wharf is positioned so as to not encroach into the existing foreshore, which could limit the area available for the terminal back lands at the west end near the S-curve of Marie-Victorin Blvd. The east end of the wharf starts at the existing dry bulk berth, continues along this alignment for the new bulk berth, then bends ±18º to provide a continuous alignment for the container berths. An additional 12.5 meters is added to the total wharf length to account for the bend between the dry bulk and container berths. No impact with the existing dry bulk terminal is anticipated.

Wharf Alignment C is positioned along the existing foreshore and thus represents the in-land limit. The west end of the wharf is again positioned so as to not encroach into the existing foreshore. The east end of the wharf starts at the existing dry bulk berth, bends ±18º for the new bulk berth and then bends again ±40º between the new bulk and container berths. Again, an additional 12.5 meters is added to the total wharf length to account for the bend between the dry bulk and container berths. In this case, however, the existing maintenance lot for the dry bulk terminal will need to be relocated to accommodate the eastern end of the wharf. Wharf Alignment C minimizes the volume of land reclamation / imported fill required since it closely follows the existing shoreline, although the dredging volumes are increased compared to the other wharf alignments.

Wharf Alignment D is positioned between Alignments A and B. The east end of the wharf starts at the existing dry bulk berth and is continuous along its entire length, but with a bend of ±16º at the junction with the existing bulk berth. The west end of the wharf is positioned so as to not encroach into the existing foreshore. The wharf has a total length of 2229 meters to accommodate the one new bulk berth and six new container berths. An additional 271 m along the berth face is available within the Port's property to accommodate an additional berth at the far west end if required at some future date. Under no alignment can a full additional 325 m berth be accommodated without crossing the west property limit.

Detailed drawings for each wharf alignment alternative showing vessel berth basin and vessel turning basin are shown on M&N Drawing Nos. 7146-MP-4, -5, -6 and -7 enclosed in Appendix A.

4.3.3 Vessel Manoeuvring / Turning Basin

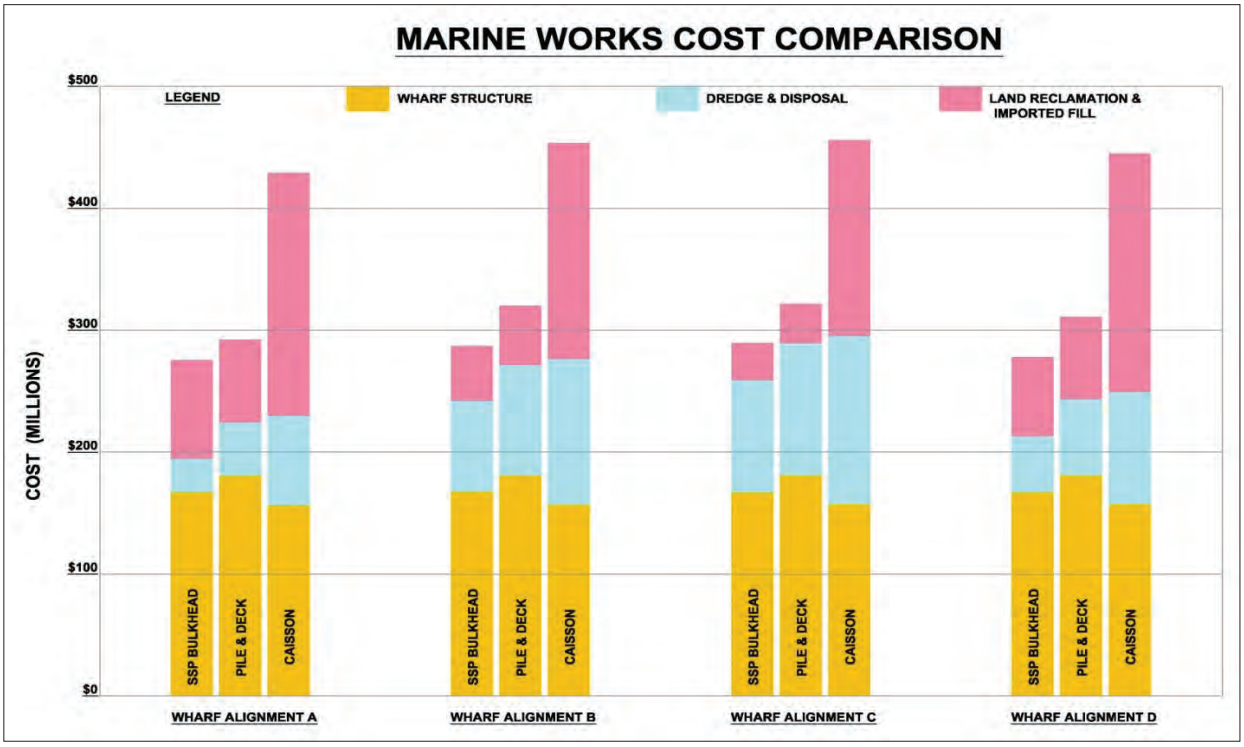
It is anticipated that vessels arriving from the Atlantic will berth portside-to (i.e. bow upstream) directly without having to turn. The MPA has indicated that outbound vessels will likely depart using the natural river current to turn the bow downstream within the channel. Alternatively, outbound vessels could depart and back up with tug assist into a turning basin located within the emergency anchorage basin immediately downstream (east) of the existing bulk berth and then turn around to leave.

Should a turning basin be included it is expected to consist of a turning circle approximately two (2) times LOA or 600 m diameter. Its proposed location has been previously dredged to provide 10.7 m of water depth at low water (or -6.28 GSC), so the turning basin will only require deepening of about 0.6 m or 200,000 cu.m. of dredging. As the river is quite narrow for several kilometres both upstream and downstream of the site, other locations for the turning basin will require substantially more dredging so other sites are not presented. If required, the turning basin assumptions, size, location, etc. are based on general guidelines and should be reviewed with local pilots to confirm vessel manoeuvring around the berths.

4.3.4 Analysis of Wharf Alignment Alternatives

For each wharf alignment the total marine works costs were estimated consisting of the wharf structure as well as the dredging and land reclamation works. These project components are related so all three components are included in the cost analysis to provide a fair and comprehensive comparison of the different wharf alignments. For example, the SSP bulkhead wharf structure requires less dredging compared to the Pile & Deck alternative but the reduced dredging for the SSP bulkhead must be reviewed against its increased imported general fill volumes. The relative quantities of dredging and imported fill not only vary between the different wharf structures but also vary between the different wharf alignment alternatives. All of these various components were analysed and the results of the marine works cost comparison for the wharf alignment alternatives is illustrated in Figure 4-4, Marine Works Cost Comparison.

Figure 4-4: Marine Works Cost Comparison



The total marine works costs do not include the typical upland improvement works such as site utilities (water, drainage), pavements and base gravels, electrical power and lighting, buildings, etc. since these are common costs applicable to all alternatives. Also, the estimates do not include the additional dredging required for the turning basin, which is not expected to be significant, or even required, since it is already located in relatively deep water. These costs estimates are provided to compare relative costs between the wharf alignments and should not be used for budgetary purposes.

A brief description of the unit rates used in the marine works cost estimate is provided below:

- For the wharf structure, a unit rate of $75,000/lin. m. of wharf length was used for SSP Bulkhead; $72,000/lin. m was used for Pile & Deck; and $70,000/lin.m. was used for Concrete Caisson. These unit rates were based on recent detailed engineering estimates and contract pricing for similar structures for Deltaport Berth 3, Vancouver Shipyards, Fairview Container Terminal, East Blair Two Terminal in Tacoma, Pier G in Long Beach and Craney Island in Virginia. Adjustment factors were applied to the reference unit rates based on the limited concept designs and geotechnical analysis completed to date. Also, various unit rates such as cast in place reinforced concrete were checked against recent local engineering estimates and contract pricing (i.e. Maisonneuve Terminal Truck Gate).
- For dredging and disposal a unit rate of $28/cu. m. was used based recent discussions with one large US based marine contractor, one large European based dredge contractor and two Quebec based marine contractors. The rate consists of $16/cu. m. for clamshell dredging (5 cu. m. bucket, including 2 spoil scows and tug assist), $2/cu. m. for mobilization/demobilization and $10/cu. m. for upland disposal (excavator, 5 rock trucks to haul and 1 dozer to spread). It

is noted that other dredging methods (i.e. cutter suction hydraulic dredge) and disposal options may be available and should be investigated at future planning stages. A recent report dated October 2012 was developed to review dredge and dredgeate disposal options including utilizing the material on-site for future development. The rate of unit prices for dredging ranged between $10-20/m3 for clamshell and $6-18 for cutterhead/suction. Additional costs for mobilization were estimated at $1-1.5 million. The mechanical dredging would require additional double handling to transport the material ($10-20/cy). The hydraulic dredgeing would require creation of containment areas and return water ($1.1 million)

- For the land reclamation and imported fill (i.e. sand), a unit rate of $32/cu. m. is used based on recent budgetary quotes from DEMIX's quarry located in Varennes and Sylvain Dube Excavation in L'Assomption. The rate consists of $22/cu. m. for the sand material, $9/cu. m. for hauling and $1/cu. m. for municipal taxes. The total unit rate for imported sand compares to recent contract pricing and previous estimates prepared for MPA. It is noted that no reuse of the dredged silty clay is assumed. For the caisson wharf structure, additional imported fill costs include $70/cu. m. average for the rock mattress, ballast infill and berm, as well as $20/cu. m. for ground improvements (i.e. vibro-compaction) that will be required for the imported fills supporting the caisson.
- The unit rates shown were adjusted to reflect local (Montreal) pricing based on 2009 Canadian dollars.

It is evident from the results of the bar graphs in Figure 4-4 that there are no significant differences in the marine works costs between Wharf Alignment Alternatives A, B, C or D. The estimated marine works costs for the SSP Bulkhead and Pile & Deck wharf structures are roughly $300 Million each and $450 Million for the Caisson wharf structure. The difference is attributed to the significant dredging, land reclamation and ground improvement costs required for the caisson structure based on the preliminary geotechnical recommendations, including dredge depth and dredging slopes.

It is noted that the wharf structure component (orange bars) is consistent between the four alternative alignments. This is expected since for example a caisson structure will cost the same whether it is located near the shipping channel (Alignment A) or near the foreshore (Alignment C). What will vary are the dredging (blue bars) and land reclamation (pink bars) costs. The closer the wharf alignment is to the shipping channel the volume of dredging goes down but conversely the volume of imported fill for land reclamation goes up. The costs for dredging and land reclamation tend to cancel each other out between alignment alternatives and thus the total marine works costs for each wharf structure remain fairly consistent between wharf alignment alternatives.

4.3.5 Preferred Wharf Alignment

As evident in Figure 4-4 a preferred wharf alignment for Contrecoeur cannot easily be determined based on a review of the marine works costs alone since the costs for a particular wharf structure (SSP Bulkhead, Pile & Deck or Caisson) is expected to be similar regardless of the wharf alignment. In this instance a preferred wharf alignment (and wharf structure) should be determined based not only on costs but also on the following parameters:

- Environmental impact;
- Vessel manoeuvring and safety;
- Geotechnical and seismic performance;
- Construction risk and local historical construction biases;
- Impact on upland terminal planning/layout; and,
- Impact on river hydraulics.

For Contrecoeur, significant issues identified to date include geotechnical and seismic performance (i.e. stability of the in-situ silty Leda clay). The wharf alignment that reduces the volume of in-situ material for dredging and disposal is preferred (i.e. Wharf Alignments A or D) since the dredgeate will be waste material and disposal locations are limited. Although Wharf Alignment A requires less dredging, Wharf Alignment D is preferred since it can accommodate a longer future berth to the west (upstream) if required. As such, it is recommended to carry forward Wharf Alignment.

5.0 SITE DREDGING

5.1 INTRODUCTION

The proposed site for the Contrecoeur dry bulk terminal wharf extension and new container terminal is located approximately 30 km downstream from Montreal along the main shipping channel of the St. Lawrence River. Although the site is adjacent to a major shipping channel that has a channel depth of -6.88 m GSC datum (-11.3 m CD) the preferred alignment as discussed in Section 4.3 of the new wharves is located in shallower waters along the southern banks of the river where the water depths are generally at elevation +4.0 m GSC datum. As a result, the river bank and near shore riverbed must be deepened by dredging to achieve the necessary safe water depth for vessels calling the facility.

5.2 DESCRIPTION OF DREDGE ZONE

The preferred wharf alignment will start at the western end of the current dry bulk wharf that is south of the main shipping channel and has a ship berth basin dredged to -6.28 m GSC datum. The new dry bulk wharf extension will begin here and proceed west for 281.5 m. At this point six new container berths with a total length of 1947.5 m will continue west.

The dry bulk berth will have some overlap with the current dry bulk terminal ship basin but will require some deepening. The eastern container berth will require dredging from the current riverbed elevation of roughly +4 m GSC datum at the wharf line down to the stipulated water depth of -6.88 m GSC datum. Dredging in this area will extend north to the shipping channel at -6.88 m GSC. The resulting approximate width of the area to be dredged at the eastern container berth is 250 m. This width tapers down to 80 metres at the west end of the western most berths. As a result, the plan area to be dredged is triangular in shape from a width of roughly 250 m at the east end of the project to 80 m at the west end over a length of approximately 2000 m. In cross section the southern edge of the dredge cut is about 11 metres thick tapering to zero at the northern shipping channel edge. Earlier discussions of including a turning basin stated that the likely operational scenario would be for departing vessels to use the river current to assist the turning operations and use the navigation channel for the turning movements. Additional costs for creating a turning basin were therefore not included.

In addition to the dredging of the ship basin that is necessary to accommodate safe berthing of ships while maintaining safe passage along the adjacent shipping channel, different wharf structural configurations require different degrees of dredging.

A steel sheet pile (SSP) bulkhead wharf does not require any additional dredging south, or shoreward, of the constructed wharf berth line as the sheet piles can be driven into the existing river bed. Dredging for the ship basin would be expected to occur after pile installation. Typical wharf sections showing the extent of dredging is shown on M&N Drawing No. 7146-MP-8 included in Appendix A.

A pile and deck wharf will require a dredged slope to be cut shoreward of the berthing line. Due to the nature of the existing material it is expected that the slope of cut line will be roughly 4H:1V. This results in an additional wedge of dredged material to be taken into account. Typical sections for the pile and deck wharf that indicates the zone to be dredged is shown on Drawing No. 7146-MP-9 enclosed in Appendix A.

The third wharf option reviewed is concrete box caissons. The installation of concrete caissons is expected to require a dredged trench below the wharf so that the wharf can rest on a rock filled

mattress that in turn will bear directly on the underlying sand or till at the site. The slopes of the dredged trench cut will be roughly 3H:1V. These slopes are steeper than for the pile and deck wharf due to their temporary nature. Typical sections for the caisson wharf including the dredged trench, is shown on M&N Drawing No. 7146-MP-10 provided in Appendix A.

5.3 MATERIAL

The primary consideration for any dredging undertaking is the nature of the material to be removed. The type, nature, density, etc. of the material will generally dictate the selection of equipment used to excavate the dredge cut and in turn the production that can be expected from that equipment. As a result, site investigations to determine the classification and properties of the material present are of paramount importance. In addition, the extent of the investigations must be carefully planned to ensure different materials and differing layers and zones of the materials present are delineated.

When conducting site investigations, and subsequent laboratory testing, standard methods and classification systems should be employed so that later when contractors are asked to bid on the dredging works the soils information provided is simple and straightforward to understand and interpret. The result is less risk, and cost, built into contractor bid pricing and minimized potential claims during construction.

Geotechnical data along the preferred wharf alignment, and within the basic dredged area described earlier, was gathered in April 2010 and is preliminary and limited at this time. Three boreholes were drilled along the river foreshore generally along the preferred wharf alignment. One hole is located at approximately each end of the 2000 plus metre wharf and one roughly in the middle. Additional information is provided in a report prepared by LVM in December, 2012 which confirmed the clay layer thickness, groundwater elevations, and potential contaminants.

Within the depth of all of the expected dredge cuts, the site investigation to date indicates the material to be primarily a grey silty clay. The material has a shear strength of roughly 50 to 100 kPa indicating the material to be firm to stiff when in-situ. The exception is the top 2 to 3 metres of foreshore or riverbed excavation where silts and sands are present. The top silts and sands layer is loose to very loose. The clay layer is underlain by medium dense to very dense till consisting of sand, some silt, trace gravel and some pebbles. Bedrock underlies the till. However, dredging of the till and bedrock is not likely required as these layers are encountered well below the stipulated dredge depths except for the caisson wharf where dredging to the till layer is needed.

The grey silty marine clays exhibit high sensitivity and if disturbed from its in-situ state will lose much of its strength due to a breakdown in its structure. Such clays are common in the St. Lawrence lowlands from Kingston to Quebec City and are called Leda clays which is a class of very sensitive natural marine soils in the area noted. The in-situ undisturbed strength can be 20 times that of its remoulded or disturbed strength. In essence, in-situ the clay is quite strong but if mechanically altered via impacts, excavation, etc. the clay can have the consistency of a thick slurry making it difficult to handle and virtually un-useable as structural fill. This presents challenges for both dredging and disposal.

5.4 VOLUMES

The volumes of material to be dredged will vary substantially depending on two primary variable factors as follows:

- The chosen wharf alignment; and,

- The selected wharf structural configuration.

In addition, phasing or staging of the project will determine the volumes to be handled within any given time frame. Table 5-1 as follows provides a summary of estimated in-situ dredge volumes for the entire 7 berth full build out development (excluding turning basin) as shown on the previously noted M&N drawings. The volumes were computed based on the depth and alignment described previously and includes an allowance of 0.6 m for tolerance to accommodate the dredge equipment operational limits.

Table 5-1: Contrecoeur Full Build Out In-Situ Dredge Volumes

	SSP Bulkhead	Pile and Deck	Concrete Caisson
Wharf Alignment A	1,200,000 cu.m.	1,900,000 cu.m.	3,200,000 cu.m.
Wharf Alignment B	3,200,000 cu.m.	3,900,000 cu.m.	5,200,000 cu.m.
Wharf Alignment C	4,000,000 cu.m.	4,700,000 cu.m.	6,000,000 cu.m.
Wharf Alignment D	2,000,000 cu.m.	2,700,000 cu.m.	4,000,000 cu.m.

However, the full build out of 7 berths will be staged over many years extending perhaps into decades. Initial stages will include:

- Stage 1: One Container Berth (eastern most), plus possibly the new dry bulk berth; and,
- Stage 2: Second Container Berth.

The time separation between Stage 1 and 2 may be a year or a few years. However, due to the generally high cost of dredge mobilization in a region that has very limited local marine equipment availability, it will likely be prudent to dredge stage 1 and 2 simultaneously. As a result, Table 5-2 provides estimated dredge volumes to dredge the vessel basin for Stage 1 and 2 noted above.

Table 5-2: Contrecoeur Stage 1 and 2 In-Situ Dredge Volumes

	SSP Bulkhead	Pile and Deck	Concrete Caisson
Wharf Alignment A	600,000 cu.m.	1,000,000 cu.m.	1,500,000 cu.m.
Wharf Alignment B	1,600,000 cu.m.	2,000,000 cu.m.	2,600,000 cu.m.
Wharf Alignment C	2,000,000 cu.m.	2,400,000 cu.m.	3,000,000 cu.m.
Wharf Alignment D	1,000,000 cu.m.	1,400,000 cu.m.	2,000,000 cu.m.

5.5 SITE CONDITIONS

In addition to the areas soil conditions other site conditions will factor into the dredging of the ship basin and foreshore slopes. These include environmental factors such as rain, snow, fog, freezing or hot weather temperatures, wind, etc. along with marine states including river water levels, currents, ice and waves. In addition, on-going shipping traffic and port operations can also have a significant impact on

dredging operations. In addition, sensitive fish/animal species can limit the times when dredging is allowed to occur, either due to impacts in the material placement site or the river. The dredge report prepared in 2012 cites a nearby project restriction that would likely constrain in-water operations between late August and April 1. Ice and inclement weather may further limit some of the open window for a month or so during this period, which results in a total limited length for the in-water dredging of four or five months.

Fortunately, the Contrecoeur site has relatively mild environmental factors that would adversely impact dredging with the exception of some periods of extreme freezing winter temperatures that could disrupt production and cause mechanical failures. Ice in the winter months along with blowing snow may also cause problems and reduce production significantly. Low currents, small waves and stable river water levels are expected and therefore will not have a significant impact on operations or production.

Regular river traffic is present immediately adjacent the site including passing vessels on their way to Montreal and the Great Lakes plus iron ore ships calling the Contrecoeur dry bulk facility. As a result, sufficient markers, navigational aids, Notices to Mariners and Safety Management Plans will be necessary to avoid conflicts and ensure safe navigation for passing ships and safe dredging for the contractor. Regardless, dredging operations in active ports is very common and has been safely and successfully executed throughout the world.

5.6 Dredge Equipment And Methods

Dredging as an activity has been on-going since ancient times. As a result, many different methods and types of dredgers have been developed over the centuries. Regardless, almost every dredger falls into one of two categories; hydraulic or mechanical.

Mechanical dredgers use mechanical means to dislodge and remove material from the dredge cut and often resemble land based excavation equipment. The various types include:

- Clamshell dredge;
- Dragline dredge;
- Dipper dredge;
- Bucket ladder dredge; and,
- Excavator dredge.

These days the two most common types are the clamshell and excavator dredge. Examples of these two types of dredges can be seen in Figure 5-1 and Figure 5-2 below.

Figure 5-1: Typical Clamshell Dredge



Figure 5-2: Typical Excavator Dredge



Generally these two types of dredgers are often used if the excavation to be undertaken requires a greater degree of precision, is located in a tight space, consists of very hard material in the case of the excavator dredge or a higher level of containment in the case of contaminated material, or reduced turbidity is required.

In using these dredgers material is excavated using the buckets whose volume can range from a few cubic metres to over 30. The size of bucket used will depend on the horsepower of the machine, precisions requirements, and the hardness of the material being dredged. Softer material can be

excavated using lighter weight buckets, which allow a larger quantity of material to be removed. Harder material requires heavier and smaller digging surfaces to obtain the pressure needed to break the material apart. Once the material is removed the bucket will generally place the material into a scow or split hull barge. The barge can then be towed to the selected disposal location and be either bottom discharged for in-water placement or offloaded using conventional earth moving equipment. Dredged material can also be partially dewatered on the barge although it is generally quite insoluble as a result of the dredging process itself.

Hydraulic dredgers use a variety of methods to dislodge the dredge material and once dislodged and in suspension in the water column they utilize specialty pumps to remove the material through a pipeline to the surface where it is pumped into hoppers, barges or directly to the disposal location. The primary types of hydraulic dredgers are:

- Cutter suction dredge;
- Trailing suction hopper dredge;
- Dustpan dredge;
- Bucket wheel dredge; and,
- Agitation dredge.

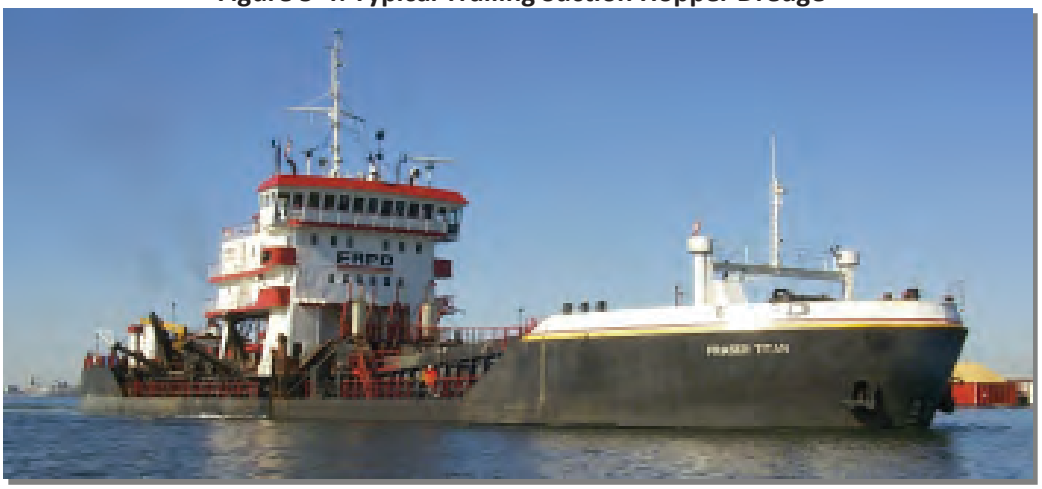
By far the two most common hydraulic dredges are the cutter suction and trailing suction hopper dredge, or TSHD. Examples of these two types of dredges are illustrated in Figure 5-3 and

below.

Figure 5-3: Typical Cutter Suction Dredge



Figure 5-4: Typical Trailing Suction Hopper Dredge



The cutter suction dredge often appears barge like with a wheelhouse and pump house with a large suction pipe and cabled support boom near the bow that can raise and lower the suction pipe to the sea or river bed. At the intake end of the suction pipe is a rotating cutter head that will cut into the dredge material causing it to dislodge and become suspended from where it can then be sucked up to the surface. The dredge is often moved using spuds. Due the strength and rotating ability of the cutter head to cut, these dredges can be used to dredge very hard clays and even bedrock along with loose alluvial deposits. In addition, production rates can be very high and the dredge can pump the material directly to nearby disposal sites through attached floating pipelines.

The TSHD generally appears like a regular ocean going vessel. However, where one would expect cargo holds there is hopper that can hold dredged material. These hoppers can hold a thousand up to and over 30,000 cu. m. of material. On board there is also a large pump house and a long suction pipe that can be lowered from the side of the vessel and dragged along the sea or river bed. At the intake end of the suction pipe is the draghead that will have fixed cutting teeth and waterjets to loosen material and once it is suspended can be sucked up and deposited into the hopper. The vessel can then sail any distance to the placement location and either bottom discharge the material, or pump it off. These type of dredges have the advantage of being able to mobilize anywhere in the world under their own power and can hold and thus transport long distances the dredged material. As the draghead relies only on suction, teeth and waterjets they are often not able to dredge stiff clays, till and bedrock and can only dredge in open spaces where the water depth already exceeds the draft of the ship. In addition, they are limited to working in areas that will accommodate the manoeuvring room for a vessel. These traits make them very efficient for active shipping channels but very limited near berths or obstructions.

In reviewing the type and volume of material to be dredged for Contrecoeur, as well as the site conditions and existing water depths, the cutter suction and excavator dredges are considered most suitable for the project and to a lesser degree a clamshell dredge. A TSHD is not considered suitable due to the strength of the silty marine clays and the shallow water depths although they may have slightly lower cost to mobilize since it may be necessary to mobilize equipment from far afield.

In discussions with dredging contractors the preference when considering the firmness of the clay, water depths and possible volumes of less than 1,000,000 cu. m., is an excavator or clamshell bucket dredge. In addition, such equipment is likely to have a lower mobilization cost including from the US east coast or Europe than a cutter suction dredge. For example, one very large European contractor

estimated a few hundred thousand dollars to mobilize an excavator dredge while $2 million to mobilize a cutter suction dredge.

For a good size excavator or clamshell dredge, production in firm to stiff clays can be expected to be in the range of 200 to 400 cubic metres per hour while a cutter dredge could achieve roughly 750 to 1500 cubic metres per hour. These rates will vary substantially depending on the equipment as there is a large range of equipment available. Dredges would likely work an 18 to 20 hour day, 7 days per week.

Using clamshell or excavator dredges also provides the option of disposing the material further away since the dredges would deposit material into dump scows or split hull barges for transfer to the disposal location. This opens up many possibilities. Meanwhile, a cutter suction dredge will usually dispose of material within range of a floating or underwater pipeline although this can be up to several hundred kilometres if booster pumps are used.

Ultimately, the method and type of equipment used will be left to the contractor. It will be imperative that the MPA provide contractors from whom they will garner pricing as much information as possible about the project including:

- Dredge area/bathymetry;
- Dredge cut sections;
- Estimated dredge volumes;
- Desired schedules;
- Geotechnical investigations and soil classifications (very important);
- Project scheduling;
- Meteorological data;
- River wave, water, current and ice information;
- Vessel traffic data;
- Regulatory permitting conditions;
- Terms of payment; and,
- Disposal location.

5.7 DREDGE PLACEMENT

The preliminary geotechnical data for the material within the expected dredge cut indicates that it is not suitable as structural fill and will definitely not be suitable as immediate fill to raise the terminal site or as backfill behind an SSP bulkhead or caisson wharf. At best, the material may be suitable as fill in a limited fashion after a few to several years of dewatering and consolidation.

As a result, disposal of the expected 600,000 to 3,000,000 cubic metres of material in Stage 1 and 2 will have to be to a location where it can be disposed of, or deposited for several years or more before being re-handled.

Since the material is essentially of little to no benefit to other parties, upland disposal on non-port owned lands is not likely. Investigations in the 2012 report for nearby quarries and use for environmental fill suggested several possibilities, but at some fairly high transport costs. Local farmlands could mix the material with the topsoil for almost immediate use. Ocean disposal may be an option but due to the shallow nature of the St. Lawrence River the nearest possible location may be the Gulf of St. Lawrence some 750 km away, or Lake Ontario some 400 km away. Discussions with Environment Canada, who is the regulatory agency responsible for ocean dumping in Canada, would be necessary to identify a suitable site. In addition, there will be a dumping fee payable to Environment Canada in the order of 49 cents per cubic metre.

The obvious options that appears available at this early stage of the project is upland disposal at Contrecoeur where the Port owns over 486 ha of land, or possibly at the Vickers Basin in Montreal.

For the Contrecoeur option clamshell or excavator dredges would place material onto scow barges. The barges would then be towed to a nearby barge ramp where front end loaders coupled with trucks or maybe conveyors would move the material to bermed cells since the material is expected to be very loose and saturated. One million cubic meters of material would require an area of roughly 50 ha if stockpiled 2 m high. One possible location would be east of the existing dry bulk terminal as shown on M&N Drawing 7146-MP-7 enclosed in Appendix A. Here the material would remain for several years before it could be made suitable as fill for simple works such as agriculture or landscaping.

Alternatively, if a cutter suction dredge is used, the dredge can pump the material directly to the upland cells and with a series of berms and retention ponds the material would be dewatered as it will be a slurry when delivered. This may be a cost effective method particularly if volumes exceed 1 million cubic metres but would require settling basins and a discharge treatment to collect fine grained materials prior to re-entering the river.

The Port has had a desire to fill Vickers Basin for some years. The volume necessary to do so is in the order of 1 million cu.m. After constructing a berm across the entrance of the basin, the Contrecoeur dredge material could be placed in the basin. However, it will be many years before the reclaimed area would be suitable to construct upon and even at that, on-going settlement would be expected. In addition, there is the added cost of towing barges to and from Contrecoeur.

Some material could be used to construct new foreshore habitats, in particular marsh areas, as compensation for the impacts of the project. These habitats may also possibly be “habitat banks” that serve as compensation for future developments in which the area credits are recognized by the regulatory agencies and can be drawn upon in the future against other projects. Generally, foreshore marshes are elevation sensitive so dredged material can be used to raise the elevation of an area. The offshore end is generally supported by a rock berm. Once established the area can be planted under the direction of an aquatic biologist. At this point, without a biophysical survey of the impacted site or any discussions with regulators, it is impossible to determine even broadly what the project compensation may look like and hence how much dredged material could be used. However, it is not expected that it will be so substantial as to eliminate or substantially reduce the need for additional disposal. In addition, due the nature of the Leda clays since they loose substantial strength once handled, they may not even be suitable for even this use. Preliminary discussions with regulatory staff and potential sites in the 2012 Dredge report suggested that there was not an immediate use for habitat enhancement in the area, however, this should be explored further.

5.8 DREDGING CONTRACTORS

Canada's major ports are fortunate as they for the most part require little to no major dredging to maintain their channels and berths. Vancouver, Halifax and Prince Rupert are all natural deep water harbours while Montreal is located on the St. Lawrence River that has a dredged ship channel that requires very little maintenance to maintain water depth. As a result, the annual volume of dredging in Canada is very small compared to the US where annual dredging volumes approach 300 million cubic meters per year.

As a result, Canada's dredge fleet is also not well developed and often large foreign dredge contractors are mobilized for major dredging works. This can be an issue since the Coasting Trade Act restricts the free use of foreign vessels in Canada including dredges. However, this is not to say that they cannot be used. They can if it can be demonstrated that the mobilization of foreign equipment has a significant economic benefit, similar equipment that is necessary to complete the work is not available in Canada and/or local firms do not object to the mobilization of foreign plant. For further confirmation of the provisions of the Coasting Trade Act the MPA should consult its counsel. For the size and complexity of this project, it is expected that foreign equipment may very well be necessary. The relatively low volume of material to be removed (600,000-1,000,000 m3) would likely not entice Canadian contractors from the west coast that maintain most of the harbour facilities in the Vancouver area, however, with significant outreach these dredgers my make that type of investment. Clamshell equipment is typically more available since the equipment can be used for pile driving or other types of work and is more likely to be available on a local basis. Foreign dredges have a disadvantage in that the ownership restrictions generally keep them from preparing meaningful bid participation.

Provided in Table 5-3 below is a partial list of eastern Canadian and prominent US east coast contractors with dredging equipment plus the four very large European Dredging contractors that operate worldwide including Canada.

Table 5-3: List of Select Contractors with Dredging Equipment

Contractor Name	Head Office	Clamsell Dredges	Excavator Dredges	Cutter Suction Dredges	TSHD
McNally	Hamilton, Ontario	5-7	1	1	0
Ocean Construction	Quebec City, Quebec	2	1	0	0
Weeks Marine	Cranford, New jersey	6	0	9	2
Jay Cashman	Quincy, Massachusetts	1	4	0	0
Great Lakes Dredge & Dock	Oak Brook, Illinois	4	1	13	8
Contractor Name	**Head Office**	**Clamsell Dredges**	**Excavator Dredges**	**Cutter Suction Dredges**	**TSHD**
Manson Construction	Seattle, Washington	20	0	3	4
Boskalis	Papendrecht, Netherlands	11	20+	40+	28
Van Oord	Rotterdam, Netherlands	0	7	21	27
DEME	Zwijndrecht, Belgium	0	4	11	14
Jan De Nul	Hofstade-Aalst Belgium	0	5	14	26

5.9 ENVIRONMENTAL CONSIDERATIONS

Environmental assessments and permitting discussions are beyond the current project mandate, but any discussion about dredging would be woefully incomplete if environmental considerations were not mentioned. Environmental considerations with regards to dredging fall into two major categories; the dredging of environmentally contaminated soils and the short and long term environmental impacts of the dredging activity itself. Some of this information was investigated as part of the 2012 Dredge study, including the potential for contaminated soils and the potential for natural resources in the region.

Although Contrecoeur itself is a greenfield site, the foreshore soils may or may not have contaminants. These are generally related to metals concentrations and hydrocarbons. If material is to be ocean

discharged then a Disposal At Sea permit is necessary from Environment Canada. Only clean inert inorganic material may be discharged at sea, unless subaqueous containment can be demonstrated. Regardless, if the material is contaminated it is usually deposited on land and treated depending on the level and type of contamination as well as the final location of the material and its use. The 2012 Geotechnical report included measurement of both bore hole and groundwater samples and states the potential on land for contaminants includes two holes with exceedance levels of manganese and zinc totalling 1400 m3 of soil. The groundwater sampling indicated no floating hydrocarbons and no other chemicals of note. No samples have been analysed of the dredged sediments.

Dredging by its very nature will be disruptive to the sea or river bed resulting in high disturbances of the existing substrate as well as an increase in turbidity in the adjacent water column. This is of concern to regulatory authorities particularly Fisheries and Oceans Canada (DFO). Generally, a DFO authorization along with other permits will be necessary to excavate the sea or river bed and mitigation and/or compensation measures will be required. In addition, measures are also generally necessary to minimize turbidity including the careful selection of dredge methods, provision of silt curtains, operating only during open fisheries windows and careful attention to waste run off from dredged material.

5.10 DREDGING CONCLUSIONS AND NEXT STEPS

The Contrecoeur project will involve a large volume of dredging ranging ultimately from 1.2 to 6 million cubic meters of material, although this volume would be dredged in smaller stages. The material to be dredged is Leda clay; a grey silty marine clay that has significant in-situ strength making the material very stiff but will lose strength once disturbed making it difficult to handle. As a result, the material is not considered suitable as structural fill in the short and long term.

Due to the high volume of this material the project will require careful selection of dredge equipment and disposal method. At this time large excavator/clamshell dredges or cutter suction dredges are considered the preferred choice for excavation. Disposal of the material to nearby port owned uplands is the leading choice at this time for long term disposal. As the Contrecoeur development moves forward the following next steps are recommended:

- Advance further the very preliminary discussions with experienced dredge contractors with regards to material type, volumes, preferred equipment, production rates, daily equipment rates and mobilization costs;
- Test the dredge material for contaminants to determine if upland treatment is necessary and if disposal at sea is an option; and,
- Engage in early discussions with Environment Canada regarding possible disposal at sea locations.
- Continue discussions with Environment Canada to identify either new or existing habitat sites that could accept at least a portion of the material.

6.0 RIVER HYDRAULIC IMPACTS

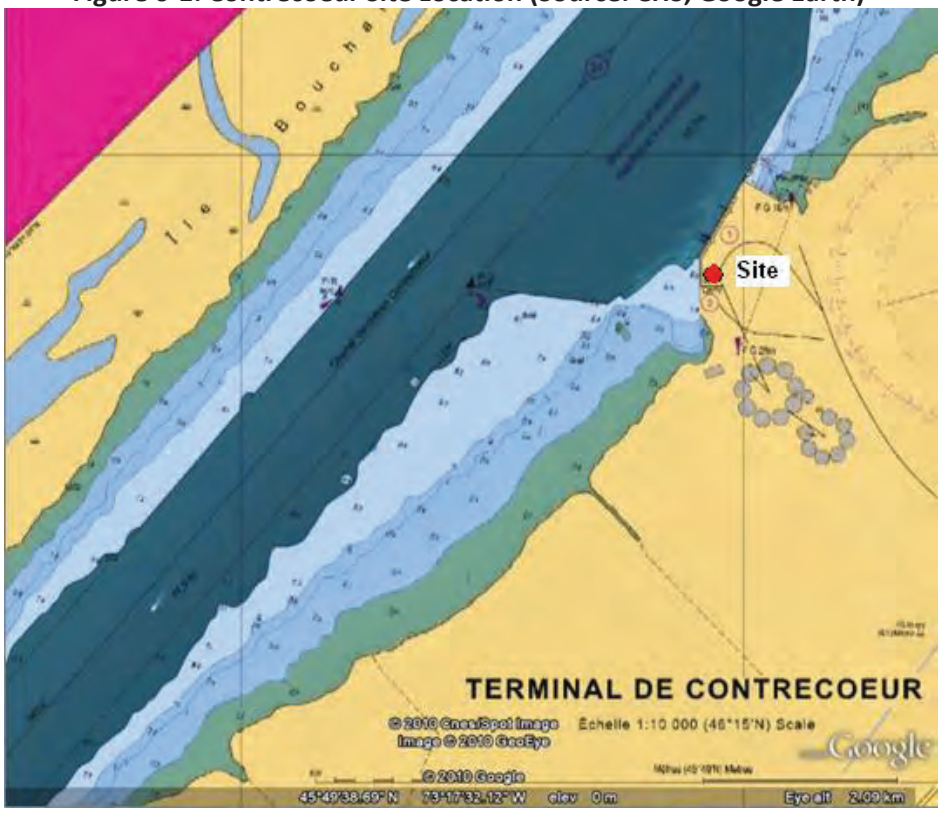
6.1 INTRODUCTION

The construction of over 2000 metres of new wharf in the river along with substantial dredging to provide a deep water ship basin may have impacts to the flow of the St. Lawrence River. To review these potential impacts the MPA retained Mr. Olivier Champoux and Mr. Jean-Francois Cantin of Environment Canada to conduct river hydraulic modelling studies of various wharf types and alignments based on parameters provided by Moffatt & Nichol. Moffatt & Nichol then subsequently reviewed the results to draw conclusions. This modelling has been supplemented with literature review and desktop calculations to support the conclusions presented. The emphasis of the analysis undertaken has been to assess how existing conditions in the river might be affected by the proposed terminal development. In addition, these numerical predictions have been used to define design terminal elevations and slope/scour protection requirements.

6.2 BACKGROUND

The Contrecoeur site is located on the St. Lawrence River near geographic coordinates 45.8309°N, 73.2848°W which corresponds to N321520, E5076810 MTM NAD83 Zone 8. The Canadian Hydrographic Service nautical chart (Chart 1311) of the site is shown superimposed on Google Earth imagery in Figure 6-1. The location of the upstream corner of the existing bulk terminal sheet pile wall is marked consistently as “Site” on all figures and plots presented in this memo.

Figure 6-1: Contrecoeur Site Location (Source: CHS, Google Earth)



6.3 NUMERICAL HYDRAULIC MODELING

6.3.1 Modelling Software

The numerical modelling software used by Environment Canada was developed by the Institute National de la Recherche Scientifique – Eau Terre Environnement (INRS-ETE). The model, H2D2, is a finite element software package that solves the horizontal 2D St. Venant shallow water equations. These equations follow from depth integration of the 3D Navier-Stokes equations after making the assumption that the vertical distribution of pressure is hydrostatic. The St. Venant model consists of the equation for mass conservation and the two equations of momentum conservation for the fluid including terms for friction, Reynolds stress, Coriolis and wind forces.

The software system was used by Environment Canada to develop numerical models of the St. Lawrence River between Montreal and Sorel. Different model grids were constructed to simulate proposed modifications to the river at Contrecoeur to allow their comparison with Environment Canada's model of existing river conditions.

6.3.2 Flow Conditions Simulated

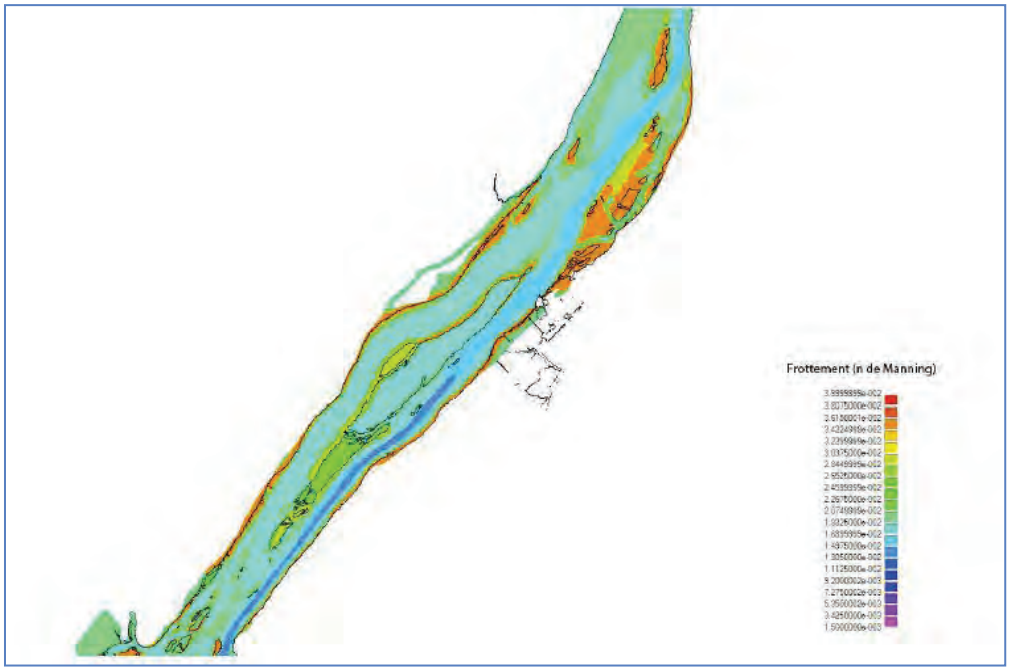
Three river flow conditions were modelled by Environment Canada as summarized in Table 6-1.

Table 6-1: Modelled River Discharge

Flow Condition	Discharge at Sorel (m^3/s)	Description
Low	6,650	minimum flow since 1960
Medium	9,500	mean flow since 1960
High	20,500	Maximum flow since 1960 (approx. 200 year return period)

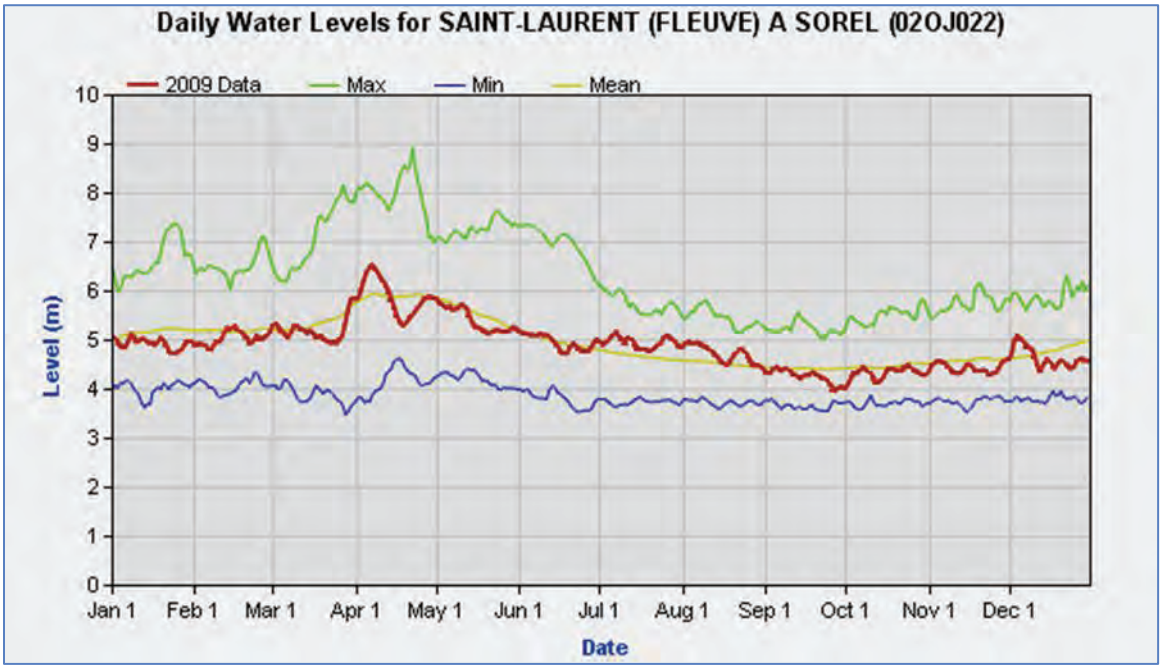
Environment Canada varied Manning's "n" between 0.016 and 0.036 as shown in Figure 6-2 here and as enclosed in Appendix E.

Figure 6-2: Variation of Friction Factor



The annual variation of discharge is reflected in the variation of water level. Figure 6-3 shows the range of historical water levels recorded at Sorel by the Water Survey of Canada (1912 to 2009). The figure shows that the maximum flows are likely to occur mid- to late-April with a minimum flow likely occurring mid-summer through fall.

Figure 6-3: Historical Variation of Measured Water Levels at Sorel (1912-2009)



The effect of each of these flow conditions on water levels and current velocities were simulated in steady-state simulations of the river. The effect of ice-cover on hydraulics was not investigated.

6.3.3 Computational Grids

A series of six-node triangular mesh grids (Table 6-2) were generated by Environment Canada to conduct hydraulic analyses of various berth configurations including pile-supported deck over rock slope, concrete caisson and steel sheet pile berth faces. These meshes reflected the current status of the design at various stages of the project which eventually lead to the preferred alignments that are shown on M&N general arrangement Drawing 7146-MP-4, and 7146-MP-7 enclosed in Appendix A. The preferred alignment is Alignment D as discussed in Section 4.3.

Table 6-2: Computational Grid Summary

EC Archive Name[1]	Nodes	Elements	Description
Mesh_base	344795	170384	Existing conditions
SSP_MESH	314957	154962	Alignment A Buildout
Align2	294011	144538	Alignment D Buildout
ALIGN_E	297426	146183	*Preferred Alignment - Buildout*
AlignE_phase1	348831	134770	*Preferred Alignment – Phase A*
AlignE_phase2	356439	136598	*Preferred Alignment – Phase B*

Notes:
Archive contains two files: *.cor (nodes) and *.ele (topology) along with hydraulic model results.

Figure 6-4 and Figure 6-5 show the existing riverbed geometry as modelled by Environment Canada, and through Figure 6-6 through Figure 6-10 show the post-project riverbed geometries of each of the computational grids listed in Table 6-2; the shoreline shown represents the water's edge at low flow conditions. These figures are also enclosed in Appendix E.

Figure 6-4: Extent of Model Domain - Depths at Low Flow (Summer)

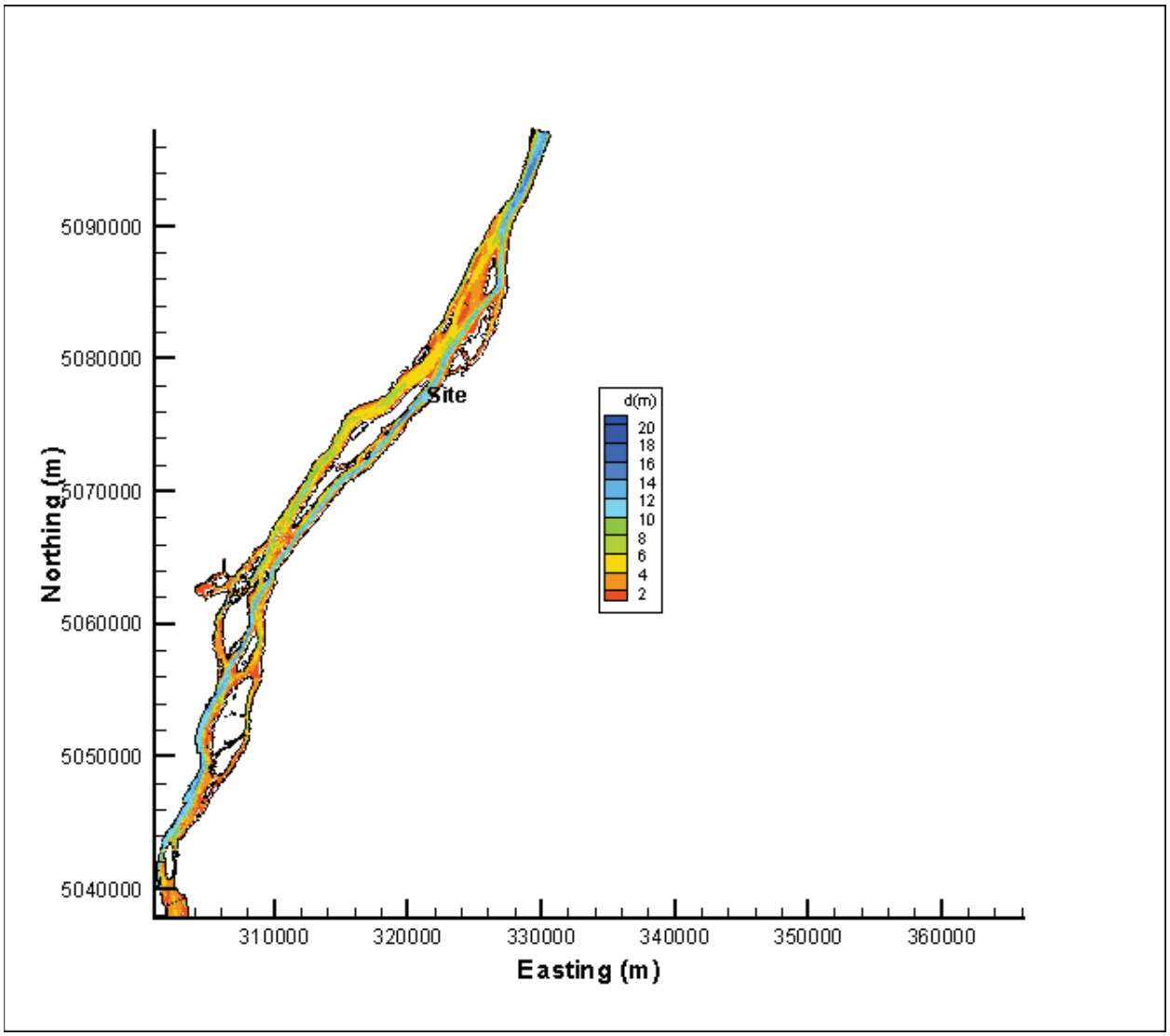


Figure 6-5: Existing Conditions Grid - Depths at Low Flow (Summer)

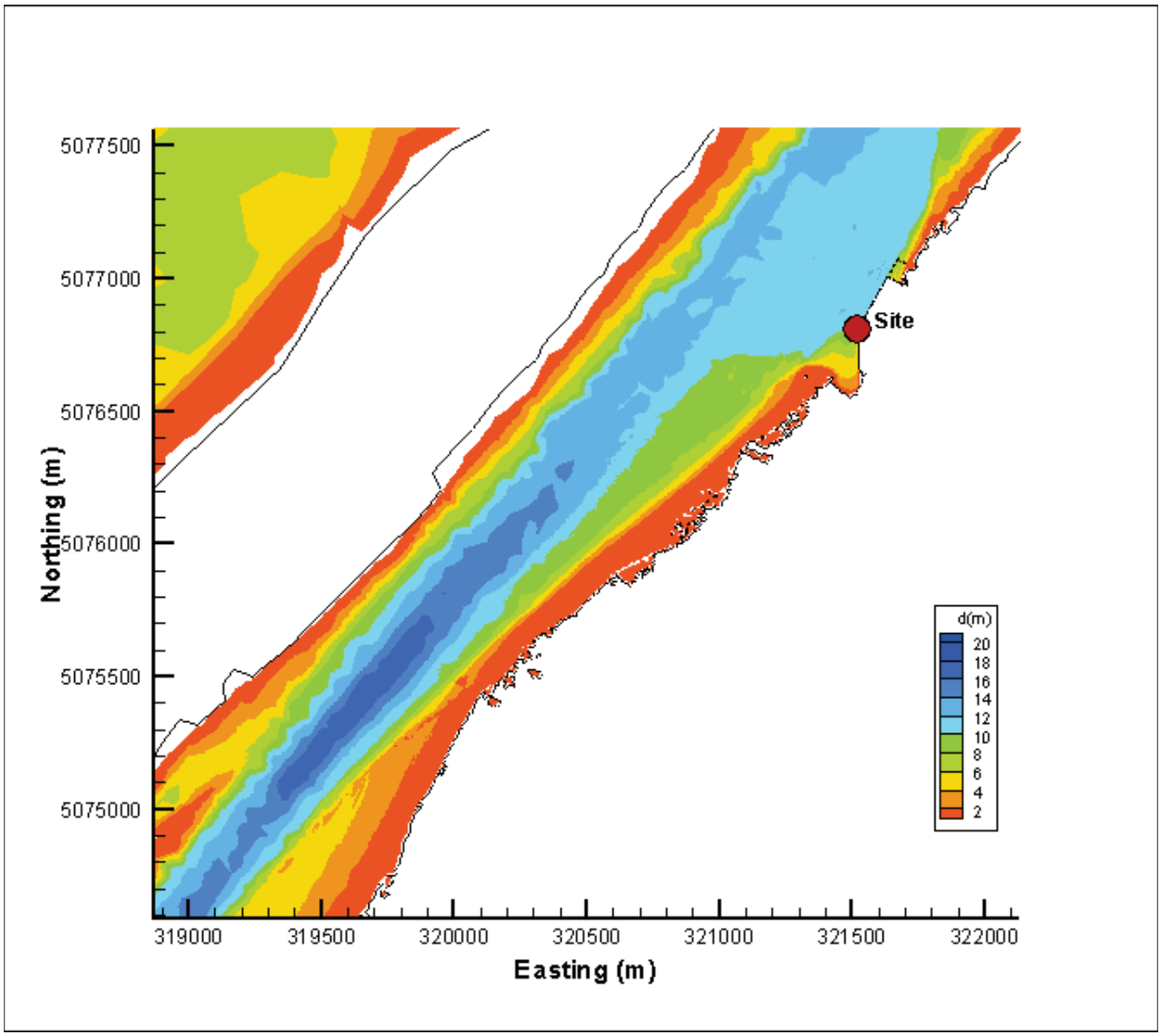


Figure 6-6: Alignment A Grid - Depths at Low Flow (Summer)

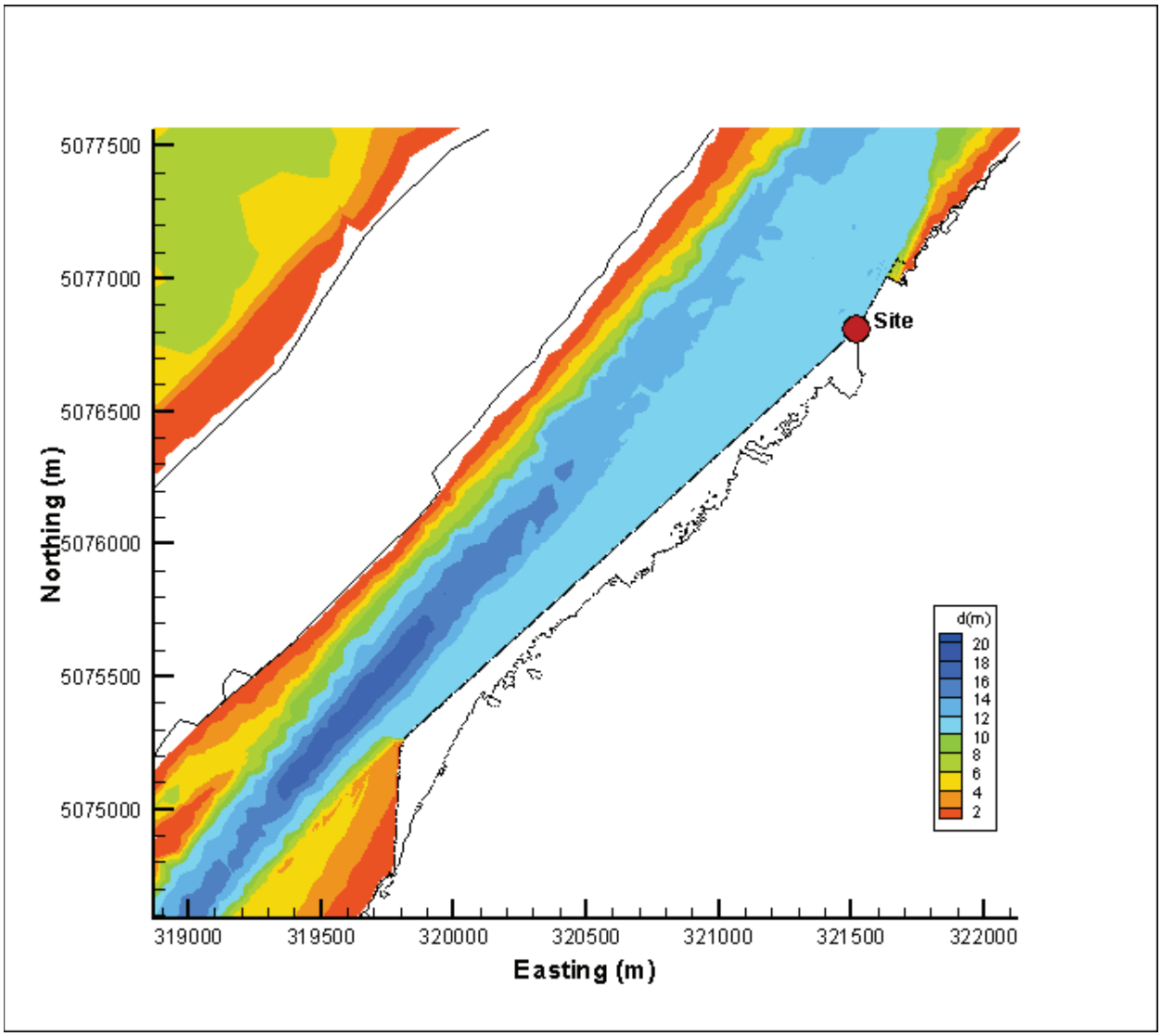


Figure 6-7: Alignment D Grid - Depths at Low Flow (Summer)

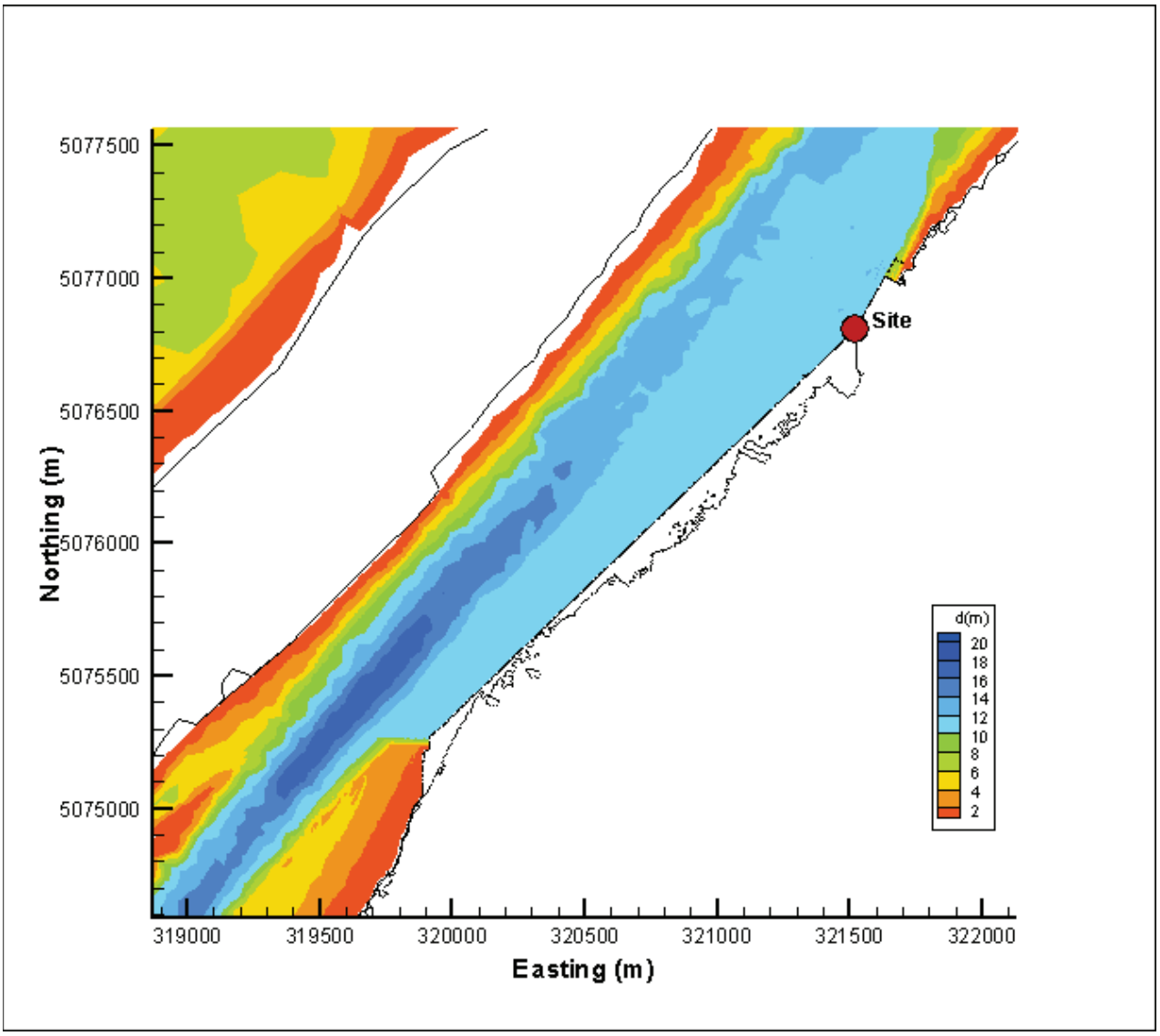


Figure 6-8: Preferred Alignment Grid Buildout - Depths at Low Flow (Summer)

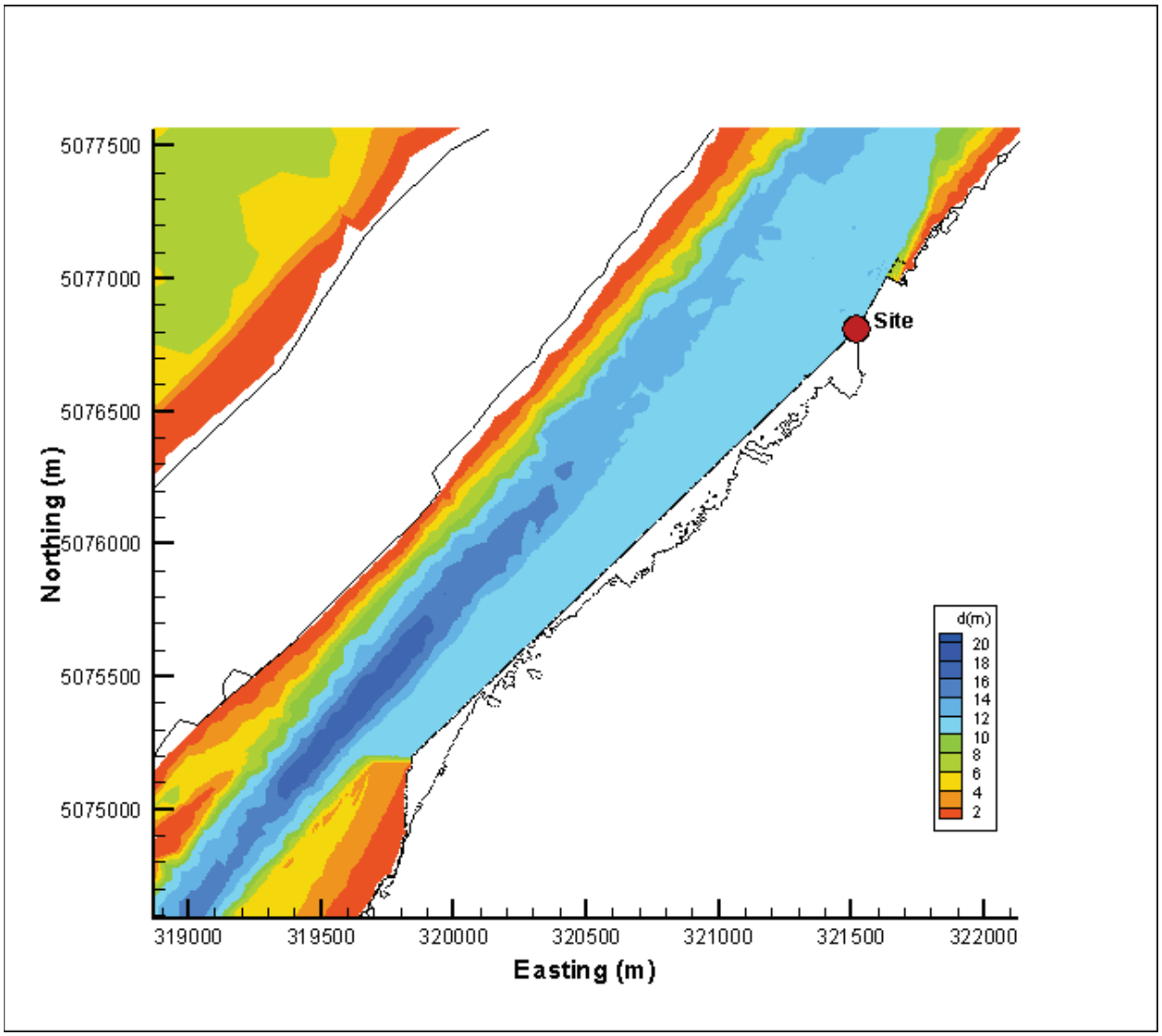


Figure 6-9: Preferred Alignment Phase A Grid - Depths at Low Flow (Summer)

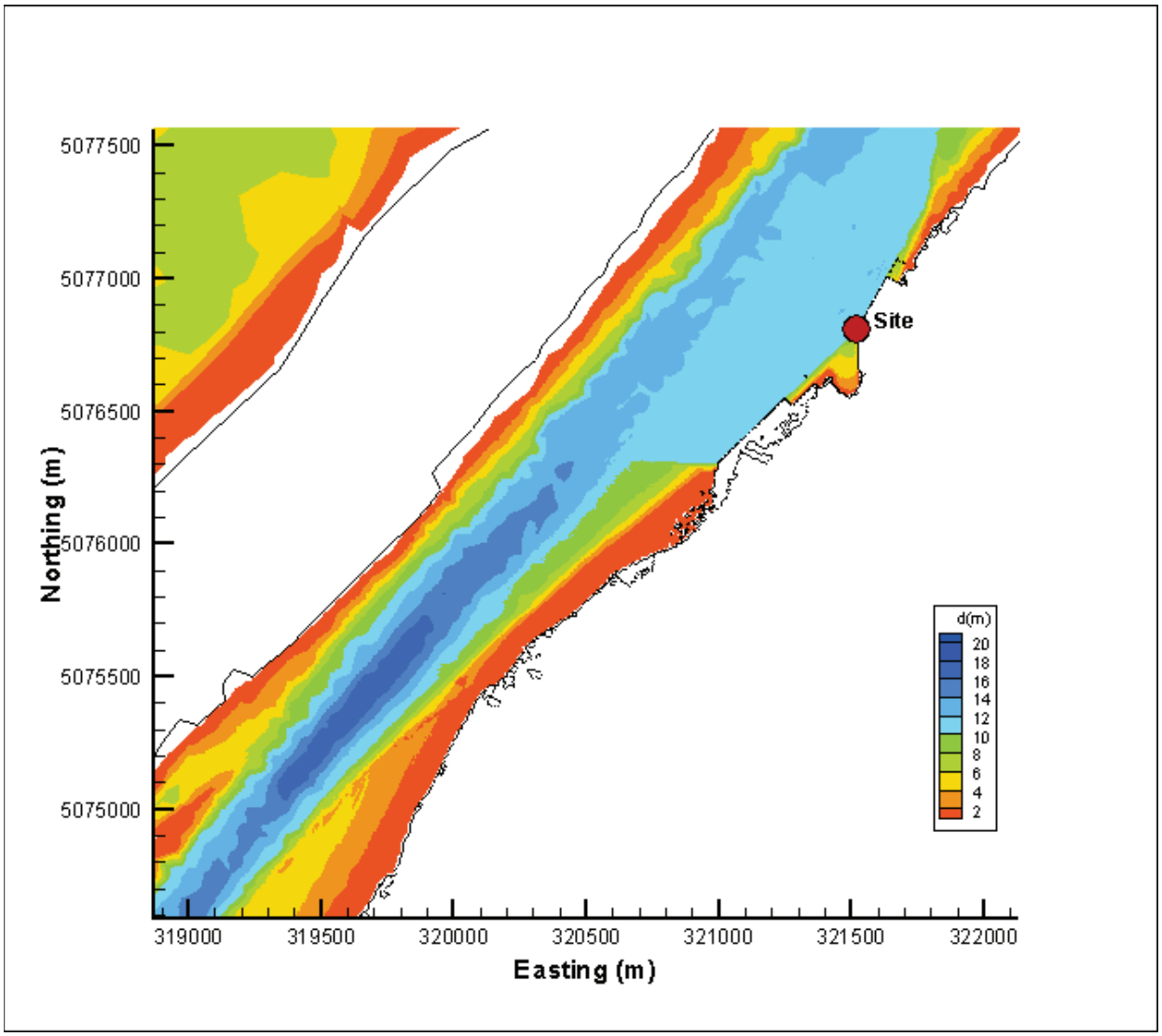
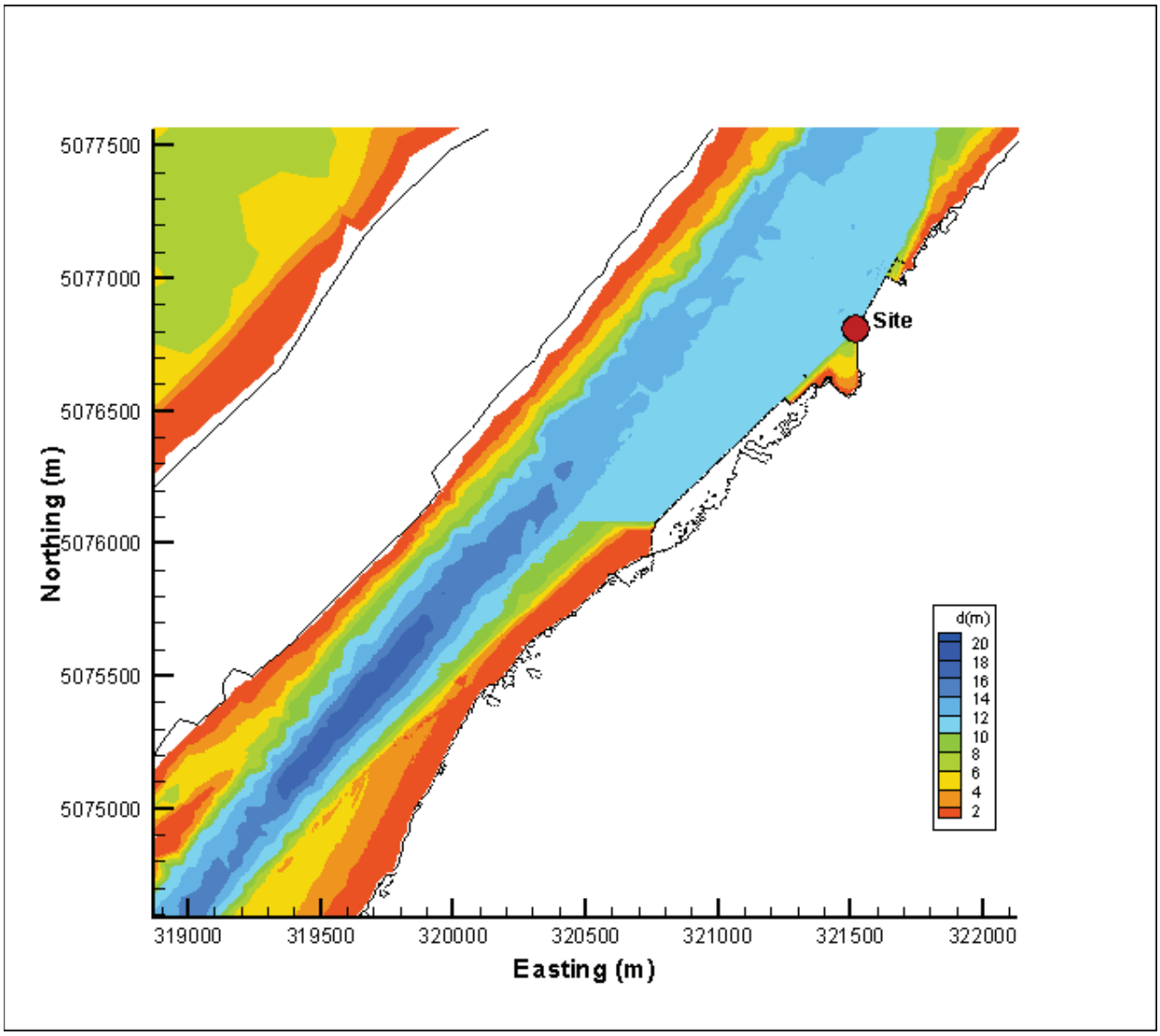


Figure 6-10: Preferred Alignment Phase B Grid - Depths at Low Flow (Summer)



Only the Preferred Alignment, including full build out (6 berths) plus Phase A (1 berth) and Phase B (2 berths) is discussed in detail in the following sections as this represents the most likely design geometry of the terminal although some references to Alignment A are made where appropriate.

Initial modelling of Alignment A determined that water level differences between the steel sheet pile (SSP) wall and the hydraulically smoother concrete caisson were about 1 mm, therefore subsequent modelling excluded the caisson berth face from consideration. Likewise, the pile-support deck over rock slope option was eliminated for non-hydraulic related reasons and was not modelled explicitly in subsequent simulations.

6.4 RESULTS

This section summarizes the results of the numerical modelling efforts and describes the anticipated effects of the Contrecoeur development on river water levels and currents. When interpreting these results, it is important to consider the accuracy of numerical hydraulic modelling techniques.

Environment Canada have calibrated their model of existing river conditions and are able to reproduce measured water levels within about a 1 cm accuracy. It is unknown precisely how well the model will predict the effect of modifications to the river alignment such as the proposed development. In general, to predict the effect of river modifications on water levels within 5 cm is considered good and within 1 cm considered excellent; most of the water level changes predicted during this study are less than 1 cm.

Currents are often more difficult to predict than water levels and generally have a prediction accuracy of 15% to 30%.

6.4.1 Water Levels

Table 6-3 shows the computed water levels at Contrecoeur for the three flow conditions considered based on existing river conditions.

Table 6-3: Modelled River Conditions (Existing Conditions)

Flow Condition	Water Level at Contrecoeur IOC (m CD)	Water Level at Contrecoeur IOC (m IGLD85)
Low	-0.54	3.87
Mean	0.75	5.16
High	4.15	8.56

This implies almost a 5 m variation in water level between extreme high and low flow conditions. The computed effect of the full buildout of Alignment A and Alignment D (Preferred) terminals on water levels at the site is shown in Table 6-4.

Table 6-4: Modeled Water Levels – Alignment A versus Alignment D

Alignment	Flow Condition	Water Level at Contrecoeur (m CD)	Water Level at Contrecoeur (m IGLD85)
A	**Low**	-0.53	3.88
	Mean	0.76	5.17
	High	4.19	8.60
D (Preferred)	**Low**	-0.54	3.87
	Mean	0.75	5.16
	High	4.16	8.57

Reviewing Table 6-4, it can be seen that the water level differences between Alignment A and Alignment D are insignificant at low and medium flow conditions (Alignment A about 1 cm higher) and minor at high flow conditions (about 3 cm higher). These values are near the accuracy limit of the numerical model but do indicate that the hydraulic efficiency of the Alignment D is better than Alignment A.

Table 6-5 shows the computed effect of Alignment D, Phase A and B on the river.

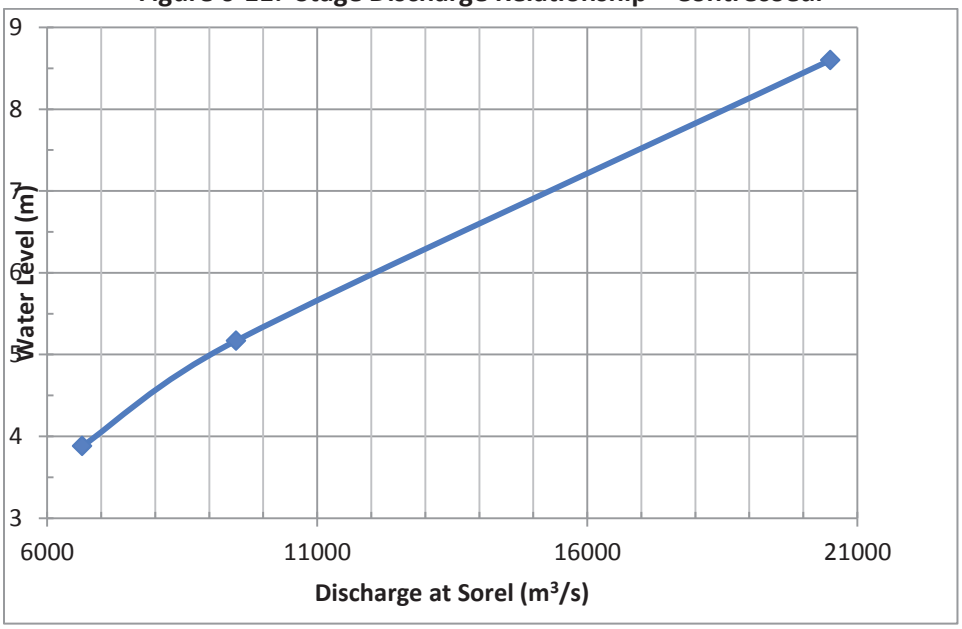
Table 6-5: Modeled River Conditions (Preferred Alignment Phase A/Phase B)

Flow Condition	Water Level at Contrecoeur (m CD)	Water Level at Contrecoeur (m IGLD85)
Low	-0.53/-0.53	3.88/3.88
Mean	0.75/0.75	5.16/5.16
High	4.17/4.17	8.58/8.58

Comparing the values in Table 6-3 with Table 6-4 and Table 6-5, it is clear that the changes in water level due to the development are minor. In fact, the computed effect of the Alignment D terminal on the river is actually to improve hydraulics although Alignment A shows a slightly negative effect. Usually, the effect of in-stream modifications is to increase velocities at the site and increase water levels upstream. In the present case, the opposite is true because the positive hydraulic effect of berth dredging more than offsets the negative hydraulic effect of land reclamation. Cross sectional average flows are decelerated adjacent the proposed terminal and flow depths upstream are decreased slightly; flow depths downstream return to pre-project levels within a short distance.

Figure 6-11 shows the stage discharge relationship at Contrecoeur based on the three discharges modelled.

Figure 6-11: Stage Discharge Relationship – Contrecoeur



The spatial variation of water levels and currents are shown on the 12 plots enclosed in Appendix E which are described in Table 6-6; water levels at the locations indicated on Plot 13 are tabulated in the top portion of Plot 14. The plots show that the spatial variation of water level in the vicinity of the berth is minor.

Table 6-6: Description of Plots showing Spatial Variation of Flow Conditions

Plot Number	Geometry Description	Flow Condition
1	Existing Conditions	Low
2	Existing Conditions	Mean
3	Existing Conditions	High
4	Preferred Alignment - Buildout	Low
5	Preferred Alignment - Buildout	Mean
6	Preferred Alignment - Buildout	High
7	Preferred Alignment – Phase A	Low
8	Preferred Alignment – Phase A	Mean
9	Preferred Alignment – Phase A	High
10	Preferred Alignment – Phase B	Low
11	Preferred Alignment – Phase B	Mean
12	Preferred Alignment – Phase B	High

Comparing the existing conditions plots (1 to 3) with post project plots for the same flow conditions, it is evident that water level differences are not significant and the maximum change is of the order of 1 cm.

6.4.2 Currents

Changes to existing current patterns in the river are limited to the immediate vicinity of the terminal. Post-project current speeds 50 metres off the buildout berth face are shown as a function of river discharge in Figure 6-12. The figure shows that depth-averaged current speeds upstream of the berth dredge pocket vary between about 0.8 and 1.2 m/s over the range of expected flow conditions. These currents will fluctuate significantly in speed and direction over the upstream 200 to 300 m of berth face, before reaching steady speeds of 0.5 to 0.9 m/s.

A comparison was made between the current velocities computed assuming full buildout of Alignment A terminal and full buildout of the Alignment D (Preferred) terminal. To simplify this comparison, Table 6-7 presents the mid-channel depth-averaged current speeds for three flow conditions at the upstream and downstream limits of the proposed terminals. For the purposes of this comparison, data were extracted from the locations indicated as Probe 4 and Probe 5 on Plot 13 of Appendix E.

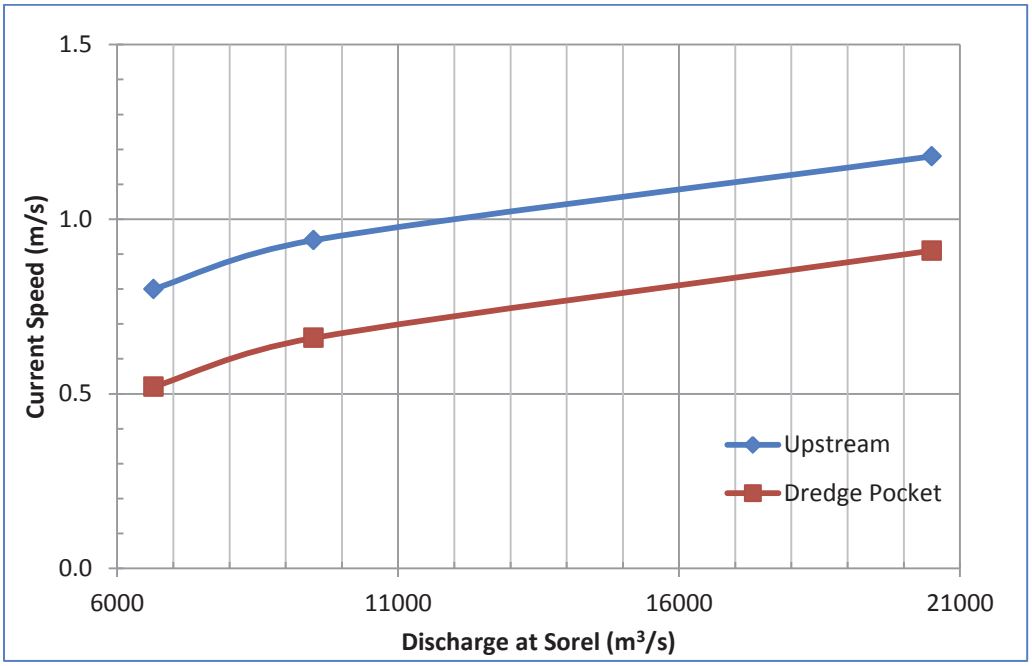
Table 6-7: Modelled Current Velocities – Alignment A versus Alignment D (Preferred)

Alignment	Flow Condition	Mid-channel Upstream End (m/s)	Mid-channel Downstream End (m/s)
A	Low	0.67	0.61
	Mean	0.81	0.73
	High	1.17	1.10
D (Preferred)	Low	0.73	0.60
	Mean	0.88	0.71
	High	0.94	0.82

Table 6-7 indicates that the Alignment D (Preferred) geometry results in similar mid-channel current speeds to Alignment A at both locations during low to mean flow conditions, but somewhat lower speeds during high flows. For example, during high flow conditions, the preferred alignment mid-channel upstream velocity is 0.94 m/s versus 1.17 m/s (24% higher) with Alignment A. The same comparison at the downstream end shows a difference of 34%. Although the magnitude of the relative difference varies with location, in general, the differences are within the model accuracy of the current prediction except at high flows.

In the immediate vicinity of the berth face, the local effects of the differing berth geometries makes the relative differences in speed and direction difficult to generalize except to note that the Alignment D flow patterns appear smoother than those of Alignment A.

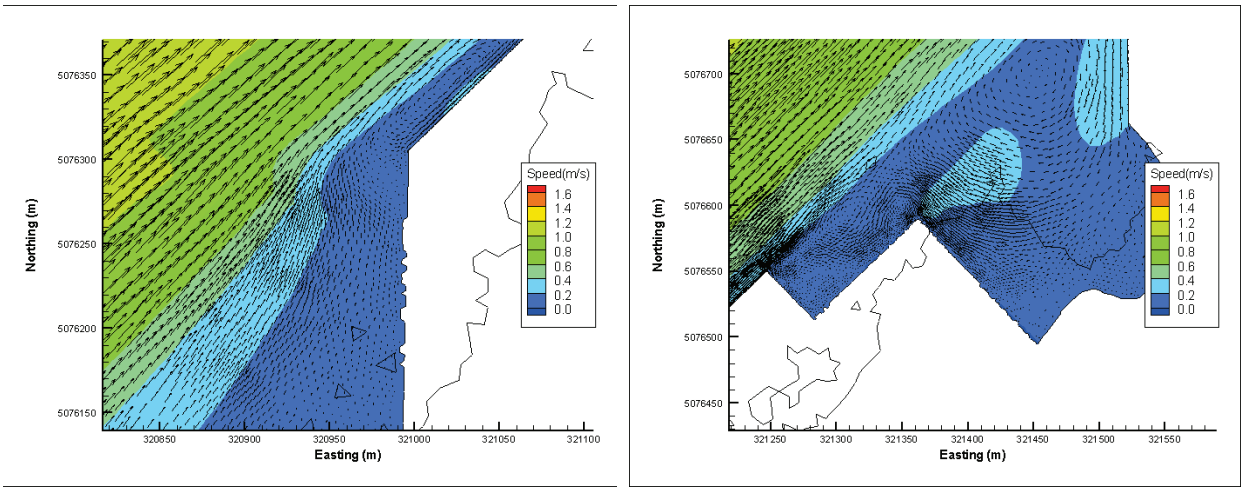
Figure 6-12: Depth-Averaged Current Speed - Preferred Alignment Buildout



The plots listed in Table 6-7 were prepared to demonstrate existing and post-project current patterns for low, mean and high flow conditions; current speeds at the locations shown on Plot 13 are tabulated in the bottom portion of Plot 14. In general, the effect of the project on currents in the shipping channel is minor. Significant changes are concentrated in areas immediately adjacent the proposed buildout wharf with pre-/post-project differences reducing to less than 10% at distances more than 200 m from the berth.

Similarly, the effects of Phase A and Phase B on existing current patterns are concentrated near the structures. Note that these proposed alignments are less hydraulically streamlined than the buildout geometry and generate eddies immediately downstream of the development (e.g., Figure 6-13), particularly at higher flows.

Figure 6-13: Local Upstream and Downstream High-Flow Flow Patterns – Phase A



Because the changes to existing current patterns are limited in spatial extent, it is not anticipated that the proposed development will have any significant effect on adjacent shorelines or Contrecoeur islands. Some local scouring of the riverbed is expected adjacent to the vertical berth face, but this can be mitigated with standard scour protection measures.

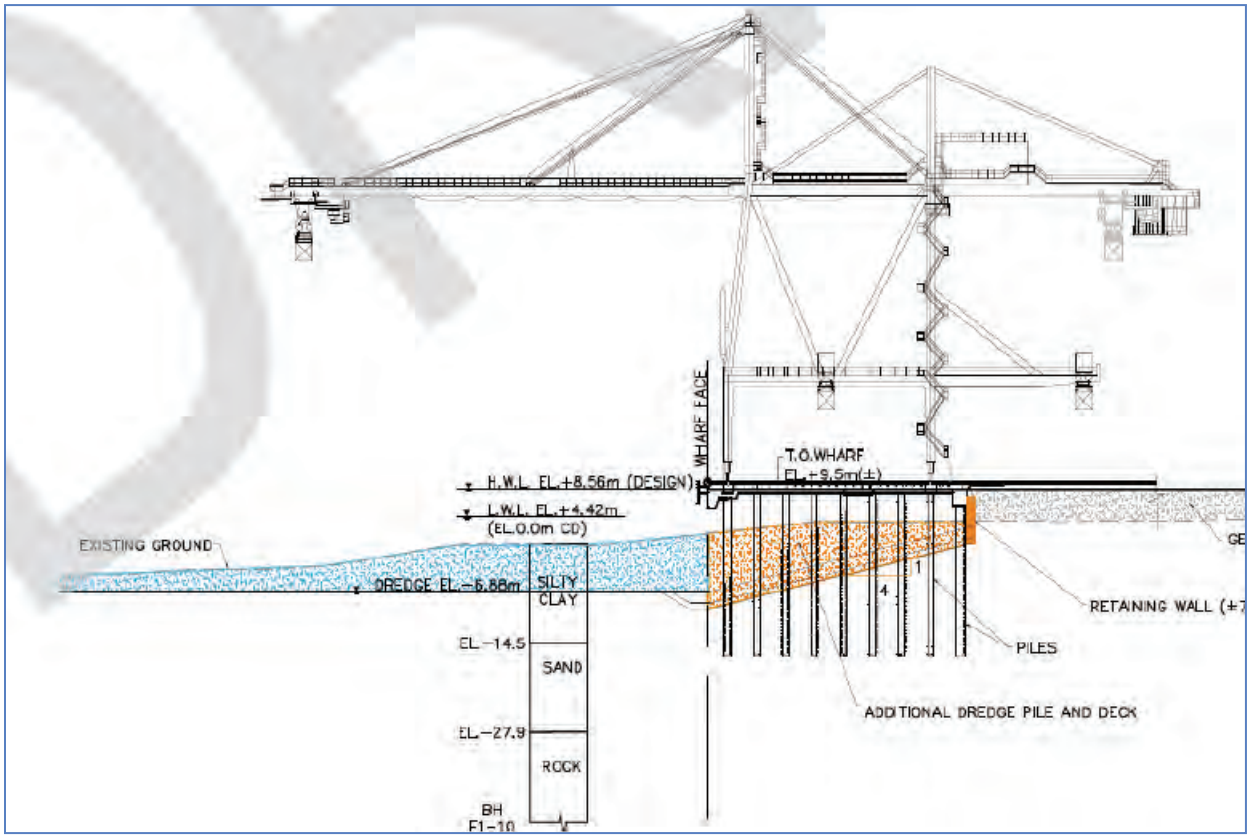
6.5 SEDIMENTATION

Detailed modelling of sediment transport and river bed morphological change is beyond Environment Canada's and M&N's present scope of work. In addition, the geotechnical program completed for this project did not include the data collection component necessary for this purpose. Nevertheless, efforts were made to develop an order of magnitude estimate of expected sedimentation at the facility.

According to Environment Canada, it has been estimated that the St. Lawrence River at Montreal transports 2.3 million tonnes of sediment in suspension each year. Material in suspension tends to stay in suspension until encountering conditions tranquil enough to allow settlement. To a lesser extent, sedimentation can occur in a dredged region whenever there is a significant negative gradient of sediment transport potential and the decelerated currents over the dredged region can no longer maintain the same load in suspension.

Based on the draft geotechnical investigations completed for this study (Golder Associates, 2010), it is assumed that the native riverbed upstream of the terminal is primarily a silty clay underlain by sand (Figure 6-14).

Figure 6-14: Riverbed Conditions



Probing the hydraulic model immediately upstream of the dredged area and at the berth, it is evident that velocities at all discharges are greater than about 0.4 m/s which should be high enough that deposition of suspended sediments will be impeded. Reviewing the speeds shown in Figure 6-12 it appears that currents at distances more than 50 m from the berth face are generally in excess of this value. Currents inside of 50 m (see Plots 1 to 12) will be slower than those shown in Figure 6-12 making these areas potentially subject to local sedimentation; this is particularly true at the upstream end of the berth face given the projection of the structure into the incident flow and the resulting local flow disturbance. This tendency for sedimentation at the berth face will be partially mitigated by ship/tug propeller wash and limited availability of sediments.

If it is assumed that most of the material moves past the terminal before having time to deposit, a preliminary estimate of sedimentation rate can be made by computing the difference between sediment transport potential upstream of the dredged area and sediment transport potential within it.

Cohesive sediment transport rates cannot be calculated without site specific information. However, if it is assumed that sediment behaviour is similar to that of fine sand, that potential sediment transport rate is described by van Rijn (2002), and that only 10% of the potential is realized due to the limited length of the berth face, the sedimentation rate would be of the order of 10,000 m^3/year. The coarser fraction of this sedimentation would be concentrated in the upstream end of the berth pocket where bedload transport of cohesionless materials will accumulate at the toe of the dredged slope. Also, regions where eddies are prevalent such as downstream of the facility will have a greater tendency to experience sedimentation of cohesive sediments due the slower current velocities in these areas.

Note that this estimate is provided to give some indication of the magnitude of sedimentation at the terminal. It is based on unverified assumptions that must be investigated at the next project stage and could be in error by more than an order of magnitude (predicting sediment even in a controlled laboratory is often in error by a factor of 2). It is recommended that a scope of work be developed for a field data acquisition program to support additional Environment Canada modelling. It is understood that EC maintains sediment transport and bed morphology modules for H2D2 that can be used to simulate the long-term evolution of the riverbed fronting the terminal considering the annual flow hydrograph, the erodability of the riverbed and variation of riverbed sediment properties.

6.6 ICE

The Sea Ice Climatic Atlas of the East Coast of Canada (Canadian Ice Service, 2001) contains a chapter on St. Lawrence River between Montreal and Quebec City where typical river ice conditions are encountered. The following paragraphs were extracted from this reference and provide an overview of ice conditions:

> *Shore-fast ice begins to form during the first week of December in most years and its main outlines are established by early January. In general, fast ice is found over the shallow coastal portions while drifting ice covers the shipping channel. Shore-fast ice becomes particularly extensive in Lac Saint-Pierre and as well in the non-navigable channels between Sorel and Montreal. Between Lac Saint-Pierre and Quebec City, drift ice moves steadily seaward during the winter with occasional ice jams developing especially above the Quebec bridges where the river is appreciably narrower. Canadian Coast Guard icebreakers are employed each year to keep the*

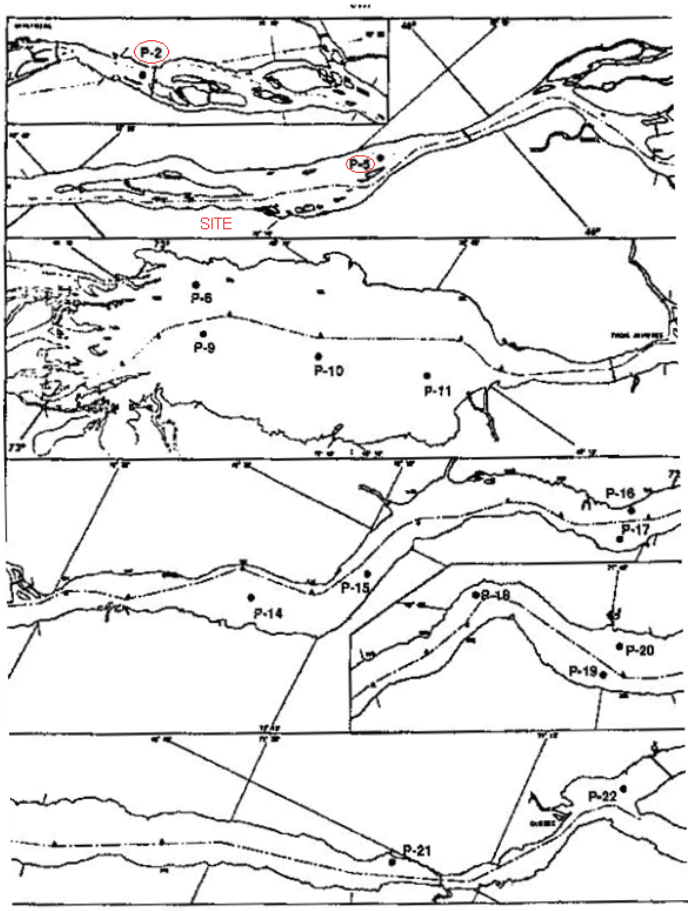
drift ice in motion so as to prevent flooding of the low-lying areas along the river and to allow year-round navigation into Montreal.

A vessel Traffic Services System is in effect in this area and one of its objectives is to help prevent disruption of the fast ice by enforcing speed limits. Lengthy delays in navigation can result if large floes of dislodged fast ice move into the channel after being broken free by the wake of passing ships. Between Lac Saint-Pierre and Montreal similar ice conditions prevail during the winter months but there are more islands to assist in holding the fast ice in place. Ice booms are installed in some locations to assist in this control. In Montreal Harbour, the combined effect of the Rapides de Lachine and an ice control structure above Champlain Bridge produces a polynya or area of well-dispersed new and young ice throughout the winter.

Melting of the ice develops in early March and results in a gradual clearing of the shipping channel below Montreal as the existing ice is carried seaward and new formations cease. Decay of the shore-fast ice follows and fragments may be carried into the channel as break-up develops. This period is short-lived however, and the whole area is normally free of ice by the middle of April.

Environment Canada collected ice thickness information at various stations on the St. Lawrence River between 1984 and 2001 (Figure 6-15). The stations that are most representative of conditions at Contrecoeur are Station P2 (upstream) and P5 (downstream).

Figure 6-15: St. Lawrence Ice Thickness Stations (Source: EC)



Based on almost 70 samples, the maximum observed ice thickness was 78 cm.

Given the relatively straight alignment of the St. Lawrence River at Contrecoeur and that the preferred wharf alignment runs parallel to it, the effect to ice on terminal operations is not expected to be significantly different than that experienced at the present facility. The angled upstream end of the land reclamation has been incorporated into the design to reduce the tendency for ice floes to accumulate in this area. Note that the slightly reduced current velocities in front of the proposed terminal (due to berth dredging) may have some negative effect on ice clearing by causing ice to accumulate temporarily due to higher upstream velocities delivering ice floes into this slower velocity region.

It is recommended that a simple ice observation program be initiated to collect information that will be useful for detailed design.

6.7 River Hydraulic Conclusions

Based on the analysis conducted to date, the following conclusions may be drawn:

- The overall effect of the proposed terminal on present upstream and downstream water levels is not significant (of the order of 1 cm).

- The effect of the buildout terminal on the river is to improve its hydraulic efficiency. Usually, the effect of in-stream modifications is to increase velocities at the location of those modifications and increase water levels upstream. In the present case, the opposite is true because the positive hydraulic effect of dredging more than offsets the negative hydraulic effect of land reclamation. Flows will be decelerated adjacent the proposed terminal and flow depths upstream slightly decreased before returning to existing levels downstream.
- The same conclusions that are noted above can be drawn with respect to the Phase A and Phase B configurations of the preferred alignment. These configurations are somewhat less streamlined than the buildout geometry, however their negative effects on the flow (e.g., eddy creation) are localized and have no signification regional effect.
- Because the expected changes to existing current patterns are limited, it is not anticipated that the proposed development will have a significant effect on adjacent shorelines or nearby islands. Some local scouring of the riverbed is expected adjacent to the vertical berth face, but this can be mitigated with scour protection.
- Sedimentation at the terminal may be of the order of 10,000 m^3/year based on many unverified assumptions. The coarser fraction of this sedimentation will be concentrated in the upstream end of the berth pocket. Regions with eddies, particularly downstream of the facility, will have a greater tendency to experience sedimentation of cohesive sediments due the slower current velocities in these areas.
- Given the relatively straight alignment of the St. Lawrence River at Contrecoeur and that the preferred wharf alignment runs parallel to it; the effect to ice on terminal operations is not expected to be significantly different than that experienced at the present facility. The angled upstream end of the land reclamation has been incorporated into the design to reduce the tendency for ice to accumulate in this area. Note that the slightly reduced current velocities in front of the proposed terminal (due to berth dredging) may have some negative effect on ice clearing by causing ice to accumulate temporarily due to higher upstream velocities delivering ice floes into this slower velocity region.

7.0 TERMINAL PLANS – FULL BUILD OUT

7.1 TERMINAL PLANS

7.1.1 Introduction

The Contrecoeur land bank is a large open area that as noted in Section 3, Opportunities and Constraints, has few constraints. As a result, the large areas of land available provide the opportunity to examine different container handling technologies including automation. In doing the preliminary conceptual terminal plans, six options are reviewed that include three different modes of operation. The three modes of operation include:

Conventional

Includes manned berth operations including ship to shore gantry cranes and bombcarts for transport between the berth and container yard (CY). Container yard is operated using manned rubber tired gantries (RTGs). Intermodal yard (IY) utilizes manned RTGs or rail mounted gantries (RMGs) with horizontal transport between IY and CY with manned bombcarts.

Semi-Automated

Includes manned berth operations including ship to shore gantry cranes and shuttle carriers for transport between the berth and container yard (CY). Container yard is operated using automated rail mounted gantries (RMGs) or automated stacking cranes (ASCs). Intermodal yard (IY) utilizes manned RTGs or RMGs with horizontal transport between IY and CY with manned bombcarts or shuttle carriers.

Automated

Includes automated berth operations including double trolley ship to shore gantry cranes where primary trolley is manned and second portal trolley is automated with automated guided vehicles (AGVs) or automated shuttle carriers for transport between the berth and container yard (CY). Container yard is operated using automated rail mounted gantries (RMGs) or automated stacking cranes (ASCs). Intermodal yard (IY) utilizes automated RMGs or ASCs with horizontal transport between IY and CY with AGVs or automated shuttle carriers.

For all options the terminals will have a similar truck gate operation utilizing proximity ID cards, optical character recognition (OCR) and remote clerk interaction.

The six options identified are shown on the following drawings enclosed in Appendix A.

- M&N Drawing No. 7146-MP-14: Conventional Terminal – Option 1 General Arrangement;
- M&N Drawing No. 7146-MP-15: Conventional Terminal – Option 2 General Arrangement;
- M&N Drawing No. 7146-MP-16: Semi-Automated Terminal – Option 1 General Arrangement;
- M&N Drawing No. 7146-MP-17: Semi-Automated Terminal – Option 2 General Arrangement;
- M&N Drawing No. 7146-MP-18: Automated Terminal – Option 1 General Arrangement; and,
- M&N Drawing No. 7146-MP-19: Automated Terminal – Option 2 General Arrangement.

7.1.2 Planning Criteria

Prior to preparing the plans a planning criteria was developed and reviewed with the MPA to identify key market and operational parameters that would reflect the expected operating environment and thus guide the development of conceptual terminal plans and estimates of annual throughput capacity. All capacities reported here are considered long term sustainable practical capacities; not peak or maximum capacities.

The planning criteria prepared for the Contrecoeur Development Master Plan contains market and operational parameters for both conventional and advanced automated container handling modes of operation. The criteria covers the four primary components that make up most gateway container terminals: berth, container yard, intermodal yard and truck gate. It is not the intent to provide a detailed explanation here of each parameter contained within the criteria, but rather key aspects are identified and discussed below. A copy of the planning criteria parameters is enclosed in Appendix D.

Berth Operations

The key operating parameters at the berth are the number of ship to shore cranes and their expected handling rate. For the Contrecoeur terminals, 3 cranes per berth were initially planned for a total of 18 cranes at the full six berths. This was later revised by the MPA to 4 cranes per berth on two berths per terminal and 3 cranes on the third berth for a total of 22 cranes over 6 berths. As a result some of the plans show 18 cranes and some show 22 cranes. Varying gross crane productive rates were adopted depending on the mode of operation. For the Conventional terminal a rate of 25 moves per hour utilizing a single trolley crane to manned tractor/bombcart operation was considered representative of rates that can be expected in the near term future as this reflects current average productivity within the Port. Currently, most NA East Coast terminals average about 24 to 26 moves per hour. For the Semi-Automated terminal operation where a manned shuttle carrier operation can be used and thus cranes don't have to wait for a bombcart, an additional 2 moves per hour is estimated thus permitting 27 gross moves per hour. Figure 7-1 below illustrates shuttle carriers in operation.

Figure 7-1: Shuttle Carrier Operation



For an Automated operation where dual trolley semi-automated ship-to-shore cranes can convey to AGVs (automated guided vehicles), or automated shuttle carriers, then the crane rate can be expected to increase by about 4 moves over conventional operations; so a conservative 29 gross moves per hour was estimated. The AGVs or shuttle carriers transfer containers from the ship-to-shore cranes to the container yard. At the handful of automated terminals operating at present worldwide this transfer occurs with AGVs that must wait to be loaded or discharged for the cranes at the berth and CY. It is not a disconnected operation like the shuttle carrier operation, however, the primary manufacturer of AGVs (Gottwald Port Technology) has developed the Lift-AGV for future use. As the name implies the Lift-AGV can lift the container at its final destination and place it on a rack from where the cranes can then handle the container thus allowing the AGV to immediately move onto its next assignment without waiting. A Lift AGV is shown in Figure 7-2 below.

Figure 7-2: Lift AGV



Simulation studies have shown that all types of automated horizontal transport vehicles mentioned above can achieve ship-to-shore crane productivity in keeping with the goals of this project. But, the various systems may require different numbers of transporters to achieve a given productivity. If automated horizontal transport is considered, a detailed cost comparison should be conducted.

In addition to the number of cranes and crane rate, the time available to work vessels is also of paramount consideration. This is reflected in the actual berth occupancy, or the percentage of time a vessel is at berth. Generally, ports that are in a competitive market strive to ensure that a berth is available to shipping lines on a first come, first serve basis, and that vessels do not generally have to go to anchor (queue). As a result, and as a rule of thumb, for a three or more berth terminal, operators try to keep berth occupancy to a maximum of 65%. Thus, this criterion was adopted. Other berth parameters are provided in the Planning Criteria referenced earlier.

Container Yard Operations

The capacity of the container yard is primarily a function of the area available, how dense that area is stacked with containers, both horizontally and vertically, and the average dwell time of those

containers. The area and density will determine how many container slots there are and the dwell times how often each slot can be turned over in a given period. For the Conventional terminal container yard (CY) options and mode of operation it was agreed with the MPA that 6 wide, 1 over 5 RTGs (rubber tired gantries), augmented with some top-picks would be utilized. This is similar to current Port operations. Wheeled and straddle carrier operations were not considered likely as these modes of operation are not used in Canada and are becoming increasingly rare in the US due to their low storage density. For the RTG operation it is generally preferred that rows of container stacks be parallel to the berth. This usually facilitates longer operating runs for the RTGs (thus less timely transfer between rows) and better separates berth and gate traffic.

The Semi-Automated and Automated terminals would use automated RMGs or automated stacking cranes (ASC's) to handle containers in the yard. For this project, machines with a lift height of 1 container passing over a 5-container high stack (1 over 5) was agreed. Figure 7-3 below shows an example ASC at the DPW Antwerp Gateway Terminal.

Figure 7-3: ASC's at Antwerp Gateway



For automated CYs manned berth and gate traffic does not mix with the ASCs for safety reasons so as a result the rows of stacked containers are orientated perpendicular to the berth with berth traffic feeding the waterside end of the rows while gate traffic is served at the landside end of the rows.

When planning for a Conventional or Automated CY the number of rows of containers is pre-planned but much more care must be taken with the automated CY since the number of rows will also dictate the number of CY cranes (ASCs) and hence its lift capacity since each row will only have two cranes. For a Conventional CY if more lift capacity is needed then more RTGs can be added later. The automated ASCs within the automated CY must be pre-planned precisely to provide sufficient lift capacity to match the berth and to match that needed to deliver and receive containers from the gate and IY traffic.

Besides orientation and equipment, the main difference between Conventional and Automated CYs is the operating utilization; or the average percentage of slots that can be filled at any given time. Not all slots should be full as space is needed to allow for peaking, digging, sorting, etc. For a Conventional

terminal the average utilization is usually between 55% and 75%, and is about 70% in the current Port according to operators; so this was adopted. Typically, automated terminals can operate at higher average storage utilization than manned terminals. For Contrecoeur an average storage slot utilization of 85% was adopted for the automated options.

The dwell times given in the planning criteria are based on local historical data and previous discussions with Port operators. The terminal is expected to have on-dock rail traffic so the percentages of rail versus truck traffic range from a 60/40 rail-truck split to 50/50 rail-truck split as well as splits between import and export traffic based on past market conditions are noted. These percentages are used to determine overall average container dwell times.

Intermodal Yard Operations

For the Contrecoeur terminals intermodal parameters will be very important since it is expected that 50% to 60% of the terminals throughput will be transferred inland via rail. For the concept design 60% was selected.

Fundamentally, the capacity of the intermodal yard will be based upon how much equipment is used and the average lift rate for discharging and loading of rail cars. For both the Conventional terminal and Automated terminal it was agreed with the MPA to review both an RTG based yard as currently in use at the Port, plus wide-span RMGs.

For the Conventional and Semi-Automated terminals it is expected that the RTGs or RMGs would be manned and serviced by manned bombcarts. In doing so a net lift rate of 25 moves per hour was selected to reflect current operations. For the Automated Terminal the mode selected for review is automated RMGs that work with AGVs that in turn transfer containers to and from the container yard. The interface between RMG and AGV is fully automated while the RMGs discharging and loading rail cars will be done by remote operator. For this operation the net lift rate adopted is also 25 moves per hour, although required simulation at future design stages may realize higher rates. Since no automated IYs currently exist it was considered prudent to be conservative at this early stage in the project.

A low daily peaking factor of 1.25 was selected to reflect a near steady state and scheduled rail service by the Class 1 railways plus multiple vessel calls per week. A factor for RTG, RMG downtime due to switching interruptions, breakdowns, breaks, supply interruption, etc. is also included.

Based upon these parameters the required amount of track, and number of RTGS or RMGs to achieve the needed throughput capacity, can be estimated .

Truck Gate Operations

For planning the truck gates for each option, the number of lanes and queuing length required for each lane depends on the expected volume of trucks, the gate hours and the time it takes to process each truck. For the Contrecoeur terminal, the percentage of truck throughput is expected to range from 40% to 50% as noted earlier.

Fairly aggressive gate processing times of 60 to 120 sec/truck for the in-gate process and 15 to 25 sec/truck for the out-gate process were adopted at this early stage of review. These process times reflect advanced gate operations using optical character recognition extensively. In addition, the MPA does not wish to implement a reservation system so a high daily/hourly peaking factor of 2.00 was adopted to reflect current Port operations. Daytime gate hours will be 06h00 to 16h00 with 20% of daily traffic using evening gates between the hours of 16h00 to 23h00.

A ratio of truck gate TEUs versus vessel TEUs is expected to be 1.43 while 39% of all trucks are expected to have two transactions. Again, this reflects current conditions in the Port of Montreal.

Other miscellaneous operational parameters include a TEU/container ratio of 1.63 (i.e. 63% of containers are 40 foot) plus a 22.5 hour work day (allows for shift change downtime) and terminals that are open 355.5 days a year

7.1.3 Terminal Layouts

Based on the established planning criteria parameters and terminal limits, two terminal layout options have been prepared for each of the three modes of operation, thus six plans total have been prepared of the full build out of Contrecoeur as a major container handling facility.

The process begins with the planning of the berth since it is generally the most costly piece of any terminal and if possible should set the overall terminal capacity. The berth length and Alignment D as reviewed in Section 4 was used for each of the terminal plans thereby providing for 2 three berth terminals in which each facility can safely accommodate three 300 m LOA vessels. With a total of 18 cranes over 6 berths, and the gross cranes rates noted earlier, the berth capacity for the Conventional terminal would be about 2,800,000 TEUs per annum, the Semi-Automated terminal will have a berth capacity of 3,000,000 TEUs per annum and the Automated terminal would have a berth capacity of about 3,250,000 TEUs per annum. With 22 cranes the berth capacities will increase to 3,420,000 TEUs per annum for the Conventional terminal and 3,690,000 TEUs per annum for a Semi-Automated terminal. For reasons discussed below the Fully Automated terminal was not pursued as a preferred option so 22 crane plans were not reviewed. As a result, the preferred terminal layouts are shown on M&N Drawing Nos. 7146-MP-14 and 7146-MP-16 as enclosed in Appendix A.

Using the berth layouts and capacities noted above, the rest of the terminals for each option are developed to match and balance the individual terminal capacity and reflect the various modes of operation under review. This is essential so that each of the remaining three terminal components (CY, IY, Gate) work efficiently with the berth operation and have a capacity similarly matched to that of the berth. Once these major components are planned, ancillary facilities such as administration buildings, maintenance facilities, parking and labour facilities are added. What follows is a description of the plans and basis thereof for the CY, IY, Gate and ancillary facilities for each option. Some are the same between options and some are interchangeable with other options.

7.1.3.1 Container Yards Layouts

Although each CY assumes the same dwell times and 5 high container stacking, the number of twenty foot ground slots (TGS) will vary for each mode of operation since the berth capacity for each varies as well as the stacking utilization is lower for the Conventional terminal versus the Semi-Automated and Automated terminals. Using static simulation modeling, Table 7-1 below summarizes the total combined number of TGS required for each terminal with 22 cranes and the resulting CY annual capacity.

Table 7-1: CY TGS Required and Resulting Annual Capacity

	Conventional	Semi-Automated
Number of TGS (Both Terminals)	21,200	18,500
CY Capacity (TEUs per annum)	3,490,000	3,750,000

Conventional Terminal CY

The 21,200 TGS needed for the preferred terminals under the Conventional terminal RTG operated yard are arranged in 6 wide rows parallel to the berths. This allows for long RTG runs which is desirable as noted earlier. The first row adjacent the berths is set back roughly 60 to 80 m from the berth face. This allows for a 6 m +/- set back from the berth face for the waterside crane rail, 30.48 m crane gauge, 15 m +/- for hatches, a 12 m roadway and an allowance for a row of high mast lights and services.

Each row then extends from the downstream end of Berth 1 to the upstream end of Berth 6 with intermediate internal roadways perpendicular to the berth every 300 m, or between each berth. To achieve 21,200 TGS a total of 13 rows are required. With that many rows another internal roadway parallel the berths for bombcart and gate traffic travel is added between rows 6 and 7, plus a fence between Berths 3 and 4 to separate the two terminal areas.

Option 1 shows each row being operated with RTGs. Option 2 only differs in that rows 4 and 5 are converted to rows that can be worked with Top-picks and has less storage as it was based on 18 cranes at the berth. It is expected that approximately 40% of the CY storage is for empties so a couple of rows for empties that can be worked by much less costly Empty Handlers will save cost and introduce added flexibility to the terminal. However, this will increase the depth of the facility since 16.5 to 20.0 metre aisles are needed between these rows to allow the Empty Handlers space to work. This is illustrated for Option 2. With the added storage needed with 22 cranes space was becoming a premium. The storage area also began to impact the storage domes at the existing dry bulk terminal so as a result the terminal has been shifted 95 metres upstream including the berths as shown on M&N Drawing No. 7146-MP-14.

Reefer access towers and container storage are introduced into the rows. Total reefer storage is roughly 6% of the total storage which is similar to current operations. The precise number of plugs and location would be confirmed at later design stages.

Based upon the expected number of hourly moves at the berth when 22 cranes are operating, plus the expected 10 to 11 RTGs or RMGs operating in the IY and including gate traffic, about 80 to 90 RTGs are required in the CY to serve the berths, IYs and two gates. This includes an allowance of 5% for maintenance spares.

Overall, the layouts for the Conventional terminal Options 1 and 2 are relatively straight forward and follow common practice at many similar terminals in North America and abroad.

Semi-Automated Terminal CY

As discussed earlier, for the Semi-automated terminal an automated CY is introduced. As a result the CY will consist of rows of end-loaded container storage blocks that are perpendicular to the berth. This

permits the automated cranes (ASCs) in the yard to operate without interference from berth or gate traffic. This is necessary for safety as automated machines cannot mix with manned machines. At the waterside end of the CY rows, the ASCs will meet with shuttle carriers that will move containers to and from the ship-to-shore cranes. Although the ASC's will work the yard rows automatically taking assignments from the terminal operating system (TOS), when the crane gets to the end of the row to pick up a container left by a shuttle carrier, or drop one off, the crane will stop and wait for a remote operator to take over and execute that function. This is because again it is not safe to mix the automated operations with manned shuttle carriers.

On the landside end of the CY rows, gate trucks and IY bombcarts (or shuttle carriers) will back into lanes at the end of the storage rows. Again the CY cranes will come to a stop at the end of the row and the final transaction between CY and truck/bombcart/shuttle carrier will be completed by a remote operator. Once complete, the operator will move the crane back to the safety stop area and engage the TOS to take over the crane for automated operation and its next assignment.

Each CY row will have two cranes; one for waterside operations (receiving and delivering containers at the berths) and one at the landside (receiving and delivering containers for the IY and gate). The two cranes can operate using the same rails, or a second set of rails can be constructed and one crane can be larger and pass over the other. Current technology and simulation has shown that, for terminals that primarily handle import/export traffic (not transhipment), twin ASC running on shared rails will work well, thereby saving the cost of a second set of rails and one larger RMG. As a result, twin ASC's are shown for each option.

Extensive simulation studies of automated CY operations show that the optimum size of the CY rows is 8 to 12 containers wide and 34 to 42 TGS long. As a result, these limits are adopted.

To determine the final width and length it is a matter of determining how many waterside CY cranes are necessary to match the berth side lift demand and how many landside cranes are required to match the IY and gate lift demand. Whichever is greater it will govern how many CY storage rows are needed. The width and length of each row will then be adjusted to provide for the needed number of TGS.

For this exercise it is assumed that the CY cranes can execute an average of 14 productive lifts per hour. This is a generally accepted average based on current operations at other facilities and simulation studies.

As a result, at the berth it is estimated that the 594 lifts per hour being executed by 22 cranes will require 42.4 waterside ASC's. The IY with 10 to 11 RTGS or RMGs (as explained later) at an average of 22.5 moves per hour will require 15 ASC's for 50% of throughput by rail and 18 ASC's for 60% of throughput by rail.

The truck gate transactions at mild peaks (1.5 times average rather than 2 times average) can generate 356 transactions per hour when 40% of throughput is by truck and 447 transactions per hour when 50% of throughput is handled by truck. This in turn requires 25 to 31 ASCs at the landside CY.

As a result for a 60/40 rail-truck split 43 landside ASC's are needed and for a 50/50 rail - truck split 46 ASC's are needed, 23 per terminal. Fortunately, this is quite close to the 22 per terminal at the waterside. One spare RMG per terminal is recommended in the event of a breakdown so 24 landside RMGs are estimated at each terminal to cover the range of modal splits.

With a total of 48 landside rows between the two terminals they would need to have 385 TGS each. With 10-wide rows each row will be 40 TGS long. For Option 1 10-wide rows, 40 TGS long are shown

since the terminal has ample width to accommodate them. These number of rows began to impact the adjacent dry bulk terminal storage domes so as with the Conventional terminal container berths are shifted 95 metres upstream to avoid this. As a result in Option 1 room still exists on each end of the terminal for access. The set back from the berth face is similar as for the Conventional terminals since the berth is a manned operation but an approximately 40 m long interchange and ASC maintenance zone is required at the end of each CY row. This area has enough room to store an RMG while it is in maintenance so at least one can still work and still have enough length for the transfer of containers between the RMGs and bombcart/shuttle carrier/truck.

With only 18 cranes for interest sake it was determined that if 4 high stacking was used 18,500 TGS is required. Four high stacking can result in lower cost machines and less handling and digging so it may prove to have reduced long term operational costs. With 4 high stacking a total of 42 – 12 wide rows 38 TGS long will provide 19,152 TGS. Option 2 illustrates this CY configuration. Although the wider rows do fit within the width of the six berths, the furthest downstream row does conflict with some of the bulk storage domes on the adjacent property which would need to be relocated, or the terminals shifted upstream as well.

Automated Terminal CY

The Automated terminal CY will follow the same planning principles as the Semi-automated terminal since both have an automated CY. As a result the CY will consist of end-loaded rows of container storage that are perpendicular to the berths. At the waterside and landside ends of the CY rows, the ASCs will now meet with AGVs or automated shuttle carriers so that a remote operator is not required to take over and execute the interchange function.

As with the Semi-automated terminals twin ASC's running on the same rails are used with rows that are 8 to 12 containers wide and 34 to 40 TGS long. In addition, similarly the ASC's are assumed to execute 14 productive lifts an hour.

At the berth it is estimated that the 522 lifts per hour being executed by 18 cranes will require 37.3 waterside ASC';s. The IY with 9 to 11 RTGS or RMGs (as explained later) at an average of 22.5 moves per hour will require 14.5 ASCs for 50% of throughput by rail and 17 ASC's for 60% of throughput by rail.

The truck gate transactions at mild peaks (1.5 times average rather than 2 times average) can generate 393 transactions per hour when 40% of throughput is by truck and 490 transactions per hour when 50% of throughput is handled by truck. This in turn requires 28 to 35 ASCs at the landside CY.

As a result for a 60/40 rail-truck split 45 landside ACS's (22.5 per terminal) are needed and for a 50/50 rail –truck split 49.5 ASC's (24.75 per terminal) are needed. The landside requirements are much higher than for the waterside so surplus waterside ASCs will result. To accommodate day time gate peaks then additional ASC's are needed for only daytime peaks and then are redundant during most other shifts. Keep in mind that for this planning exercise the gate transactions are already only based on 1.5 peaking, not 2 as we found 2 was very difficult to accommodate. One spare ASC row per terminal is recommended to cover maintenance downtime, so 24 to 26 landside ASC's are required at each terminal to cover the range of modal splits.

The width of the 6 berths will accommodate 24 - 10 wide rows which is only good for a 60/40 rail split. With a total of 48 rows between the two terminals they would need to have 333 TGS each. As a result with 10 wide rows each row will be 34 TGS long. If we tried for 52 - 8 wide rows then they would need to be 40 TGS long. This will accommodate the 50/50 rail –truck split.

Option 1 shows the 24 – 10 wide rows 34 TGS long per terminal to accommodate a 60/40 rail split, while Option 2 shows 26 – 8 wide rows that are 40 TGS long per terminal that will accommodate a 50/50 split as well as the 60/40 split. Bear in mind the Option 2 terminal requires the purchase of 8 additional cranes and supporting infrastructure just for a higher truck gate percentage and high hourly peaking.

For the Automated terminal the container rows are set back from the berth face a greater distance than that for the Conventional and Semi-Automated terminals. For automated berth operations the width of berth apron between the ship-to-shore gantry crane landside rail and container storage area must be wide enough for a container interchange area immediately adjacent the landside rail, a turning zone for AGVs, travel lanes and then a turning zone into the 40 m wide CY interchange area. For the Conventional and Semi-automated terminals this width is about 30 m whereas for an automated terminal this width would increase to approximately 90 m. Table 7-2 provides a summary of the approximate berth apron width needed for each terminal type from berth face to first container storage slot.

Table 7-2: Comparison of Suggested Berth Apron Widths

	Approximate Berth Apron Width
Conventional Terminal	60 to 80 m
Semi-Automated Terminal	100 to 120 m
Automated Terminal	160 to 180 m

In addition, as with the Semi-automated terminal Option 2 the wider rows do fit within the width of the six berths but the furthest downstream row does conflict with some of the bulk storage domes on the adjacent property which would need to be relocated.

7.1.3.2 Intermodal Yard Layouts

For the intermodal yards a total of four different configurations have been developed. All four are interchangeable with each of the Conventional and Semi-automated terminals while only two work with the Automated terminal options.

All of the IY plans shown are based on trying to provide a similar total track length and numbers of IY equipment, and hence lift capacity, based upon estimated required throughput, rail footage/TEU ratio and hourly lift rate. In addition, each IY (with a few exceptions) is double ended to allow complete pull through of rail cars. Although more track and IY equipment is needed for the two options with 22 berth cranes.

Firstly, static simulation models specifically developed to replicate Port of Montreal conditions were used to determine the required total length of track necessary in the IY based upon switching, car dwell times and equipment rates. The length of track will vary depending on the rail footage/TEU ratio that in turn varies with the split in market share between CN Rail and CP Rail since CN has an average rail footage/TEU ratio of 18 while for CP it is 27. The MPA has requested that three market share scenarios be reviewed as follows:

Scenario One:

- CN: 100%
- CP: 0%

Scenario Two:

- CN: 70%
- CP: 30%

Scenario Three:

- CN: 30%
- CP: 70%

Scenario Three requires the maximum amount of track in the IY (and supporting track network as well) since it will have the highest rail footage/TEU ratio. In addition, the Automated terminal will require the most track due to its higher throughput; while the Semi-automated terminal needs more than the Conventional terminal. Based on 18 berth cranes and accommodating 60% of the terminal throughput, each IY is required to handle the volumes of rail traffic shown in Table 7-3 below.

Table 7-3: Required IY Throughput Capacity for 60% Rail

Terminal Mode	IY Throughput
Conventional Terminal	1,680,000 TEUs
Semi-Automated Terminal	1,800,000 TEUs
Automated Terminal	1,950,000 TEUs

The difference between the Conventional and Automated terminals is only 16%. As a result, the worst case scenario (most track) is the Automated terminal with a market share of CN 30% and CP 70%. Under this scenario it was found that 29,000 feet of IY working track is required plus 96,000 feet of working support track for the combined two terminals.

For 22 berth cranes for the Conventional and Semi-Automated terminals with their higher throughput it was found that roughly 31,000 and 33,000 feet of IY working track is needed respectively and roughly 110,000 feet of working support track.

When laying out the IY it was found that a clear working length of 4900 feet was possible so with 6 tracks the IY will have 29,400 feet. For the 22 crane options a 7th and 8th track were added to get the required IY footages. The removal of one track will reduce the overall length of track by 17% so 6 tracks are still required for the early Semi-Automated and Conventional terminals. Under the CN 70%, CP 30% scenario 14% less track is needed, and when CN has 100% market share an additional 9% of track can be eliminated. As a result, for the Conventional throughput, with CN having 100% market share, only 5 tracks are necessary. Under each of the other scenarios six tracks is needed for 18 cranes also with 7th and 8th tracks as shown for 22 cranes. This is summarized in Table 7-4.

Table 7-4: IY Track Summary

	Terminals w/ 18 Berth Cranes	Conventional Terminals w/ 22 Berth Cranes	Semi-Automated Terminals w/ 22 Berth Cranes
IY Track Required	29,000 feet	31,000 feet	33,100 feet
IY Track Provided	29,392 feet	33,521 feet	39,163 feet
Number of Tracks	6	7	8

Wide Span RMG IY

The first IY plan is one with 6 – 4900 foot tracks under wide span RMGs. This IY would be shared by the two terminals thereby likely requiring a third party operator. This RMG IY plan is shown for all the terminals plans.

Since the required matching throughputs vary for each mode of operation due to differing berth capacity levels the number of RMGs can also vary. The number of IY machines for each terminal type with 18 cranes is summarized in Table 7-5 below. The table also shows how many RMGs would be needed if only 50% of terminal throughput is required to be handled by the IY.

Table 7-5: Required IY RMGs

Terminal Mode	No. of RMGs for 60% Rail	No. of RMGs for 50% Rail
Conventional Terminal	9	8
Semi-Automated Terminal	10	8
Automated Terminal	11	9

With 22 berth cranes about 20 percent more lift capacity is needed so roughly 2 more RMGs per plan. Each of the RMGs will be cantilevered at the north end of the machine and has a turntable spreader. It is expected that bombcarts, shuttle carriers or AGVs will all place and leave containers for loading at the north side of the IY perpendicular to the tracks. The RMG will pick up the container and rotate it 90 degrees for rail car loading. The reverse procedure will be used for offloading containers. Approximately 500 containers can be “buffered” adjacent the IY.

For the Conventional and Semi-automated terminal IY’s the RMGs will be manned and manned bombcarts will likely be the preferred method to transport containers to and from the IY. The hostlers will leave the bombcarts once dropped off with an import container and retrieve the cart once an export has been placed on the bombcart.

For the Automated terminal AGVs or automated shuttle carriers will move containers from the landside end of the CY rows and place them in the IY buffer. Lift AGVs would place or retrieve containers from racks while shuttle carriers would use the ground. The IY RMGs will be automated except for the final lift and placement on the rail car which will be done by a remote operator. Otherwise the interchange with

the buffer and movement within the IY will be automated. This requires precise indexing of rail cars when switched into the IY.

For Automated terminal Option 2 a variation of the Wide Span RMG layout is provided that cuts the IY in two with separate lead tracks so each Terminal has its own individual IY so sharing is not required. Although this is an advantage, the disadvantage is that the individual IY tracks are much shorter requiring smaller cuts of rail cars and more switching. In addition, overall there is less working track, and thereby the IY's may not be capable of supporting the required throughput.

Side By Side RTG IY

While the Wide Span RMG IY is likely the most efficient mode of IY operation, it is a new type of operation to the Port of Montreal and it requires costly wide span RMGs with rotating spreaders. As a result, RTG IY plans have been prepared as well to reflect the current preferred mode of IY operation in the Port of Montreal. The first RTG IY option described here is two separate side by side yards that have long tracks. It will not work for the Automated terminal if the IY is to be an automated operation.

Essentially, the north IY would have four 4900 foot IY tracks under standard span RTGs. This yard could be allocated to Terminal A. A second south IY, allocated to Terminal B, would have four 4700 foot tracks under standard span RTGs. Thus the Terminal A IY has 19,600 feet of working track while Terminal B has 18,800 feet of track, for a total of 38,400. This is about 10,000 feet more than necessary for 18 berth cranes. As a result, this should be sufficient for 22 berth cranes.

For Terminal A bombcarts would travel along the side of the IY to their assignment and then wait for an RTG to load or discharge their container. About half the length of the IY can be accessed directly while the remaining yard length has access from the middle of the yard only. At Terminal B bombcarts only have access to one end of the IY so at times bombcarts may need to travel the full length of the IY twice.

End to End RTG IY

To allow each terminal direct adjacent access to their respective IY two End to End RTG IYs per terminal that have lengths generally the same as the width of the terminals is also a possibility. The sacrifice is track lengths of only 1640 feet are much shorter that in turn requires much more rail car switching, approximately double. With two RTG runs at each terminal, total track length is 26,240 feet. Overall there is less working track, and thereby the IY's may not be capable of supporting the required throughput for 18 or 22 berth cranes.

Support Tracks and Rail Service

The plans include at least the estimated 88,000 feet of support track required including arrival and departure tracks for trains up to 12,000 feet in length as necessary for 18 berth cranes. Discussion of the support track requirements, track plans and rail service is provided in Section 7.2.

7.1.3.3 Truck Gate Layouts

Each terminal for each mode of operation option has an advanced truck gate that would be constructed with a two or three lane pre-gate OCR, multi-lane receiving gate and multi-lane out-gate OCR. The receiving and delivery gates are located so to provide access to and from Marie-Victorin Boulevard Marie-Victorin Blvd. and to the outer ends of their respective terminals in order to get around their respective intermodal yards. The gate process will be as follows:

A two-stage receiving gate is shown, reflecting the current state of the art optical character recognition (OCR) technologies for North American gates.

At the first stage (pre-gate), data collection by OCR including driver, container and truck ID plus line scan photo record of container to record its condition and if desired weighing at an unmanned station. In addition, if a reservation system is included the reservation is confirmed.

The second stage (receiving gate) includes data verification and equipment inspection using intercoms and cameras that are remotely manned with clerks. If there is an issue with the information the driver would pull into a trouble resolution area to resolve these issues separately. Once everything is in order, the driver receives yard locations by means of a printed ticket and enters the terminal.

The out-gate process again involves data collection by OCR to confirm the out-going truck contains the correct container. Once a match is confirmed the truck will be allowed to exit with no interaction with a clerk.

Although each operating parameter is the same for each mode of operation the number of in and out gate lanes, and hence clerks, required to process trucks will vary with each terminal mode of operation as a result of different required matching throughputs. Based upon the planning criteria, including 50% of terminal throughput handled by trucks, and static simulation modeling, Table 7-6 as follows provides the primary requirements as estimated for each terminal with 18 berth cranes along with the average number of daily truck trips and hourly peak traffic.

Table 7-6: Comparison of Truck Trips and Gate Lanes

	Average No. of Daily trucks Inbound	Peak No. of Hourly Trucks Inbound	No. of In-Lanes Per Terminal	No. of Out-Lanes Per Terminal
Conventional Terminal	1015	163	8	4
Semi-Automated Terminal	1095	175	9	4
Automated Terminal	1178	235	11	5

For 22 cranes the above noted values will increase by roughly 20 per cent. For the in-gate, lanes approximately 250 m long are shown to provide roughly 25 to 30 minutes of queuing capacity while the out-gate lanes are shown to be 200 m long to provide roughly 10 to 15 minutes of queuing.

Since the central areas of each terminal are essentially blocked by a significant depth of rail and tracks, for each of the six terminal plans truck access to the terminals would need to be to the ends of the terminal. At the downstream end of Terminal A the gate is located between the bulk storage domes and support tail tracks with access to and from Marie-Victorin Boulevard via the current Contrecoeur port entry road. An example is shown on M&N Drawing No. 7146-MP-15. Alternatively the truck gate can be moved west next to Marie-Victorin Blvd. as shown on M&N Drawing No. 7146-MP-14. For this plan trucks will access the gates directly from Marie-Victorin Blvd.

For Terminal B only one location is shown for the truck gate. With the substantial number of lead tracks crossing Marie-Victorin Boulevard at the upstream property boundary of the Contrecoeur land bank, an

overpass for Marie-Victorin Boulevard will be required. Although for Terminal B there is quite a bit of room on Contrecoeur port lands adjacent the upstream end of the terminal, it is not considered sufficient to accommodate the truck gates along with required maintenance facilities and equipment parking. As a result, the truck gate has been positioned next to and south of Marie-Victorin Boulevard as shown on each terminal option plan. Trucks will access the gate directly from Marie-Victorin Boulevard. The connection between the gate and terminal itself will be via an underpass below the support and IY lead tracks plus the Marie-Victorin Boulevard overpass.

Once through the gates, for the Conventional terminal trucks will proceed into the CY to drop off or retrieve containers similar to current port operations. For the Semi-automated terminal, trucks will proceed to the landside end of the CY rows and back into the interchange areas where a remote operator will take over the CY RMG and pick up or place a container on the truck chassis. Unfortunately, for the Automated terminal trucks cannot proceed to the landside end of the CY rows since there AGVs or automated shuttle carriers are operating to receive and deliver containers to the IY. For safety reasons the two cannot mix. As a result, a container staging and truck loading area at the ends of the CY are required. Since we have two terminals side by side the truck loading and staging areas can only be on one side of each terminal.

In essence AGVs will pre-stage containers for local pick up into a buffer yard that is operated by RMGs. This pre-staging should be done during the night before a day shift when the RMGs are not required to handle trucks. Then during the day shift when the truck gates are open, the buffer RMGs are used almost exclusively to unload and load trucks. During the night shift or during slower gate periods the RMGs can then move received containers via AGV to the CY. This operation will generally necessitate a gate reservation system so the TOS knows which containers to pre-stage for the following day. If this can be done efficiently then it is likely possible to reduce the number of CY RMGs or ASCs since the imbalance in waterside and landside CY machines is the result of attempting to handle truck gate peaks.

Options 1 and 2 for the automated terminal illustrate the truck staging and interchange areas at the ends of each terminal. Unfortunately, substantial areas are required for this operation and so the terminal footprints impinge into the adjacent bulk facility in the case of Terminal A and adjacent properties for Terminal B.

7.1.3.4 Ancillary Facilities

In addition to the four major terminal components; berth, CY, IY and Gate each terminal requires a number of ancillary facilities that support container operations. These primarily include:

- A maintenance & repair facility including building;
- Space for mobile equipment parking;
- Electrical substations;
- An administration, planners and clerk office building;
- Meal, restroom and change room for labour;
- Parking for terminal labour;
- Parking for regular terminal staff; and,
- Fueling station.

It is expected that separate facilities will be required for each terminal. At the very least the maintenance facilities, equipment parking and fueling facility should be located directly adjacent the terminal CY and IY for easy access by the terminal's mobile equipment. It is also preferred that labour parking be near the equipment parking area and maintenance facility.

For each terminal the location of the maintenance facility, equipment parking, major substation and fueling facility will at the outer ends of each terminal. Where the berths have not been shifted 95 metres west Terminal A space is limited due to the adjacent bulk facility while ample space exists next to Terminal B. At Terminal A there does not appear to be enough space left over for labour parking so it has been located south of the dry bulk terminal storage domes. This will require that labour be shuttled to and from their work areas. At Terminal B labour parking can be located next to the maintenance building that can also provide labour facilities or near the truck gate where the administration facility and staff parking are also located. The following provides a further description of some of the ancillary facilities for each terminal mode of operation.

Conventional Terminal Ancillary Facilities

Each terminal has labour automobile parking lot that should contain about 500 to 600 spaces.

The maintenance and repair facility/building for each terminal would contain an RTG bay, hostler bays, top-pick and empty handler bays that could also double as spreader repair bays plus a wash bay and welding shop. A parts room and offices for shift foremen and supervisors is also required. The maintenance and repair building is expected to be in the order of 2000 to 2500 square metres in size.

The labour meal, break, change and restroom facilities can be a separate building or attached to the maintenance building. The floor area required will be in the order of 1000 to 1500 square meters.

Roughly 5000 to 7000 square metres is needed for mobile equipment parking; mostly hostlers and bombcarts.

The administration building would hold offices for senior staff, planners, clerks, IT, etc. and would be expected to be in the order of 2000 to 2500 square meters in floor area.

Staff parking at the administration building would contain 100 to 120 spaces.

Semi-Automated Terminal Ancillary Facilities

Each terminal has labour automobile parking lot that should contain about 450 to 550 spaces.

The maintenance and repair facility/building for each terminal would contain hostler bays and spreader repair bays plus shuttle carrier bays plus a wash bay and welding shop. A parts room and offices for shift foremen and supervisors is also required. The maintenance and repair building is expected to be in the order of 2000 square metres in size.

The labour meal, break, change and restroom facilities can be a separate building or attached to the maintenance building. The floor area required will be in the order of 900 to 1200 square meters.

Roughly 4500 to 6500 square metres is needed for mobile equipment parking; mostly hostlers and bombcarts, and/or shuttle carriers.

The administration building would hold offices for senior staff, planners, clerks, IT, etc. and would be expected to be in the order of 2500 to 3000 square meters in floor area.

Staff parking at the administration building would contain 150 to 240 spaces.

Automated Terminal Ancillary Facilities

Each terminal has labour automobile parking lot that should contain about 250 spaces.

The maintenance and repair facility/building for each terminal would contain mostly AGV or shuttle carrier bays and spreader repair bays plus a wash bay and welding shop. A parts room and offices for shift foremen and supervisors is also required. The maintenance and repair building is expected to be in the order of 2000 square metres in size.

The labour meal, break, change and restroom facilities can be a separate building or attached to the maintenance building. The floor area required will be in the order of 500 to 750 square meters.

The administration building would hold offices for senior staff, planners, clerks, IT, etc. and would be expected to be in the order of 2500 to 3500 square meters in floor area.

Staff parking at the administration building would contain 125 to 175 spaces.

7.1.4 Terminal Capacity Analysis

The terminal capacity analysis as performed by M&N uses a wide array of proprietary computer simulation models developed specifically to assess the operations and capacity of modern day container terminals. These models take into account three primary sets of data, namely:

Physical characteristics of the terminal;

Productivity of terminal equipment and personnel; and,

Market conditions and container flows at the terminal.

The physical characteristics of the terminal include such items as number of berths, number of ship to shore cranes, container yard space as ground slot equivalents, length of working track within the intermodal yard and number of in and out lanes at the truck gates.

Terminal equipment and labour productivity includes such data as number of lifts per hour by an overhead gantry, stacking efficiency, gate process times, etc. Such productivity measures are influenced by a number of factors such as training, operating costs, labour skill, vessel stowage and computer automation.

Market conditions reflect the characteristic flow of containers through the terminal on a daily, weekly or monthly basis. Market conditions play a significant role in stated terminal capacities, as capacity results are reported on a common basis such as equivalent capacity at the berth. For the Contrecoeur terminals, if a truck gate can handle say 1,000,000 TEUs/annum and 50% of all containers handled over the berth are destined to or from trucks, then the truck gate will have an equivalent berth capacity of 2,000,000 TEUs/annum.

The majority of the data used for the simulations is provided in the Planning Criteria.

Most North American container terminals have four primary components plus ancillary facilities, namely:

- Berth;
- Container yard;
- Intermodal yard; and,
- Truck Gate.

The component with the lowest capacity will govern the overall terminal capacity. For the Contrecoeur terminals, the capacity of the berths was determined first, which is generally the most costly component. The analysis was carried out in an effort to match the capacity of the three remaining components to that of the berth. Doing so utilizes the full potential of the berths. The capacity for each of the four components that determine overall terminal capacity are reviewed and reported as an equivalent berth capacity. Doing so allows for an "apples to apples" comparison of components to determine where constraints lie and informs the MPA or potential operator as to the volume that can be handled over the berth and through the terminal as a whole.

All capacities given are practical capacities which can be defined as the upper, sustainable limit of terminal throughput that maintains levels of service which meet customer requirements. The maximum capacity of a terminal can exceed the practical capacity by a wide margin but service issues (i.e. congestion) are likely to result. Certain minimum acceptable service levels are incorporated into the simulations. Finally, it is noted that given practical capacities do have a margin of error and can vary day to day, month to month and year to year. It is reasonable to expect that the capacities reported here are generally within a margin or error of plus or minus 10%.

From this analysis, the following practical capacities were determined for each component of the terminal plans for 18 and 22 berth cranes as summarized in Table 7-7 and Table 7-8.

Table 7-7: Combined Contrecoeur Terminal Capacity – 18 Berth Cranes

Terminal Components	Conventional Terminal (TEUs/annum)	Semi-Automated Terminal (TEUs/annum)	Automated Terminal (TEUs/annum)
Six Berths	2,800,000	3,000,000	3,250,000
Container Yards	2,860,000	3,040,000	3,250,000
Intermodal Yards	2,800,000	3,090,000	3,260,000
Truck Gates	2,800,000	3,000,000	3,250,000
Governing Capacity	**2,800,000**	**3,000,000**	**3,250,000**

Table 7-8: Combined Contrecoeur Terminal Capacity – 22 Berth Cranes

Terminal Components	Conventional Terminal (TEUs/annum)	Semi-Automated Terminal (TEUs/annum)
Six Berths	3,420,000	3,690,000
Container Yards	3,490,000	3,750,000
Intermodal Yards	3,420,000	3,710,000
Truck Gates	3,450,000	3,700,000
Governing Capacity	**3,420,000**	**3,690,000**

7.1.5 Conclusions

The planning effort undertaken to develop the plans in Appendix A and described above are very preliminary and conceptual in nature. Although the static simulation techniques used here are considered sufficient for Conventional terminal operations which by their very nature have a high degree of flexibility in the event of changing market or operating conditions, facilities where automation is introduced require more detailed analysis. To do so, dynamic simulation is considered necessary to confirm and prove operating conditions before a final selection of a terminal plan. In addition, besides throughput and operating parameters along with equipment and capital infrastructure costs, the assessment and comparison of different modes of operation must take into account the long term labour and operating costs over the lease life of the facility to provide a thorough evaluation of the return on investment. Without this, automated facilities will almost always appear unfavourable since they generally only provide modest capacity gains and have much higher initial equipment and infrastructure costs. It is the typically labour savings where they show a superior return.

Regardless, some observations can be made from the conceptual work done here. Both the Conventional and Semi-automated terminals appear feasible from an operating perspective. They are balanced and offer flexibility to handle truck gate peak periods. The Automated terminal does not appear well suited to the available land area if six berths is required as a result of the need for adjacent truck buffer and interchange areas. However, the automated terminal may be desirable if the IY were manned while maintaining automated horizontal transport via AGVs at the berth. As a result, operation plans with the MPA's preferred 22 berth cranes have only been prepared for the Conventional and Semi-Automated operations. This effort has shown that the throughput of 22 cranes can be accommodated within the Contrecoeur land bank.

7.2 RAIL PLANS

7.2.1 Rail Function

Each container terminal at Contrecoeur should include the following rail-related functionality:

- Rail access to the CN network, which is to address the presence of Marie-Victorin Blvd. (Marie-Victorin Blvd.) and Montee-Lapierre;
- A railway yard or support tracks, located on or off-terminal; and,

- Railway tracks for loading containers on the terminal, including the necessary infrastructure required for the container handling equipment.

7.2.2 Planning Criteria for Intermodal Yard

The rail intermodal yard (IY) shall be located "on-dock" with transfer between the container storage yard and intermodal yard by hostler/bombcart, manned shuttle carrier or AGV. Discharge and loading of rail shall be by RTG or RMG. The layout and throughput capacity of the intermodal yard shall be determined using the primary factors below.

Percentage of Terminal Throughput Handled by Rail: 60%

Market Share By Class 1 Railways:

Scenario One:

- CN: 100%
- CP: 0%

Scenario Two:

- CN: 70%
- CP: 30%

Scenario Three:

- CN: 30%
- CP: 70%

Average Equipment Lift Rate:

The average lift on and lift off rates that the IY equipment can achieve throughout the year. This rate is measured between rail switches so as not include switching downtime or breakdowns.

	Maximum Lifts per Hour
Imports:	25
Exports:	25

Rail Footage to TEU Ratio:

The ratio of rail footage to volume of TEU loaded within that footage.

- Rail Footage/TEU Ratio (CN Rail): 18
- Rail Footage/TEU Ratio (CP Rail): 27

Downtime Due to Switching, Shift Change, Breakdowns, etc.:

The duration of time during a shift that IY equipment is unable to work due to rail switching, breaks, etc. activities expressed as a percentage of total shift time.

- Downtime for manned RTGs: 25%
- Downtime for automated RMGs: 25%

Daily Peaking Factor:

- Assuming relatively even vessel schedules: 1.25

7.2.3 Rail Terminal Configuration and Operations Plan

To address the Montreal Port Authority's preference for a facility that would accommodate two terminal operators, four distinct configurations of working tracks were considered. For all four, the configuration and quantity of track feet for the Storage tracks as well as for the Arrival / Departure tracks is virtually unchanged. The primary advantages and disadvantages of each are listed in the table below.

Additionally, the tracks have been configured to accommodate six or seven lead tracks at the west end of the terminal. These comprise:

- A lead for each of the two or three Arrival / Departure tracks (=2 or 3);
- A lead for the Run-around track (=1);
- A lead for the Storage tracks (=1);
- Lead tracks for each of the two sets of Working tracks (=2); and,

The leads for each of the Arrival / Departure tracks and for the Run-around track allows for arriving / departing trains to access/egress the terminal with minimal or no impact to the adjacent tracks. Similarly, the lead track for the Storage tracks as well as the lead tracks for the Working tracks allows for virtual independent access/egress – from the west end, to their associated tracks. Two Arrival/Departure tracks are needed if one Class 1 railway is serving the terminal as preferred by the MPA. A third track is needed if two railways serve the terminals.

These leads require additional length for a grade separation structure at the intersection of the west end railroad tracks and the Marie-Victorin Boulevard. To facilitate design and construction of a suitable bridge structure for this grade separation, six or seven tracks have been spaced in a manner that accommodates reasonable individual bridge span lengths. Assuming an offset of approximately 15 feet from the face of pier to adjacent track centerline, the spacing of lead tracks provided would require span lengths of about 70 feet. Additionally the plans separate the Run–around track from the Arrival/Departure tracks, so that should a derailment occur on one of the Arrival/Departure tracks, in the vicinity of the grade separation structure, the Run-around track would still be operational, assuming the derailed railcars were not also blocking the Run-around track. It is recommended that the grade separation structure be constructed before the railroad tracks. The sequence would allow for the construction of the grade separation structure with little or no impact to the existing alignment of the Marie-Victorin Boulevard.

Due to the configuration of the Montreal Port Authority land bank at Contrecoeur, the configuration of the tracks on the east end of the proposed terminals cannot accommodate all desirable switching manoeuvres. Movement of railcars from the Storage tracks to the Working tracks (or the reverse) can be performed all without impacting rail operations on the west end. However, movement of railcars from

the Working tracks or from the Storage tracks, to any of the Arrival / Departure tracks, can only be done at the west end. The following Table 7-9 summarizes the operational moves that are available.

Table 7-9: Railcar Movement Summary

RAILCAR MOVEMENT	WEST END OF TERMINAL	EAST END OF TERMINAL
Arrive a train	Yes	No
Switch railcars from an Arrival/Departure track to Storage tracks or to Working tracks	Yes	No
Switch railcars from Storage tracks or to Working tracks to an Arrival/Departure track	Yes	No
Depart a train	Yes	No
Simultaneously arrive or depart a train, as well as switch railcars from Working tracks to Storage tracks (or from Storage to Working)	Yes	No
Switch railcars from Working tracks to Storage tracks (or from Storage to Working)	Yes	Yes

For all scenarios, trains (up to 12,000 feet in length) would arrive from the west and be placed on an available Arrival / Departure track. The train would then be split into segments of multiple railcars and those railcars would be moved onto a Working track or onto a Storage track or a combination of the two. The road locomotives that brought this arriving train into the terminal would disconnect from the rest of the train and either leave the terminal or be repositioned to the head (or west) end of a string of railcars – already placed on a Departure track, by using the Run-around track. The assembled train would have a brake test performed and when that process is completed, and approval from Canadian National dispatching is obtained to depart the terminal, the train would depart the terminal. In a similar but reverse pattern, railcars that are ready to leave the terminal would be collected and connected on an available Arrival / Departure track.

Scenario 1 = Side by Side RTG Working Track Configuration

This allows each terminal operator to operate a dedicated set of four Working tracks without operational interference from the other operator. Each operator's set of four Working tracks extend the full length of the six berths. One operator has access and utilization of the north set of four tracks; the second set of four tracks are accessed and utilized by the other operator. This allows for each operator to load / unload from Working tracks.

Scenario 2 = RMG Track Configuration

This allows each terminal operator to operate their own dedicated set of three or four Working tracks without operational interference from the other operator. Each operator's set of Working tracks would extend the full length of the six berths. In this scenario, one operator has access and utilization of the north set of tracks; the other operator would utilize the south set of Working tracks.

Scenario 3 = End-to-End Configuration with RTG Cranes

This allows each terminal operator to operate their own dedicated set of four Working tracks, but in this scenario, the Working tracks are somewhat less than half the length of the basic configuration or the side-by-side configuration. Each operator can operate their own Working tracks, but due to the lead track alignment required for each operator's yard, the required cumulative Working track length cannot be provided. Additionally in this configuration the west working yard is a "dead ended" yard which will require all switching between the working and storage tracks to be done from the west end. This scenario is included to reflect another possible track configuration for a two-operator terminal. The Working tracks available to each operator total approximately 8,900 (2700 m). Because of the substantially inadequate track length, this scenario – if adopted, would not generate the Montreal Port Authority's anticipated annual rail throughout, per berth.

Scenario 4 = Fully-Automated Operation, End-to-End Configuration with RMG Cranes

Operation for this scenario is other than the facility now being fully automated, is much the same as it would be for scenario 2 except with the use of RMG cranes in which six tracks can be accommodated under each. Working tracks available to each operator total approximately 12,650 (3855 m). Because of the inadequate track length, this scenario – if adopted, likely would not generate the Montreal Port Authority's anticipated of annual rail throughout, per berth.

Table 7-10: Working Track Configuration Advantages and Disadvantages

CONFIGURATION NAME	ADVANTAGES	DISADVANTAGES
BASIC – RMG	More efficient utilization of track length since longer lengths of track can be accommodated.	
	Can be converted to semi-automated operation, if a transfer area is included (at the west and east ends of the container yard) in the design.	
	Can be converted to fully-automated operation, if a transfer area is included (at the west and east ends of the container yard) in the design.	
SIDE BY SIDE – RTG	More efficient utilization of track length since longer lengths of track can be accommodated.	Trucks serving the south set of Working tracks will have to cross the north set of Working tracks to access the container yard.
		Cannot be converted to semi-automated operation, because AGV's would need to cross tracks to position themselves under the cranes.

CONFIGURATION NAME	ADVANTAGES	DISADVANTAGES
SIDE BY SIDE – RTG		Cannot be converted to fully-automated operation, because AGV's would need to cross tracks to position themselves under the cranes.
END-TO-END – RTG or RMG	RMG can be converted to semi-automated operation, if a transfer area is included (at the west and east ends of the container yard) in the design.	Switching for the 'west' Working tracks can only occur from the west end. Switching for the 'east' working tracks can be done from both ends.
	RMG can be converted to fully-automated operation, if a transfer area is included (at the west and east ends of the container yard) in the design.	Insufficient working track length, overall, to accommodate desired annual rail throughput.

7.2.4 Analysis Methodology

The rail service delivery system anticipated for the facility would consist of the following components:

- On-Terminal container loading tracks where the terminal operators strip and load containers to and from railcars. These tracks are the working tracks;
- Storage tracks, to accommodate railcars when not spotted on the working tracks and not at the arriving or departing tracks; and,
- Interchange tracks where inbound and outbound trains are received, or trains are assembled and prepared for departure from the facility.

Modeling of the Montreal Port Authority's proposed Contrecoeur container facility rail capacity was performed using Moffatt & Nichol simulation modeling tools. The modeling addressed the criteria listed earlier. Additionally, the following average feet per TEU, for CN and for Canadian Pacific Railway (CP) were used:

- Average Feet per TEU, CN = 18 (account double-stack equipment); and,
- Average Feet per TEU, CP = 27 (account single stack equipment).

The foregoing facts and assumptions serve as the input for simulation modeling.

7.2.5 Analysis Results

Overall Terminal Throughput

Initially, modeling addressed the issue of overall throughput (and associated rail throughput) based on Montreal Port Authority's initial operating criteria, including:

- Size of vessels, (5,800 TEU);
- Quay cranes, three per vessel, total of 18 cranes;

- Average of 25 to 29 moves per hour per quay crane;
- Near-full discharge and load per call;
- 65% berth occupancy; and,
- 1.25 gross/net berth time factor.

M&N models generated an estimated annual capacity, per three-berth terminal, of 1,400,000 TEUs per annum for the Conventional terminal, 1,500,000 TEUs for the Semi-automated terminal and 1,625,000 TEUs per annum for the Automated terminal. Based on an estimated 60% rail throughput, this yields a "Rail TEU per Terminal throughput of 840,000, 900,000 and 975,000 TEUs per annum per terminal.

Based on the available data and given operational criteria, the modeling produced the following findings.

Working and Storage Track Requirements

The working and storage tracks were modeled for the following scenarios:

- Scenario 1 = CN only operation.
- Scenario 2 = CN is 70% of total rail traffic and CP is 30% of total rail operations.
- Scenario 3 = CN is 30% of total rail traffic and CP is 70% of total rail operations.

The modeling considered not only the percentage CN – CP split of rail traffic, but the respective CN – CP Average Feet per TEU; Rail feet generated by each railroad; their respective average train lengths as well as peaking factor to address schedule variations and/or weather impacts.

The total Working track plus Storage track – in feet, required, per terminal as calculated from the models for each scenario under the high case Automated terminal throughput are shown in Table 7-11.

Table 7-11: CN/CP Rail Split Track Footages

Scenario	1	2	3
Percentage CN	100%	70%	30%
CN	46,536	32,575	13,961
CP	0	20,941	48,863
Total	46,536	53,517	62,824

Working Track Requirements

To determine the working track lengths required, M&N analyzed the needs, based on the following:

- Cranes per track group;
- Average crane productivity;
- Feet per spot (what length of train for each spot);
- TEU per spot (how many TEUs are carried on length of train spotted); and,

- Lifts per spot (how many lifts are needed to discharge/load the TEUs per spot).

Also considered was labour required to accommodate the railcars being spotted and unloaded, including blueflags, the cone removal; car inspection and repair, and labour needed to reload the railcars, including reload, attach cones and remove blueflags, plus some built-in time to accommodate waiting for switch engine and actual spotting (or pulling) railcars. Additionally, it was assumed that each working track would be turned over two times per day, on a peak day. A turnover is a complete cycle that comprises receipt of railcars, unloading containers from the railcars, minor repairs as needed, and then reload containers onto the railcars.

Accordingly, the resulting working track total, for each terminal, is approximately to 14,500 feet.

Although these totals may appear to be high, it should be noted that the relative anticipated terminal rail throughput for this study is somewhat similar to that of the 2007 Montreal Port Authority International Capacity Study. For a comparable annual TEU throughput for rail only, it was determined that a total of approximately 125,000 feet of track (total infrastructure) would be required. The preliminary layouts we have provided reflect the totals provided in Table 7-12.

Table 7-12: CN Market Share Rail Footages

Scenario	1	2	3
Percentage of Rail Traffic from CN	100%	70%	30%
Total System Track required, for both Terminals (Automated operation) excluding Arrival/Departure and Run Around Tracks	93,073	107,033	125,648

These totals can be re-stated as shown in Table 7-13.

Table 7-13: Rail Footage Totals

Track Type	Remarks	Total length (feet)	Total length (m)
Working Tracks	For layouts other than the end-to-end	29,000 feet	8839 m
Storage Tracks	Applies to all layouts	96,648 feet	299458 m
Two Arrival/Departure (Interchange) tracks	Applies to all layouts	24,000 feet	7315 m
TOTAL, for non 'end-to-end' options		149,648 feet	45612 m
Run-around track		12,000 feet	3658 m

The Arrival Departure (Interchange) tracks total is 24,000 feet, which is two 12,000 foot tracks. The layouts provided however do include two or three tracks of at least 11,000 foot long. Should it be necessary to provide additional Interchange track, it is suggested that a siding of 11,000 to 12,000 feet be constructed, within the CN right-of-way, immediately west of the connection to the proposed

Contrecoeur facility. This would accommodate a convenient location to hold an 11,000 foot train and minimize impact to the terminals.

7.2.6 Rail Conclusion

The modeling analysis indicates that to achieve the Montreal Port Authority's objectives for the proposed Contrecoeur two-terminal container handling facility with 18 berth cranes, the following is required:

- Six Working Tracks, that collectively total 29,000 feet (8839 m), for the two terminals;
- Working and Storage Track Requirements total 93,072 feet (28,368 m), 106,634 feet (32,502 m) and 125,648 feet (38,298 m) for Scenarios 1, 2 and 3; and,
- Interchange tracks including arrival/departure and run around tracks, to accommodate trains entering the terminal and a train ready to depart the terminal.

As indicated herein, these values and rail footage requirements were developed for 18 berth cranes under the throughput of an Automated operation. The corresponding terminal throughput under this scenario is 3,250,000 TEUs per annum. With 22 berth cranes the above noted track requirements would increase accordingly for the estimated 3,420,000 TEUs per annum for the Conventional terminal and 3,690,000 TEUs per annum for the Semi-Automated terminal. Table 7-14 as follows provides a summary of track requirements with pro-rated values for the 22 berth Conventional and Semi-Automated terminals.

Table 7-14: Terminal Track Summary

	Automated Terminals (18 Berth Cranes)	Conventional Terminal (22 Berth Cranes)*	Semi-Automated Terminals*
Total Terminal Throughput	3,250,000 TEUs/annum	3,420,000 TEUs/annum	3,690,000 TEUs/annum
Rail Throughput (60%)	1,950,000 TEUs/annum	2,052,000 TEUs/annum	2,214,000 TEUs/annum
Minimum Required Working Track	29,000 feet	31,000 feet	33,100 feet
Minimum Required Support Track	96,648 feet	102,500 feet	110,200 feet
Two Interchange Tracks	24,000 feet	24,000 feet	24,000 feet
One Run Around Track	12,000 feet	12,000 feet	12,000 feet
Track Total (excl. leads)	161,648 feet	169,500 feet	179,300

*all rail footages pro-rated from 18 berth crane Automated terminals rail footages

8.0 TERMINAL PLANS – INITIAL PHASES

8.1 INTRODUCTION

Following on from the full 6 berth build out plans described in Section 7, Phase A (one berth), Phase A2 (two berths) and Phase B (two berths) plans for the Contrecoeur Terminal have been prepared. These initial terminal phase plans are prepared for both a Conventional and Semi-Automated mode of operation as shown on the following drawings enclosed in Appendix A:

- M&N Drawing No. 7146-MP-20 Conventional Terminal Phase A (one berth);
- M&N Drawing No. 7146-MP-20B Conventional Terminal Phase A2 (two berths);
- M&N Drawing No. 7146-MP-21 Conventional Terminal Phase B (two berths);
- M&N Drawing No. 7146-MP-22 Semi-Automated Terminal Phase A (one berth);
- M&N Drawing No. 7146-MP-22B Semi-Automated Phase A2 (two berths); and,
- M&N Drawing No. 7146-MP-23 Semi-Automated Terminal Phase B (two berths).

These phased plans are based on the preferred full build out plans for the Conventional and Semi-Automated terminals as depicted on M&N Drawing Nos. 7146-MP 14 and 7146-MP 16 enclosed in Appendix A and reflect a full build out with 22 total berth cranes. These two preferred full-build out plans were subsequently revised from earlier versions with 18 total berth cranes to reflect additional berth capacity with the addition of more berth cranes as discussed in Section 7. As also discussed earlier, the berths on these plans have been shifted 95 m upstream so as the new terminal will not impact the existing bulk facilities, plus the second future bulk berth has been removed. A brief summary of the preferred full build out capacity for the Conventional and Semi-Automated terminals, utilizing a total of 11 ship to shore cranes per terminal (22 total), is provided below for reference.

Full Build Out Conventional Terminal (ref. M&N Drawing No. 7146-MP-14):

- Practical Capacity: 3,420,000 TEUs per annum;
- Berth: for each terminal there are 4 cranes for the first and second berths and 3 cranes for the third berth.
- CY: 21,200 TGS (manned RTG);
- IY (Manned RMG): 11 RMGs on 33,521 feet of working track; and
- Truck Gate: 18 in-lanes, 10 out-lanes.

Full Build Out Semi-Automated Terminal (ref. M&N Drawing No. 7146-MP-16)

- Practical Capacity: 3,690,000 TEUs per annum;
- Berth: for each terminal there are 4 cranes for the first and second berths and 3 cranes for the third berth;
- CY (Automated RMG): 18,500 TGS (automated Rail Mounted Gantry or Automated Stacking Canes);

- IY (Manned RMG): 12 RMGs on 39,163 feet of working track; and
- Truck Gate: 18 in-lanes, 10 out-lanes.

A description of the phased terminal layouts is described in the following section.

8.2 PHASED TERMINAL LAYOUTS

The Contrecoeur terminal development will begin at the far downstream end of the site next to the bulk terminal and expand westward (i.e. upstream). The initial phase will include one-berth (Phase A) that is located as noted about 95 metres away from the proposed new bulk berth in order to minimize impacts to the adjacent dry bulk port facility. Phase A includes one berth with 4 cranes that is 350 m long to accommodate a 300 m LOA vessel. The upland facilities for Phase A will match the capacity of the single berth. Phase A2 will add a second berth and one crane upstream of Phase A for a total berth length of 675 m, however, the upland facilities will remain unchanged along with the terminal capacity. Phase 2 will maintain the two berths, but add 3 cranes and expand the upland facilities to match the new berth capacity. The following sections provide details on the phased development for the Conventional and Semi-Automated terminals.

8.2.1 Conventional Terminal - Phase A (One-Berth) Layout

As directed by the MPA, Phase A shall utilize 4 ship to shore cranes. Based on single trolley ship to shore gantry cranes to manned bombcarts, the estimated berth capacity, and hence terminal practical capacity, for Phase A is 430,000 TEUs per annum.

The corresponding CY, utilizing a manned RTG operation, will require a total of 2,800 TGS, or 11 stacks. Each stack would be 46 TGS long x 6 containers wide; the stacks are located directly behind and orientated parallel to the berth.

The IY, based on a three (3) manned RMG's over four (4) working tracks, will require a minimum of about 3,000 m of total working track; however, a total of 3,660 m of working track is provided to minimize relocating switch ladders, etc. between subsequent phases (915 m x 4). The remainder of the rail work includes 3,596 m of storage tracks, 3,840 m of runaround tracks and 7,210 m of interchange tracks. Both the runaround and interchange tracks are constructed to its full build out requirements. It is noted that in all layouts the storage tracks are located adjacent to the interchange tracks. While this isn't an effective land use plan or construction phasing plan, the layouts are intended to provide a conceptual view for each scenario.

For the truck gate, 3 entry lanes, 2 exit lanes and 2 pre-gate lanes are included. The main ancillary facilities include an administration, maintenance, labour check-in/lunch and electrical substation building. The maintenance building could be built in stages (i.e. additional RTG repair bays could be added to a modular maintenance building structure as the terminal expands and additional equipment is required). The remaining building structures, however, are expected to be constructed to its full build-out requirements in Phase A to avoid future disruptions to office and terminal operations at a relatively small cost. Similarly, the locations of the berth, CY, IY, storage tracks and gate in Phase A allow for relatively easy expansion into Phase B and beyond.

8.2.2 Conventional Terminal – Phase A2 (Two Berth) Layout

The Phase A2 plan is the same as Phase A in all respects except one; a second lay-by berth 325 m long is added along with one additional crane. Although the berth capacity will increase, the terminal will still be constrained by the container yard at 430,000 TEUs per annum. The second berth is simply provided to give berthing flexibility to the shipping lines in order to avoid ships having to wait, and possibly go to anchor. As a result, two ships can now be worked simultaneously.

8.2.3 Conventional Terminal - Phase B (Two-Berth) Layout

The third stage, or Phase B, of the Contrecoeur terminal development will include the addition of three more cranes on the second berth. As such Phase B will include a total of two berths, with a total of 8 ship to shore cranes (4 cranes per berth). Based on the same market and operating assumptions as in Phase A, the estimated two berth Phase B capacity is 1,050,000 TEU's per annum.

The corresponding CY will require a total of 7,000 TGS, or a total of 26 stacks that will be divided into two equal rows of 13 stacks located behind each berth.

The corresponding IY, based on a total of five (5) manned RMG's over eight (8) working tracks, will require a total of 7,320 m of working track (915 m x 8), and the storage tracks are increased to a total of 8,970 m.

The truck gate includes a total of 6 entry lanes, 3 exit lanes and 2 pre-gate lanes. The maintenance building is expanded to its full build out requirements to complete the major components for the Phase B Conventional Terminal.

8.2.4 Semi-Automated Terminal - Phase A (One-Berth) Layout

The berth location for the semi-automated terminal remains the same as the conventional terminal but based on higher production single trolley ship to shore gantry cranes to manned shuttle carrier operation, the estimated semi-automated berth capacity is increased slightly over the conventional terminal to 470,000 TEU's per annum.

For the CY, the Semi-automated terminal utilizes automated cranes (RMGs or ASCs) in the yard rather than manned RTGs. The corresponding CY requires 2,400 TGS, or 6 rows of 40 TGS long x 10 containers wide. The rows are located directly behind and orientated perpendicular to the berth.

The corresponding IY, based on a three (3) manned RMG's over four (4) working tracks, will require a minimum of about 3,280 m total of working track; however, a total of 3,972 m of working track is provided to minimize relocating switch ladders, etc. between subsequent phases (993 m x 4). The storage tracks total 4,860 m, and the runaround and interchange tracks remain the same as the conventional terminal layout. Also, staying the same are the 3 entry lanes, 2 exit lanes and 2 pre-gate lanes as provided for the truck gate.

8.2.5 Semi-Automated Terminal – Phase A2 (Two –Berth) Layout

As was done with the Conventional plans, the Semi-Automated Phase A2 plan is the same as Phase A in all respects except one; a second lay-by berth 325 m long is added along with one additional crane. Although the berth capacity will increase, the terminal will still be constrained by the container yard at 470,000 TEUs per annum. The second berth is simply provided to give berthing flexibility to the shipping

lines in order to avoid ships having to wait, and possibly go to anchor. As a result, two ships can now be worked simultaneously.

8.2.6 Semi-Automated Terminal - Phase B (Two-Berth) Layout

The second stage or Phase B of the Contrecoeur terminal development will include the addition of a second berth located immediately upstream of Phase A. As such Phase B will include a total of two berths, with a total of 8 ship to shore cranes (4 cranes per berth). Using the same market and operating parameters as in Phase A, the estimated two berth Phase B capacity is 1,140,000 TEU's per annum.

The corresponding CY will require a total of 5,900 TGS, or a total of 15 rows located directly behind and orientated perpendicular to the two berths.

The corresponding IY, based on a total of six (6) manned RMG's over eight (8) working tracks, will require a total of 7,944 m of working track (993 m x 4), and the length of storage tracks is increased to 10,290 m.

The truck gate includes a total of 6 entry lanes, 3 exit lanes and 2 pre-gate lanes. The maintenance building is expanded to its full build out requirements to complete the major components for the Phase B Semi-Automated Terminal.

9.0 CAPITAL COST ESTIMATES

9.1 INFRASTRUCTURE

9.1.1 Summary of Cost Estimates

The Contrecoeur container terminals will be constructed in several phases based on market growth trends. The project consists of many varied work components that include significant dredging and land reclamation, heavy civil marine works to construct the wharf structure, on and off site rail construction, underground civil and electrical utilities and services, extensive asphalt and concrete pavements, off site highway works, various buildings and container handling processes. Provided below are opinions of probable cost to design and construct the container terminal development infrastructure, for both a conventional (RTG) operation and a semi-automated (RMG) operation.

Based on the preferred general arrangement phasing plans as discussed in Section 8, the following utility plans are developed and are provided in Appendix A:

- 7146-MP-24: Conventional Terminal Full Build Out Utility Plan;
- 7146-MP-25: Conventional Terminal Phase A Utility Plan;
- 7146-MP-26: Conventional Terminal Phase B Utility Plan;
- 7146-MP-27: Semi-Automated Terminal Full Build Out Utility Plan;
- 7146-MP-28: Semi-Automated Terminal Phase A Utility Plan; and,
- 7146-MP-29: Semi-Automated Terminal Phase B Utility Plan.

These utility plans show the required civil and electrical utilities to service the terminals for the Full Build Out (six berths), Phase A, and Phase B developments for the conventional and semi-automated terminal operations.

Cost estimates are provided for the initial phases of terminal development. As a result the following eight (8) cost estimates are included here:

- Conventional Terminal Phase A;
- Conventional Terminal Phase A-2;
- Conventional Terminal Phase B;
- Conventional Terminal Entry Costs;
- Semi-Automated Terminal Phase A;
- Semi-Automated Terminal Phase A-2;
- Semi-Automated Terminal Phase B; and,
- Semi-Automated Terminal Entry Costs.

As described in Section 8, the following summarizes the proposed project phasing:

Phase A: One berth with 4 STS gantry cranes and annual throughput capacity of 430,000 TEUs per annum for a Conventional operation and 470,000 TEUs per annum for a Semi-Automated operation.

Phase A-2: Two berths with 5 STS gantry cranes and annual throughput capacity of 430,000 TEUs per annum for a Conventional operation and 470,000 TEUs per annum for a Semi-Automated operation. As such the terminal infrastructure works include only the second berth extension and backlands fill.

Phase B: Two berths with 8 STS gantry cranes and annual throughput capacity of 1,050,000 TEUs per annum for a Conventional operation and 1,140,000 TEUs per annum for a Semi-Automated operation. As such the terminal infrastructure works include the CY, IY and gate improvements related to the second berth extension from Phase A-2.

Separate Entry Costs are provided for each terminal operation since these costs are not within the terminal boundary and thus are not considered directly attributable to terminal development. These include offsite road and rail improvements, as well an allowance for environmental habitat compensation.

The following Table 9-1 below summarizes the cost estimates to implement the proposed Contrecoeur development for the conventional and semi-automated terminal operations.

Table 9-1: Terminal Infrastructure Cost Estimate Summary

ESTIMATED COST				
Scenario	**Conventional Terminal**	**Conventional Terminal Entry**	**Semi-Automated Terminal**	**Semi-Automated Terminal Entry**
Phase A	$233,000,000		$226,000,000	
Phase A-2	$85,000,000		$85,000,000	
Phase B	$70,000,000		$71,000,000	
TOTAL	$388,000,000	$67,000,000	$382,000,000	$68,000,000
	$455,000,000		$450,000,000	

A detailed breakdown of each scenario showing the individual itemized work components and associated cost estimates is provided in Appendix F.

In the absence of detailed engineering design and analysis, estimates for the scope of work and quantity take-offs are based on the concept level drawings. As a result, a contingency allowance generally ranging from 20% to 25% is included for the individual itemized components of work to account for the undefined or indeterminate items due to the limited level of site investigation and engineering analysis completed to date.

As requested by the MPA, the individual unit rates are based on 2009 cost levels in the Montreal area (Canadian dollars) and do not allow for future escalation. The individual unit rates have been developed based on historical and current estimates and contract pricing data using in-house and Port of Montreal sources, discussions with manufacturers and material suppliers, Statistics Canada Construction Cost

Indices, BC MOT Construction and Rehabilitation Cost Guide and RS Means Heavy Construction Cost Data. Contract unit rate pricing data is referenced from the following projects: Deltaport Berth 3, Fairview Container Terminal, Port of Montreal Terminal Upgrades, East Blair Two in Tacoma, APL Berth 60-63 in Oakland, Pier E and Pier G in Long Beach.

The estimates include a permitting, engineering and contract administration allowance, which is estimated to be 10% of the total capital construction costs to cover preliminary and detailed engineering design, geotechnical investigations, bathymetric and upland topographic surveys, environmental impact assessment studies and costs associated with obtaining the regulatory and environmental permits, as well as costs associated with onsite construction supervision, environmental monitoring and overall project management services during design, tender and construction stages.

The cost estimates exclude container handling equipment, which is addressed separately in Section 10.2.

All costs exclude applicable federal and provincial taxes, including the GST and QST.

9.1.2 Description of Work Components

The following section describes the major work items included and/or excluded and some of the relevant assumptions made in preparing the cost estimates for each scenario.

Mobilization and Demobilization

- For general mobilizing of equipment and personnel for the work, a lump sum allowance is used based on 4% of the capital construction cost based on a competitive bid during tendering, which we would expect given the size of the project. Insurance and bonding are included in the above allowance.

Dredging (including disposal) and Land Reclamation

- For dredging a unit rate of $28/cu. m. plus a 50% contingency allowance is used based on recent preliminary quotations from two eastern Canadian based and one European based dredging contractors. This unit rate is based on the average of a $40/cu. m estimate based on a large clamshell or barge mounted excavator with dump scows, towing to the wharf, offloading and trucking to a prepared site 1 km from the wharf head as well as a $15/cu. m. estimate based on a large hydraulic cutter suction dredging operation and pumping the dredgeate directly onshore. The estimate includes a significant mobilization cost as the large hydraulic dredger would likely originate from Europe. A temporary barge ramp facility is assumed immediately upstream of the new bulk berth, and upland disposal is assumed within the Port owned non-developed Contrecoeur site. The unit rate estimate could be refined (with a smaller contingency allowance) with subsequent geotechnical analysis. The volumes of dredging exclude any ship turning basin, but do include the 700 cu. m. for dredging of the tug basin. An over dredge allowance of 3% is included which is roughly equal to 100 mm.
- For the land reclamation and imported fill (i.e. sand) behind the wharf structure, and to bring the site up to the desired sub grade elevation, a unit rate of $32/cu.m. is used based on recent budgetary quotes from DEMIX's quarry located in Varennes and Sylvain Dube Excavation in

L'Assomption. The rate consists of $22/cu. m. for the sand material, $9/cu. m. for hauling and $1/cu. m. for municipal taxes. The total unit rate for imported sand compares to recent contract pricing and previous estimates prepared for MPA. It is noted that no reuse of the dredged silty clay is assumed as recommended by Golder.

- For the scour protection along the berth face, a unit rate of $80/cu. m. is used, which consists of a 6 m wide, 1 m thick layer of rip rap stone running along the entire length of the SSP wall toe. In addition, slope protection is provided along the ends of the SSP wall returns to connect back to the existing shoreline.
- The cost estimates do not allow for any ground improvements to mitigate against long term settlements based on preliminary geotechnical recommendations. However, these assumptions should be further investigated based on detailed geotechnical analysis and terminal operating preferences.
- The cost estimates do not include any land reclamation and fill downstream of the proposed container terminal to connect to the existing bulk terminal. These works are considered beyond the scope of the container terminal development.

Removals and Site Preparation

- For site preparation an allowance is made for removal of the organic surface material, including shrubs, trees, organic cover that is generally located along the river shore and miscellaneous construction debris throughout the site. No allowances are made for removal of the existing pre-fill materials (i.e. silty sand and gravel).
- No allowances are made for removal and/or remediation of any contaminated soils and hazardous materials from the site as this is unknown at this time. As such the existing onsite materials are considered at this point to be suitable for all disposal sites (i.e. Level B or better, based on the provincial soil quality criteria stated into the *Soil Protection and Contaminated Sites Rehabilitation Policy*).

Wharf Structure

- For the wharf structure, a steel sheet pile (SSP) wall is recommended as described in Section 4. The cost estimate includes an H-Z type steel sheet piling system consisting of a series of "single" H-piles alternating with standard Z-pile pairs for the entire length of wall. All steel is assumed to not require protective coatings for corrosion. Budget quotes were obtained from several steel suppliers (i.e. Skyline Steel and Pipe and Piling Supplies) for the SSP wall system and steel pipe piles.
- Installation of the H-Z SSP bulkhead wall system was based on typical contractor equipment and labour rates for a pile driving crew, consisting of a crawler crane, vibro hammer and leads, foreman, welder, and labourers. Since installation of the HZ wall requires a high degree of precision, it is assumed that approximately 12 m of HZ SSP wall can be installed per week, or 7 H-piles. In addition, separate crews are assumed for the following work:

  - The installation of the anchor piles and rear crane beam foundation piles;
  - The two front crane beam foundation piles;
  - Cast in place (CIP) concrete cope wall, pile caps and crane beams; and,
  - Installation of the miscellaneous tie rods, fenders and crane rails.

- It is envisioned that the entire SSP wall can be built using land based equipment to reduce costs. To do so will require infilling the wharf area, to a distance behind the berth face with imported material, to an elevation above current water levels to provide a working area for the land based equipment.
- For the CIP reinforced concrete used for the SSP cope beam, pile caps, front and rear crane beams and seismic ties beams, a unit rate of $600/cu. m. is used based on recent local engineering estimates prepared by Golder and contract pricing (i.e. Maisonneuve Terminal Truck Gate).
- For the fenders, a unit rate of $30,000 each is used, based on a buckling column fender pairs with steel panel coupled with UHMW Polyethylene facing pads.
- The wharf structural cost estimates include the SSP wall required for the various phasing of the container terminal development only, and do not include any additional wharf structures that may be required for connect to, or replace, the existing bulk terminal wharves.

Civil & Structural Utilities

- The fire protection water system is separated from the domestic water system as requested by the MPA and consists of a dedicated fire protection pump station drawing water from a river intake, fire hydrants and a separate non-potable water fire protection distribution system. For the conventional terminal, fire hydrants are spaced approximately every 100 m in accordance with the National Fire Protection Association (NFPA), or at every high mast light pole. For the semi-automated terminal, however, the NFPA standard does not strictly apply, nor can it be achieved, so a new standard will need to be adopted requiring input from both the MPA and the local municipal Fire Department. For the semi-automated terminal cost estimate hydrants are located at every high mast light pole (and thus greater than 100 m spacing).
- The domestic water system consists of a connection to the existing potable water system that is located along Marie-Victorin Blvd. to supply potable water and to service the various buildings and ships. A reduced unit rate per meter of distribution pipe is used compared to the fire protection system since the flow rates for the domestic system are significantly smaller and thus the pipe sizes can be reduced.
- The sanitary sewer system that services the various buildings consists of the typical collection pipes and manholes (MH). However, the system will also include an onsite wastewater treatment unit and river discharge as well as perhaps a sanitary pump station to service the administration buildings as these are located a fair distance from the river discharge. The cost estimate includes a two-stage anaerobic/aerobic treatment unit with Ultraviolet light

disinfection to meet the current provincial regulations on wastewater treatment (i.e. BNQ), similar to the BIONEST™ system that is currently used in the Maisonneuve Terminal.

- The storm drainage system for the conventional terminal includes the typical collection pipes, manholes and trench drains and catch basins. The trench drains will be orientated parallel with the container stacks at the low points to collect stormwater. A series of ridges and valleys will be used throughout the CY, which is typical for a manned RTG operation. For the semi-automated terminal, however, flat or virtually flat grades throughout the CY are generally required for the automated RMG's. To avoid ponding of surface drainage, a grid of closely spaced under drains, or French drains, in conjunction with an open graded/porous asphalt pavement (i.e. low fines content) is proposed. This type of asphalt pavement will require concrete strips underneath the container corner castings since it is not as strong as typical heavy duty asphalt. Storm water treatment is included prior to discharge into the river, and consists of Stormceptor™ type pollutant removal system (i.e. sediment and heavy metals, free oils).
- Heavy duty pavement is assumed for the container handling and stacking areas, traffic aisles and truck gates, and would consist of a relatively thick (approximately 1.0 m) layer of asphalt cement, roller compacted concrete pavement (RCCP) or cast in place concrete pavement (CIPCP), as well as the foundation base gravels (MG-56 and MG-20). Light/Medium duty pavement is assumed for equipment and POV parking areas and areas surrounding the buildings, and would consist of a reduced pavement structure (approximately 0.75 m thick layer). A unit rate of $130 per square meter is used for the heavy duty pavement and $70 per square meter for the light/medium duty pavement based on recent local engineering estimates and contract pricing (i.e. Maisonneuve Terminal Truck Gate).
- Pavements for the RTG runways are assumed to consist of RCCP, or CIPCP founded on base gravels as is typical for the Port of Montreal. The runways are assumed to be approximately 2.6 m wide. For the RMG runways, the loads are much larger and tolerances for settlement are more stringent. Subject to further geotechnical investigations the estimate includes a larger, non-pile supported strip footing for the RMG runways. As a result, a unit rate of $500 per meter length is used for the RTG runways and $1500 per meter is used for the RMG runways.
- Miscellaneous civil work includes fencing, pavement markings, reefer tower structures, fueling facility and CBSA Radiation Portal Monitors (RPM).

Off Site Improvements

- Based on our initial site visit and discussion with MPA staff, there are a series of existing drainage channels running through the site. An allowance is included for relocating these existing drainage channels to avoid negative impacts to the terminal development. The allowance includes ditching, underground piping and river discharge.
- Also included is a $400,0000 allowance for the tug basin located at the downstream end of the existing bulk terminal. It is assumed that the tug basin will not be required until Phase B, and includes the mooring support piles as well as an access gangway and support piles. It is

assumed that the Port will have, or can obtain at a reasonable cost, an appropriate mooring barge which is not included.

Rail Works

- The Intermodal Yard (IY) includes the working tracks, rail, ballast, sub ballast and ties, turnout assemblies and switches, and end of track bumpers. The IY also includes the concrete RMG runways and asphalt paving. The unit rates for the various items are taken from the previously issued Hochelaga-Viau project rail estimates, which were prepared by M&N's Rail group.

Gate Complex

- The terminal gate complex includes the latest container terminal gate processing standards for the OCR pre-gate, receiving (in) gate and OCR delivery (out) gate. The pre-gate, receiving and delivery gate equipment include the intercoms, proximity card readers, printers, cameras, OCR portals as required, lighting, bollards and gate arms. The cost estimates include new canopy structures at the pre-gate, receiving gate and delivery gate area to shield equipment from ice and snow. No weigh scales are provided. The cost for new or enhanced terminal management software, and any associated training required for such software, is excluded from the estimates.

Buildings

- The unit costs for the various building structures are based according to standard industrial buildings that are found typically at other terminals. Building components include concrete spread and strip footings, concrete slab on grade, steel floor deck with concrete topping, open web steel joists, steel roof deck, structural steel beams & columns and exterior steel cladding. The unit rates for the various items are taken from the previously issued Hochelaga-Viau project building estimates, which were prepared by Genivar's Building/Architecture group. Mechanical, electrical and general miscellaneous allowances are included in all building structures. Soft costs, including architectural fees and furniture items, are excluded from the estimate.
- The Administration/Control Building is estimated to be in the order of 2,500 sq. m. for the conventional terminal and 3,000 sq. m for the semi-automated terminal. The Maintenance Building is estimated to be in the order of 2,500 sq. m. for the conventional terminal and 2,000 sq. m. for the semi-automated terminal. The Labour Check-In/Lunchroom is estimated to be in the order of 1,500 sq. m. for the conventional terminal and 1,000 sq. m. for the semi-automated terminal. Refer to Section 7.1 for additional discussion on the building requirements. The estimate allows for a modular maintenance building that can be expanded as the terminal develops.

Electrical Terminal Infrastructure

- The electrical and power distribution work includes the overall power supply to the site from Hydro-Quebec's (HQ) main transmission lines along Marie-Victorin Blvd., as well as individual electrical services to new buildings and structures, main substation and separate substations

for the reefers, RMG's, berth cranes, (including transformers, switchgear, conduits, wires and outlets), electrical power and communication distribution (duct banks, manholes, pull boxes, conduits, wires) and high mast light poles (incl. poles, fixture and foundations).

- Provisions for ship to shore power are provided, and include the berth vaults and conduits running from the main substation.

Entry Cost (Off-Site)

- At the south-west corner of the terminal site, a two-lane vehicle overpass is included along Marie-Victorin Boulevard where the rail support tracks cross the highway at grade. At this stage it is assumed that the MTQ will not allow lengthy delays for Marie-Victorin Blvd., and the necessary support track cannot be located outside of the Port owned Contrecoeur site. In order to provide the standard railway clearances and vehicle ramp grades, the overpass is expected to be approximately 300 m long. Assuming a typical precast concrete I-beam with a cast in place concrete deck on piled foundation structure, a unit rate of $4,000 /sq. m. is used based on BC MOT costs for similar structures. It is assumed that the full structure would be constructed during Phase A.
- The entry costs also include the off-terminal support tracks, including the storage, runaround and interchange rail works. These would be constructed in phases as required by the terminal development. At this stage it is assumed that CN will not construct, or contribute to any portion, of these works (conservative assumption). It is recommended to review the off-terminal rail works with CN to determine if another site could be found, or whether CN would be willing to build or fund a portion of these works.
- The entry costs also include an environmental habitat compensation allowance, which is likely to be significant given the size and scope of the marine works. An allowance of 5% of the total capital construction costs is provided based on similar large scale in water terminal infill projects.

9.1.3 Capital Cost Discussion and Recommendations

A simplified sensitivity analysis for the terminal cost estimates indicates a relatively small number of components contribute to the majority of the total project cost. Using the Conventional Terminal Phase A as an example, the following Table 9-2 identifies the individual components that have a significant impact on the total project cost (i.e. greater than 10%):

Table 9-2: Sensitivity Analysis

Description	% of Total Project Cost
Dredging and Land Reclamation	16%
Wharf Structural	17%
Civil Infrastructure	22%
Entry Cost (Road and Rail)	15%
TOTAL	70%

A pie chart showing the relative percentage breakdown of Total Project Costs for all the main individual components is provided in Appendix F for reference.

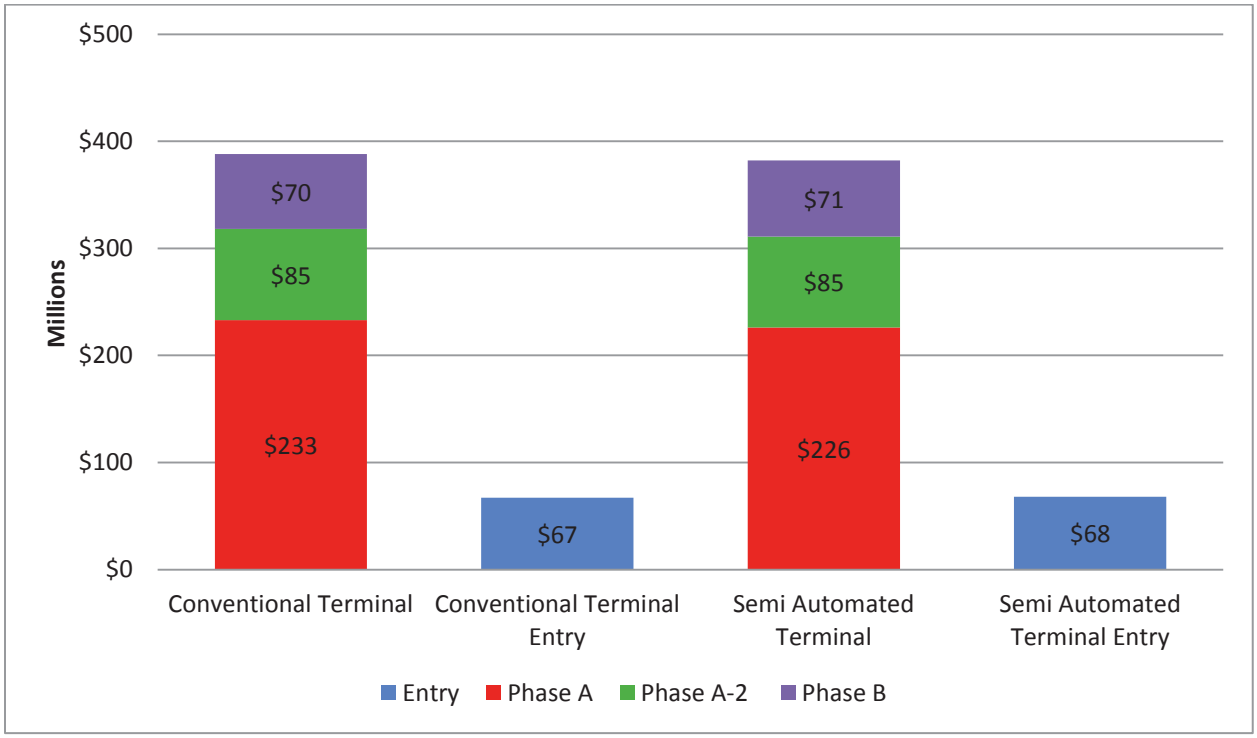
Typical of many new Greenfield container terminal developments a major portion of the overall project cost is the dredging and land reclamation, wharf structure and civil pavement structures. These items, whose designs are dominated by geotechnical and structural related issues, are important because of the many assumptions made to this point for cost estimating purposes have not been verified. In order to manage this uncertainty effectively, it is recommended to perform a thorough geotechnical, environmental and structural analysis early in the design phase to better define these items.

Another high cost, high uncertainty item at this stage is the Marie-Victorin Blvd. overpass entry costs. It is recommended to engage early discussions with the provincial highway jurisdiction (i.e. MTQ) so as to provide early feedback what may be required to obtain approvals.

Similarly, environmental approvals (i.e. DFO authorization) and related habitat mitigation entry costs have not been determined at this stage. As such, it is recommended to engage early discussions with the DFO or other authority having jurisdiction so as to provide early feedback what may be required to obtain the necessary in water works and environmental approvals.

A cost comparison is made between the conventional and semi-automated terminal operations. Figure 9-1 below illustrates the terminal infrastructure costs for Phase A plus Phase A-2 plus Phase B, as well as the separate entry costs.

Figure 9-1: Terminal Infrastructure Cost Comparison



At the completion of Phase B, the total estimated infrastructure project cost is $388 million for the Conventional terminal operation and $382 million for the Semi-Automated terminal operation, with

entry costs of approximately $67 million for either terminal. For this level of analysis the cost estimates for terminal infrastructure for the Conventional and Semi-Automated operations are considered equal.

9.2 EQUIPMENT

9.2.1 Introduction

As noted in Section 9.1 the project consists of a variety of work components that include significant dredging and land reclamation, heavy civil marine works to construct the wharf structure, on and off site rail construction, underground civil and electrical utilities and services, extensive asphalt and concrete pavements, off site highway works and various buildings. Section 9.1 addressed the requirements and possible costs for these capital construction works. In addition, an important component of the project will be the procurement of container handling equipment for operations at the berth, container yard, intermodal yard and truck gate. This memo provides a summary of the equipment needs, and opinions of probable cost to procure and commission the equipment.

Although the full build-out of the site could consist of two terminals of three berths each, initial project phases are expected to be as follows:

Phase A: One berth with 4 ship-to-shore gantry cranes and annual throughput capacity of 430,000 TEUs per annum for a Conventional operation and 470,000 TEUs per annum for a Semi-Automated operation.

Phase A2: Two berths with 5 ship-to-shore gantry cranes and annual throughput capacity of 430,000 TEUs per annum for a Conventional operation and 470,000 TEUs per annum for a Semi-Automated operation.

Phase B: Two berths with 8 ship-to-shore gantry cranes and annual throughput capacity of 1,050,000 TEUs per annum for a Conventional operation and 1,140,000 TEUs per annum for a Semi-Automated operation.

These initial phases are summarized in Section 8 and shown on the following drawings enclosed in Appendix A:

- M&N Drawing No. 7146-MP-20 – Conventional Phase A;
- M&N Drawing No. 7146-MP-20B – Conventional Phase A2;
- M&N Drawing No. 7146-MP-21 – Conventional Phase B;
- M&N Drawing No. 7146-MP-22 – Semi-Automated Phase A;
- M&N Drawing No. 7146-MP-22B – Semi-Automated Phase A2; and,
- M&N Drawing No. 7146-MP-23 – Semi-Automated Phase B.

9.2.2 Summary of Equipment Requirements

The largest and most costly piece of container handling equipment is the ship-to-shore (STS) gantry cranes. The number of cranes noted above were specified by the MPA to provide desired service and capacity levels for calling shipping lines. As a result, the number of STS cranes, and expected throughput they can generate over the berths, will be the basis for the degree of equipment needed in the container yard (CY) and intermodal yard (IY).

The STS cranes are expected to be 65 tonne, single trolley, twin 20 lift cranes with a rail gauge of 100 feet (30.48 m) and an outreach sufficient to work ships that stow 16 to 18 containers across deck.

For the Conventional operation, hostlers and bombcarts will transport containers between the STS cranes and container yard. Gangs of 5 to 6 hostlers per STS crane can be expected. For the Semi-Automated operation manned shuttle carriers are proposed for the horizontal transfer of containers between the berth and perpendicular automated container stacks. As there is no longer a need to travel into the CY, and the berth operation is disconnected, roughly 2 shuttle carriers per STS crane are needed.

In the CY, RTGs will be the predominant equipment for stacking and transferring containers to the stacks for the Conventional operation, while automated RMGs or ASCs will be used in the Semi-Automated terminal plan. A sufficient number of machines is needed for both modes to keep up simultaneously with the receipt and delivery of containers from the berth, receipt and delivery of containers with the intermodal yard and receipt and delivery of containers for local trucks, i.e. gate traffic. For each mode of operation, the total number of lifts expected in an average and peak hour, and the number of lifts each machine can manage in an hour, will determine the number of machines needed. Typically RTGs will average 12 moves per hour while RMGs and ASCs will sustain 14 moves per hour. Both may be augmented with a few Reachstackers, Top-picks and MT (empty) handlers due to their lower unit cost.

At the IY the same type of operation has been adopted for the both the Conventional and Semi-Automated operations. This includes wide span RMGs with one end cantilevered and a 90 degree swivel spreader. Hostlers and bombcarts will be used to move rail bound containers between the CY and IY. At the IY hostlers may park and leave the bombcarts to be loaded or discharged while returning to the CY for the next assignment. Empty bombcarts can be retrieved and re-used on the next trip. Based on operational simulations discussed in earlier sections, 3 IY RMGS are expected for Phase A and 2 or 3 additional IY RMGs added for Phase B. A total of 2 to 4 hostlers per IY RMG is expected plus a fleet of bombcarts to allow for the disconnect operation.

In addition, fuel and repair crews will be needed to service the main container handling equipment along with a fleet of pick-up trucks for foreman, crews and supervisors.

On this general basis, Table 9-3 as follows provides estimates of the primary equipment required for Phase A, and the additional Phase B purchase. Phase A2 only anticipates the purchase of one additional STS crane and no other equipment, so this crane has been included with Phase B.

Table 9-3: Estimates of Container Handling Equipment

	Conventional Phase A	Conventional Phase B	Semi-Automated Phase A	Semi-Automated Phase B
STS Cranes	4	4	4	4
IY RMGs	3	2	3	3
CY RTGs	10	14	n/a	n/a
CY RMGs	n/a	n/a	12	18
Reachstackers	1	1	n/a	n/a
Top-picks	1	1	1	1
MT Handlers	2	2	n/a	n/a
Shuttle Carriers	n/a	n/a	9	9
Hostlers	35	32	10	10
Bombcarts	42	38	15	15
Fuel/Repair Trucks	2	2	2	2
Pick-Up Trucks	24	24	16	16

These estimates will vary depending on specific terminal operator preferences, and also include a few additional units as spares in the event of breakdowns and downtime for routine maintenance.

9.2.3 Estimated Procurement Costs

The cost estimates presented here includes all costs, excluding applicable taxes, for the quantity of estimated equipment noted in Table 9-3 above, plus a contingency allowance. Table 9-4 below summarizes the probable cost estimates to purchase the proposed Contrecoeur equipment for the Conventional and Semi-Automated terminal operations.

Table 9-4: Summary of Equipment Cost Estimates

Mode and Phase	Total Equipment Cost
Conventional Terminal A – Phase A	$69,500,000
Conventional Terminal A – Phase B (Phase A + B, Total)	$71,700,000 ($141,200,000)
Semi-Automated Terminal A – Phase A	$92,400,000
Semi-Automated Terminal A – Phase B (Phase A + B, Total)	$107,900,000 ($200,300,000)

A detailed breakdown of each mode of operation and phase showing the individual units, unit rate and associated total cost estimate is provided in Appendix F.

In the absence of detailed specifications, estimates for the equipment are based on the concept level analysis and recent budget price quotes from recognized manufacturers. As a result, a contingency allowance generally ranging from 5% to 10% is included for the individual units to account for the undefined or indeterminate items due to the limited level of specification completed to date. The estimate is based on typical order quantities (i.e. 2 or 3 gantry cranes per order) and mid-range equipment.

As requested by the MPA, the individual unit rates are based on 2009 cost levels in the Montreal area (Canadian dollars) and do not allow for future escalation. However, container handling equipment is usually purchased in US dollars or Euros and therefore its Canadian dollar cost is dependent on exchange rates at the time of purchase. The exchange rate applied reflects recent rates and for this review are US$0.95 = CDN $1.00 and $0.75 Euros = $CDN 1.00.

The cost estimate includes an allowance for procurement efforts and contract administration associated with the purchase of equipment. This allowance is estimated at 1.5% of the total purchase price.

All costs exclude applicable federal and provincial taxes, including the GST and QST.

10.0 WORKS SCHEDULES

Two preliminary design and construction schedules for the initial phases of the Contrecoeur container terminal development have been prepared. These two schedules reflect the Conventional RTG and Semi-Automated terminal plans described in Section 8 although they turned out to be virtually identical. The plans on which the schedules are based include:

- M&N Drawing No. 7146-MP-20;
- M&N Drawing No. 7146-MP-20B;
- M&N Drawing No. 7146-MP-21;
- M&N Drawing No. 7146-MP-22;
- M&N Drawing No. 7146-MP-22B; and,
- M&N Drawing No. 7146-MP-23.

Clearly at this very early project stage numerous assumptions are required to develop each schedule. Some of the major assumptions include:

- The project will follow a design-tender-build procurement strategy. The wharf, dredging and backlands work will all be tendered separately as will the entry works.
- The marine works will include construction of an HZ steel sheet pile bulkhead wharf as described in Section 4.
- The HZ steel sheet piles and pipe piling for anchors and crane beams will be pre-ordered by the MPA.
- The two berths as shown for Phase A2 and B will be constructed at one time.
- Dredging will be completed by a large imported cutter suction dredge as quoted by a large European dredge contractor.
- During winter months (Dec 15 thru Mar 1), the ground is assumed too frozen to do any excavation/paving work so there are splits in the related tasks to accommodate.
- During winter months concrete works will continue with the use of heaters, warm water additive and enclosures.
- One piling crew will be used for the installation of the HZ piles and a second crew will be used for the installation of anchor and crane beam pipe piles.
- Production rate for the HZ piles will be 8 H piles per week along with the intermediate Z piles.
- Production rate for the pipe piles will be 4 to 6 per day.
- Production rate for the cope beam will be 20 meters per week.
- Production rate for pavement is about 0.5 hectare/ day plus a contingency.
- Rail installation is about 30 meters / day plus a contingency.

- RTG or RMG concrete runways would be about 100 meters / day.
- Acquisition of STS cranes, RTGs and RMGs are included in the schedule.
- For brevity we have shown a 3 month lag between the Phase A and B backlands works although this will be longer depend on market conditions and the need for additional capacity.
- Project permitting is not included as a permitting assessment and strategy has not been reviewed for the project at this time.
- The schedules use October 1, 2010 as a start date.

The two design and construction schedules are provided in Appendix G.

11.0 PROJECT RISKS AND MITIGATION MEASURES

11.1 INTRODUCTION

The Development of the Montreal Port Authority's land bank at Contrecoeur into two new 3 berth container terminals (the Project) includes the tendering and construction of numerous components that includes a wide variety of market, planning, environmental, financial, engineering and construction facets. The project includes a significant investment in infrastructure including heavy civil marine works, dredging and fill placement, dredgeate disposal, civil works, rail and track, bridges and highway construction, heavy duty pavements, buildings, optical character recognition gate systems, electrical distribution, lighting, etc.

As with any large, and even small, scale construction project there are risks with respect to price and schedule variances. On almost every construction project, the owner, design team and construction contractor strive to deliver a project that is on-budget and on-time. And yet many projects run over schedule and over budget. The reasons are many, but often it is the unforeseen that leads to the chance of the project being delayed or additional effort (cost) being incurred to deal with the issue that arises. Often such chances, or risk, can be mitigated, but a lack of contingency plans to deal with unforeseen eventualities fails to do so.

Although the Project is still at an early planning and design stage, it is prudent of any project owner to plan early for risks and attempt to foresee what circumstances or chances could result in budget or schedule overruns during design and construction and following on a project that does not develop the market, and hence revenue, it had hoped.

11.2 RISKS AND MITIGATION MEASURES

Provided as follows is a list of what we consider are some of the more significant risks inherent in the Project.

11.2.1 Lack of Design Detail

It has yet to be determined the strategy moving forward with respect to tendering the works whether it be design-bid-build or design-build. If design-bid–build, the eventual contractor will rely upon the bid documents (drawings and specifications) to outline every aspect of the works down to the smallest detail. Construction details that are missing, ambiguous, unconventional or difficult to construct will lead to higher bid prices and claims for additional reimbursement during construction, plus possible schedule delays.

For a design-build project again the contractor will reply upon the bid documents to develop their price. Naturally, as the contractor will be responsible for much of the detailed design many design details will be missing but the more complete and unambiguous the bid documents are, the more confident the contractor will be in providing a lower price. Regardless, since most of the project detail has yet to be determined the contractor will add in additional cost to the bid to account for the level of risk they foresee in taking on the design and construction of the project.

Mitigation

The more detail provided in the bid documents whether design-bid-build or design-build the better. But this does not just mean a quantity of detail, but as importantly details are provided that are conventional, have proven constructability on past similar projects and are clearly illustrated so easily understood. In addition, specifications and designs need not always be the "Cadillac" version that adds cost to the project whereas alternative materials or methods will more than adequately meet the owner's requirements. To ensure the above, the owner's interests are best served by putting in place a design team that is well versed and experienced in the type of project being undertaken, and is given sufficient time and budget to develop the bid documents. The project design is generally only a few percent of the overall project cost and yet a "good" well thought out design can save that amount and more through construction savings.

11.2.2 Changing Planning Criteria/Tenant Requirements

For any project the point in the life of the project where the greatest impacts on cost and schedule are made is during the planning phase. This is where the scope and overall extent of the works is determined. For example, shall a building be 3000 square meters or will 2000 square meters do? This has a huge influence on cost compared to future design details such as whether the building should have sheet metal or aluminum siding.

Major changes in the planning or design criteria during the detailed design and construction phases of the project can have a compounding impact on costs and schedule. If major scope changes are made during detailed design, the design may need to be re-done resulting in additional effort (cost) and more time needed to complete. If changes occur during construction, the owner is exposed to major claims where the cost is not subject to competitive bidding, but negotiation with an already selected contractor.

For the Project under consideration a tenant for the container terminal has not yet been selected. Many terminal operators have specific preferences with regard to how the terminal should be laid out and operated. As a result, depending on when an operator is selected, they may demand, or undertake themselves, those changes. Although the costs of these changes can be allocated to the operator it is an additional cost to the Project as a whole.

Mitigation

Take the time and make the effort to carefully plan the project. Assemble and utilize a planning team that is familiar with not only the type of construction being contemplated, but also the operation of the facility. Engage those personnel who will operate and maintain the facility and document all decisions for future reference when someone asks why. Progress the detailed design carefully as to not get ahead of the planning, or be prepared to undertake design changes by having a change management plan in place.

During construction, review carefully how changes will impact the works and the contractor. When preparing construction documents accept that changes will occur and set out procedures to deal effectively with those changes including requirements for documentation and time frames to establish the additional cost and time needed. The MPA may also consider requesting unit prices where applicable as opposed to lump sums so changes can be readily quantified and not left to subjective negotiation.

11.2.3 Conventional vs. Automated Operations

Planning to date for the Contrecoeur development has reviewed operations with fully manned equipment (Conventional), manned operations but with an automated RMG container yard (Semi-Automated) and fully automated operations including berth-CY transfer and CY-IY transfer. The conventional and semi-automated terminal plans were studied in further detail including an estimation of initial capital costs and construction schedules. The initial capital outlay and time to design and build for each are quite similar. However, this extent of analysis does not show the true life cycle cost of the facility which would include the cost of labour between the options over a 30, 40 or 50 year lease period. Recent studies for other proposed new terminals have shown substantial savings through varying levels of automation which in turn can have a significant impact on the project ROI and ability to attract an operator.

Mitigation

A comprehensive life cycle cost analysis of different terminal operating models should be undertaken before final selection of the terminal operating plan.

11.2.4 Fisheries and Oceans Authorization Requirements

It is understood that the Montreal Port Authority (MPA) will be required to obtain a *Fisheries Act* Authorization from the federal Fisheries and Oceans Canada (DFO) to infill the Contrecoeur foreshore in order to develop port infrastructure. Experience has shown that obtaining an Authorization (Section 35 (2) of the federal *Fisheries Act*) from DFO for any major infill aquatic project can be a lengthy process to complete in order to define the area of habitat lost and potential options and plans to provide compensated habitats based on DFO's "No Net Loss" of habitat policy. The process is subject to variations and the conditions that the Authorization can set upon the Project which are generally unknown until the final Authorization is granted. The conditions to determine the Authorization can often be subjective by DFO. As a result, the Authorization review process itself can impact the Project Schedule in the event of review delays (often the result of a lack of DFO staff and resources), and protracted negotiations with DFO regarding conditions for approval to proceed with the Project. In addition, the conditions set upon the Project implementation can add substantial cost to the project. For example, closure periods, requirements for isolating water bodies, barge versus trucking of imported materials, etc.

Mitigation

Our experience has shown that a responsive and positive result from DFO depends upon early and constructive engagement with DFO personnel by a qualified owner team that includes individuals with past experience on similar projects, constructive approaches to habitat compensation, sound and defined mitigation measures built into the project development process, and familiarity with the local DFO contacts.

11.2.5 Canadian Environmental Assessment Act/Canada Port Authority Environmental Assessment

The project is reviewable under the *Canadian Environmental Assessment Act* (CEAA) and the Canada Port Authority (CPA) Environmental Assessment Regulations (current Sept 15, 2010) as either a screening level assessment or a comprehensive study based on triggering a *Fisheries Act* habitat Authorization from DFO (above) and potentially Environment Canada (sediment dredging). A

comprehensive study environmental review involves a longer timeline and greater cost for the extent of the review, than a screening level review.

A comprehensive study is designated for a project review by the Canadian Port Authority in consultation with Canadian Environmental Assessment Agency and federal responsible authority, in this case the Montreal Port Authority and potentially DFO. A comprehensive study is triggered based on: "a marine terminal designed to handle vessels larger than 25 000 DWT unless the terminal is located on lands that are routinely and have been historically used as a marine terminal or that are designated for such use in a land-use plan that has been the subject of public consultation". A comprehensive study will be determined based on the project description and the potential extent of project-related impacts defined as outlined above.

A screening level assessment will include consideration of: environmental effects of the project, the significance of the effects, comments from the public received as part of the assessment process, and technical and economic measures to mitigate potential project-related effects. In contrast a comprehensive study will include all the components found in a screening of the project (above) and will also include consideration of: purpose of the project, alternatives to the project, follow-up monitoring for the project, sustainability issues, enhanced review of social and environmental potential project-related impacts, and a larger scope for public consultation.

Other associated regulatory approvals may be needed and incorporated into either a screening level review or comprehensive study which may include permitting and authorization from Environment Canada under the *Species at Risk Act*, and *Migratory Birds Convention Act* for loss or disruption of wildlife habitats, *Fisheries Act* and *Environmental Management Act* for Sediment Disposal, and from Transport Canada under the *Navigable Waters Protection Act*.

Mitigation

Early discussion with regulators will greatly improve the prediction of project costs and schedules based on the extent of environmental assessment and review (screening level or comprehensive study) under CPA and CEAA and the implications of various federal and provincial regulations and approvals.

Project planning can generally involve two environmental assessment process paths to help limit risk by predicting and creating costs and scheduling efficiencies.

The project can make an early determination to conduct an environmental assessment as a comprehensive study for the entire project and develop the review, permitting and authorizations early in the planning and definition stages of the project. This approach would help clearly define a timeline and costs for review, consolidate all studies, consultation, permitting and authorization into a single review. This would provide assurance of a detailed project description and an understanding of timelines for construction.

The project can conduct smaller reviews for each individual component of the larger project as defined by project's development planning schedule and feasibility. In some cases this may avoid the need for a larger comprehensive study. This approach may provide cost efficiencies and help define shorter timelines for review and planning. In some instances, DFO is agreeable to amending existing Authorizations to an expanded project scope. In some instances, additional permitting and authorizations may be warranted for new projects. Depending on the larger project timeline, this approach could provide immediate known outcomes and expedite shorter timelines leading to project construction.

11.2.6 Climate Variation and Change

The Project is on the St. Lawrence River downstream of Montreal in a region where climatic variation and weather extremes can have strong influence to construction schedules and engineering standards used for design and construction and may have consequences on operation (shipping). Climate variation and specific weather events can add costs and may result in changes to construction schedules and may have direct consequences on seasonal shipping and navigation issues associated with lower water levels on the river as a whole and near the proposed project site.

Mitigation

The project can use innovative approaches to help define engineering design standards, approaches for construction and schedules to limit exposure and adaptively cope with climate variation and change including: weather extremes, water levels and potential downstream flow. Project design and expanded navigation planning, both locally and regionally, may be needed to help scope and predict future adaptive management solutions to changes in navigation and maintenance dredging to maintain water levels into the port, and up and downstream through existing shipping lanes.

11.2.7 Lack of Local Dredge Plant and History

The development of the Contrecoeur land bank as two container terminals will require approximately 930,000 cubic metres of dredging for the initial phases of construction (two berths) and a subsequent 1.0 million cubic meters of dredging for the subsequent 4 berths. As a result, the project has a significant dredging component. Major capital dredging is rare on the St. Lawrence River and in eastern Canada in general. As a result, there is limited dredging equipment available and what is available locally is small. Discussions have been held with 4 dredging contractors; two from Quebec, one from the US and one from Europe. The contractors from the US and Europe have much greater dredging experience and significantly larger fleets of equipment including large cutter suction dredges that the two local contractors do not have. Budget quotes received from each contractor showed a substantial price spread of $15 to $40 per cubic meter of dredging; an almost 300% difference. The lower prices were quoted by the foreign dredgers. In addition, production rates varied from 3000 cubic meters per day for a small local clam shell dredge to 17,000 cubic meters per day by a large cutter suction dredge, a difference of 36 weeks in total time to complete the dredging. As a result, it is apparent that a foreign dredger is more suitable to complete the work at a lower price and within a faster time frame. However, foreign equipment is subject to the federal *Coasting Trade Act* that limits import of foreign floating equipment although exemptions can be granted.

Mitigation

The large variation in received prices and production rates for dredging warrants much further investigation and in depth discussions with contractors before finalizing project budgets and schedules. Early tendering for firm price quotes may also be advisable. In addition, legal advice should be sought regarding the *Coasting Trade Act* and possible costs or exemptions for the import of foreign equipment.

11.2.8 Risk Allocation to Contractor

The bid documents, whether design-bid-build or design-build, will contain contract general conditions which will allocate responsibilities between the MPA and contractor. These responsibilities will inevitably include a degree of risk. Contractors will carefully review these contract provisions and will assess the level of risk they are expected to take, and then in turn will price that risk accordingly in their

bid. Contracts that are one-sided with excessive risk passed onto the contractor will result in higher bid prices which in turn may lead to strains on the budget.

Mitigation

Contract general conditions should rely are standardized documents that include clauses that are familiar to bidders. The general conditions should be prepared, or reviewed, by legal counsel. However, such legal counsel should be one that is familiar with construction contracts and construction processes. Often legal counsel is not, and has a tendency to "one-side" the documents trying to pass all risk onto the contractor thinking they are doing their client a service. They often are not. It is also advisable that the general conditions be reviewed by construction professionals who have experience in the day to day administration of construction projects. They can often identify clauses that contractors will take exception to, and that can cause conflicts during construction in the event of changes.

11.2.9 Cost Estimate Sourcing

It is likely that the project budget will be based on cost estimates prepared by the MPA and their design team. The estimates and unit prices for the individual items will be based upon the level of design completed to date and a variety of sources for unit rates including published rates (RS Means, etc.), quotations from contractors and suppliers as well as bid prices from past projects.

The depth and extent of the pricing data base will reflect on the prepared budget estimates. The more broadly based the data the more likely the result will be averaged as published rates, quotations and bids from other projects will not take into account the exact particulars of the Project.

Mitigation

When developing the project budget bear in mind the level of design completed to that point. The more complete the design, the more detailed and accurate items and item quantities can be defined. A contingency should be included to reflect the level of design completed. Keep in mind even at 100% design, contractor bids are often not within 10% to 15% of each other.

Develop unit rates from as wide a source of data as possible. Average the rates or weight the rates that are considered most reflective of the specific conditions of the Project. Finally, consider the services of a professional construction cost estimator.

11.2.10 Geotechnical Data

Comment in 2011 Final report:

The site is underlain by quick clay, also known as Leda clay that exhibits low strength and stiffness in a highly disturbed or a remoulded state. A limited number of boreholes have been drilled onshore and offshore to obtain data on this deposit as well as the underlying till-like soils. Also, a bulk of the laboratory testing has been conducted from samples collected only from one of the boreholes. Cyclic behaviour of clay influences the stability of the wharf system.

Update March 2013:

Additional geotechnical investigation and analysis was conducted in 2012 and a report was produced entitled:

- "10017796_E Caracterisation environnementale et geotechnique sols et eau"

This new report principally addresses:

- "chemical quality of soils, residual materials located in fills, and groundwater with a view to the construction of the future container terminal infrastructure" and
- "identifying the geotechnical characteristics of four potential locations considered as dredged sediment disposal sites within the scope of the wharf construction".

This new report is incorporated herein within Appendix B.

The new report cites no restrictions that would inhibit construction of the proposed container port development. Two conclusions of note are:

9.3.4 Roads

Surface clay is Type CH with a liquidity index lower than 0.9. This type of soil remains frost-prone, but a liquidity index lower than 0.9 means that clay is not likely to produce significant settlements during the initial freeze/thaw cycles and that it requires no particular treatment. **On the other hand, if excavating is planned under the level of very stiff clay (crust), or deeper than 1 to 1.5 m, clay thus exposed will require thicker frost protection since liquidity indices measured are close or equal to the 0.9 value.**

and

9.3.5 Buildings

Loads associated with planned buildings may be transferred to the ground through conventional footings.

The topsoil and in-situ fills are not capable of receiving rigid construction loads, as they are likely to experience significant settlements. Indeed, unless fill placement conditions and quality control are quite well known, this fill must be considered as an unsatisfactory foundation soil. Fills will have to be excavated and rigid construction foundations will have to rest directly on the clay deposit or yet on a controlled fill erected from this deposit. If large fill areas are to be treated, soil improvement solutions might be considered, such as dynamic compaction.

These comments pertain to development on possible dredged material placement sites.

Mitigation

Comment in 2011 Final report:

Undertake additional field investigations utilizing both boreholes and CPTs to cover full extent of onshore and offshore development. Obtain undisturbed piston tube samples from the clay soils to further evaluate stability under cyclic loading conditions by conducting laboratory testing on carefully collected and extruded clay samples. Develop soil stratigraphy and confirm soil parameters used.

Update March 2013:

Additional field investigations were conducted. No new findings of significance to cost or feasibility are noted.

11.2.11 Risk Associated With Pile Penetration

The HZ king piles and sheet piles for the wharf bulkhead may not achieve the required design penetration into till/bedrock. Given the variability in strength and consistency of soils encountered at the site, there is a risk that the piles may not penetrate over the full depth assumed in the design.

Mitigation

Comment in 2011 Final report:

By undertaking sufficient field investigations and engineering analyses to assess the impact of the variables, the design team will be able to quantify the risk and implement mitigative measures. Conducting adequate laboratory testing to confirm the quality of bedrock and overlying till will also help reduce the uncertainties.

2013 Update:

The additional geotechnical investigations and reports completed in 2012 did not specifically address pile driving for the bulkhead and wharf, so no new conclusions are offered.

11.2.12 Single Class 1 Railway Mainline

Any container terminal is only as good as its road and rail connections. Fortunately, the Contrecoeur land bank is located in close proximity to a CN Rail mainline and a major autoroute. As a result, CP Rail does not currently serve the area. Shipping lines are often reluctant to use terminals that are only served by one railway since they feel that they may become beholden to them. Although CP Rail may interchange traffic with CN in Montreal and CN crews will then deliver and return the CP traffic to them, CP may experience higher costs and reduced service than the CN traffic which in turn will be passed onto shipping lines.

Mitigation

Early and on-going discussions with CN and CP are necessary along with potential terminal operators and shipping lines in order that the terminal can provide the most flexible, low cost and reliable rail service possible. If at all possible full running rights to the terminal for CP would be a desirable goal.

11.2.13 Steel Prices and Exchange Rates

The project at this early stage envisions an HZ steel sheet pile bulkhead wharf with pipe pile anchors and pipe piled crane beams. As a result, there is in the order of 9000 tonnes of steel piling that requires procurement. In addition, there are numerous berth, CY and IY cranes that are in large part constructed of steel. As a result, the current market price of steel at the time of order can have a large impact on the final project price. In addition, steel pile purchase and container handling equipment are generally in US dollars or Euros so prevailing currency exchange rates will impact final prices.

Mitigation

Current steel prices and currency exchange rates should be monitored and when fluctuations occur, their impact on the project budget should be assessed. If the impact is substantially negative then the project scope may need to be re-visited in order to meet established budgets.

11.2.14 Distance from Montreal

The new terminals proposed at Contrecoeur are roughly 30 km from Montreal and the current port. This will require a new operating regime and patterns for all stakeholders; shipping lines, operators, railways, and most impacted, trucking companies. The added trucking haul to and from Montreal may add costs over competing terminals in the current port and competitor ports on the east coast. This in turn could deter shipping lines. However, trucking to Ontario, New York and other further afield destinations may be closer and easier since urban traffic can be avoided.

Mitigation

Origin and destination surveys of truck traffic and assessments of potential added cost or savings should be investigated. The results, if positive, must be conveyed to stakeholders along with an education campaign of the significant attributes of Contrecoeur so as to avoid a reluctance to use Contrecoeur. The same issue occurred with Canada's largest terminal at Deltaport in the mid 1990's when shipping lines were very reluctant to relocate from the inner harbour; yet within a couple of years Deltaport became the preferred location.

11.2.15 Local Community

The project will involve the construction and then operation of a large port industrial terminal in what is a relatively rural setting although a smaller port facility and industrial plant are already operating in the area. However, a container terminal will significantly increase the amount of shipping, truck and rail traffic in the area not to mention a well lit 24/7 operation. This will get the attention and possible backlash of local residents. As noted above, a substantial number of permits will be required before terminal construction can begin. Condition of these permits may include public consultation as this is a large project as noted. Opposition is likely which can add to the time required to secure permits and additional cost for mitigation of resident concerns.

Mitigation

An early, constructive, informative and on-going public consultation program will be necessary to avoid permit delays and costly programs to address public concerns.

11.2.16 Construction Market Conditions

In the recent past, we have seen how a booming and then bust construction market can impact bid prices and hence project budgets. From 2004 to mid-2008 the construction market in Canada was booming and construction prices were rising at double digit rates year after year. This caused a great deal of volatility in pricing and often reduced bid competition. As a result, many owners received project bids well above established budgets.

With the recent recession, prices have stabilized and in some cases have dropped as more contractors bid on available jobs and are prepared to cut profit margins and take on more risk to keep their staff and equipment working. Federal infrastructure funding is intended to also stabilize the market and ensure people keep their construction related jobs.

Mitigation

As the project progresses an awareness of the overall global, national and local economy, the impact of federal infrastructure funding and the local general construction workload is necessary. This awareness should be augmented by casual discussion with prospective contractors with a view to gauge their

overall work demands, backlog and eagerness for new work. This information should be taken into account when preparing the Project budgets and preparing bid documents. In addition, construction cost indices like those published by Statistics Canada should be consulted.

Tender strategies should be developed to garner maximum exposure for the project and attract the maximum number of bidders. This will enhance competition and reduce prices. This may include pre-advertising and advertising, and separating the project in distinct packages.

11.2.17 Lack of Experienced Contractors

The Project is the largest capital investment to be undertaken in the Port of Montreal in decades. Although the project has many aspects that can be considered standard civil or building construction such as most underground utilities, track work, lighting, buildings, pavements, roads, etc., there are some components that involve marine construction including berth upgrades, crane rails, dredging, land filling. This type of work is not common in the Montreal and Quebec market and the number of marine general contractors we understand is limited. As a result, when contractors are not familiar with a type of construction they will bid it higher or miss items for which they will claim for later; directly or indirectly. This will increase budgets and cause delays.

Mitigation

Be aware of the construction market and the capabilities of local contractors. Develop construction documents including details and products that take advantage of those capabilities. Divide the work into smaller packages that meet specific contractor capabilities and that minimize the need for too many sub-contractors under one general. Allocate risk evenly and fairly. Ensure mandatory pre-bid meetings are held so bidders are advised of the project scope and can pose questions. Extend bidding periods to allow sufficient time to prepare bids.

Implement a stringent QA/QC program during construction.

11.2.18 Severe Weather During Construction

The Project is in Montreal where weather can vary from severe winter snow storms to blazing hot summer days. Weather impacts construction. Extreme weather adds cost and results in delays.

Mitigation

We can’t change the weather or move the project to a moderate climate. However, during the design stage prepare details that minimize labour intensity and are difficult to construct; even in good weather. Modularize and standardize construction details. Specify materials that are less affected by extreme weather. Allow for weather downtime in project budgets and schedules.

Try to time the issuing of tenders to coincide with expected schedules that can take advantage of moderate weather seasons for certain activities.

Include provisions in the contract documents to deal with extreme weather impacts. If schedule is paramount include bonus provisions as opposed to liquidated damage provisions.

12.0 NEXT STEPS

Recommended next steps for the project should include:

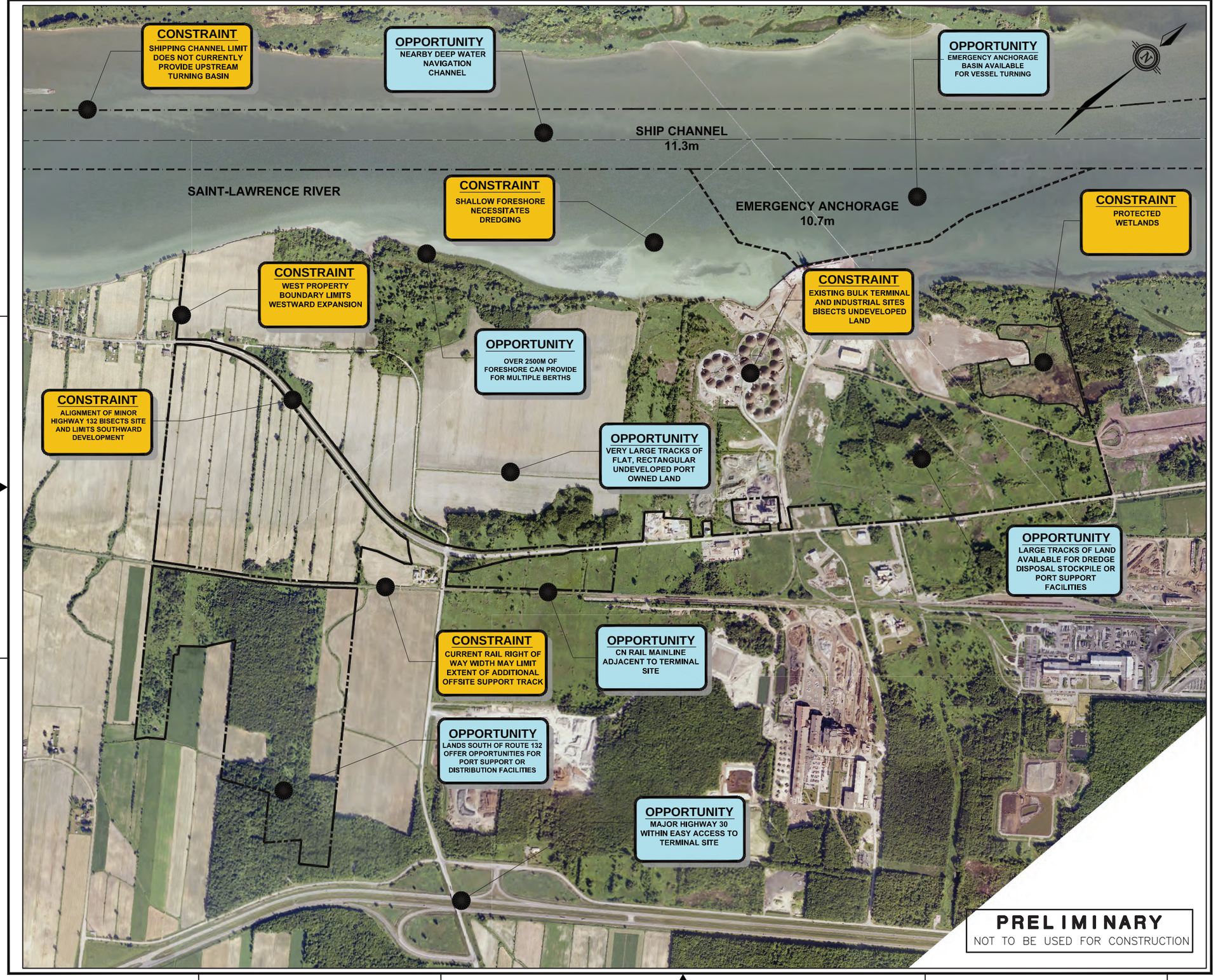
- A detailed financial assessment of the project to confirm financial feasibility to both the MPA and potential operators.
- Preliminary discussions with regulators to set the framework for environmental studies and permits.
- Discussions with the Class 1 railways to review and develop the rail service to the facility.
- Conduct additional planning and simulation studies, financial modeling and discussions with operators to develop the preferred mode of terminal operation for the initial development phase to a higher level of detail.

APPENDIX A

DRAWINGS

FORMAT SIZE A-0

DESIGN No. 7114161- | Mtl P- 12.0 | MOD. C
DRAWING No.



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0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND:

CHANNEL LIMIT

PROPERTY BOUNDARY

100m 0m 100m 200m

SCALE: 1 : 5000

AUCUN

TITRE-TITLE | No. | MOD.

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
C	JAN 18/11	ISSUED FOR FINAL REPORT	AT
B	JUN 11/10	ISSUED FOR CLIENT REVIEW	JL
A	JUN 01/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal

Administration portuaire de Montréal
Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
OPPORTUNITIES AND CONSTRAINTS MAP

SOUS-TITRE/SUB-TITLE:

CONSULTANTS:

777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

DESSINÉ/DRAWN: JL
PROJETÉ/DESIGNED: MC
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APPROUVÉ/APPROVED: -
CHEF DE SERVICE/DEPARTMENT HEAD:

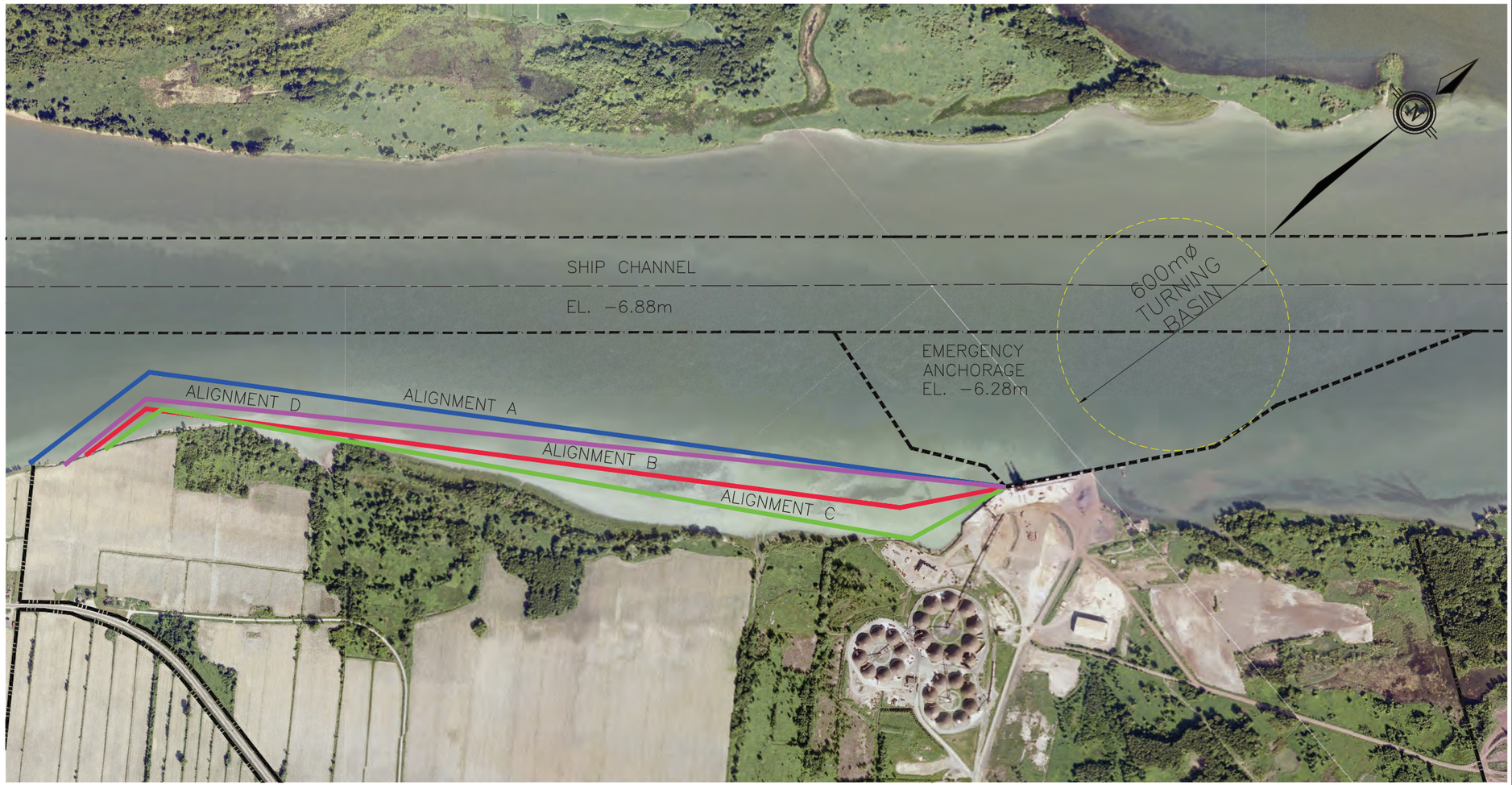
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DATE: MAY 19 2010
FEUILLE/SHEET: 1 DE/OF 1
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DESIGN No. 7114161- | Mtl P- 12.0 | MOD. C
DRAWING No.

FORMAT SIZE A-0

DESIGN NO./ DRAWING NO. 711416 1 – MP– 13.0 MOD. C



NOTES

LEGEND:

CHANNEL LIMIT

PROPERTY BOUNDARY

VERTICAL DATUM:

ALL ELEVATIONS ARE PROVIDED IN GEODETIC DATUM

0.0m CHART DATUM (CD) = 4.42m GEODETIC DATUM (GEO.)

80m 0m 80m 160m

SCALE: 1 : 4000

AUCUN		
TITRE–TITLE	No.	MOD.

DESSINS DE RÉFÉRENCE–REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
C	JAN 18/11	ISSUED FOR FINAL REPORT	AT
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Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
WHARF ALIGNMENT ALTERNATIVES

SOUS–TITRE/SUB–TITLE:
GENERAL ARRANGEMENT

CONSULTANTS:

MMM GROUP
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VANCOUVER, BC, CANADA, V5Z 4J7
604–707–9004

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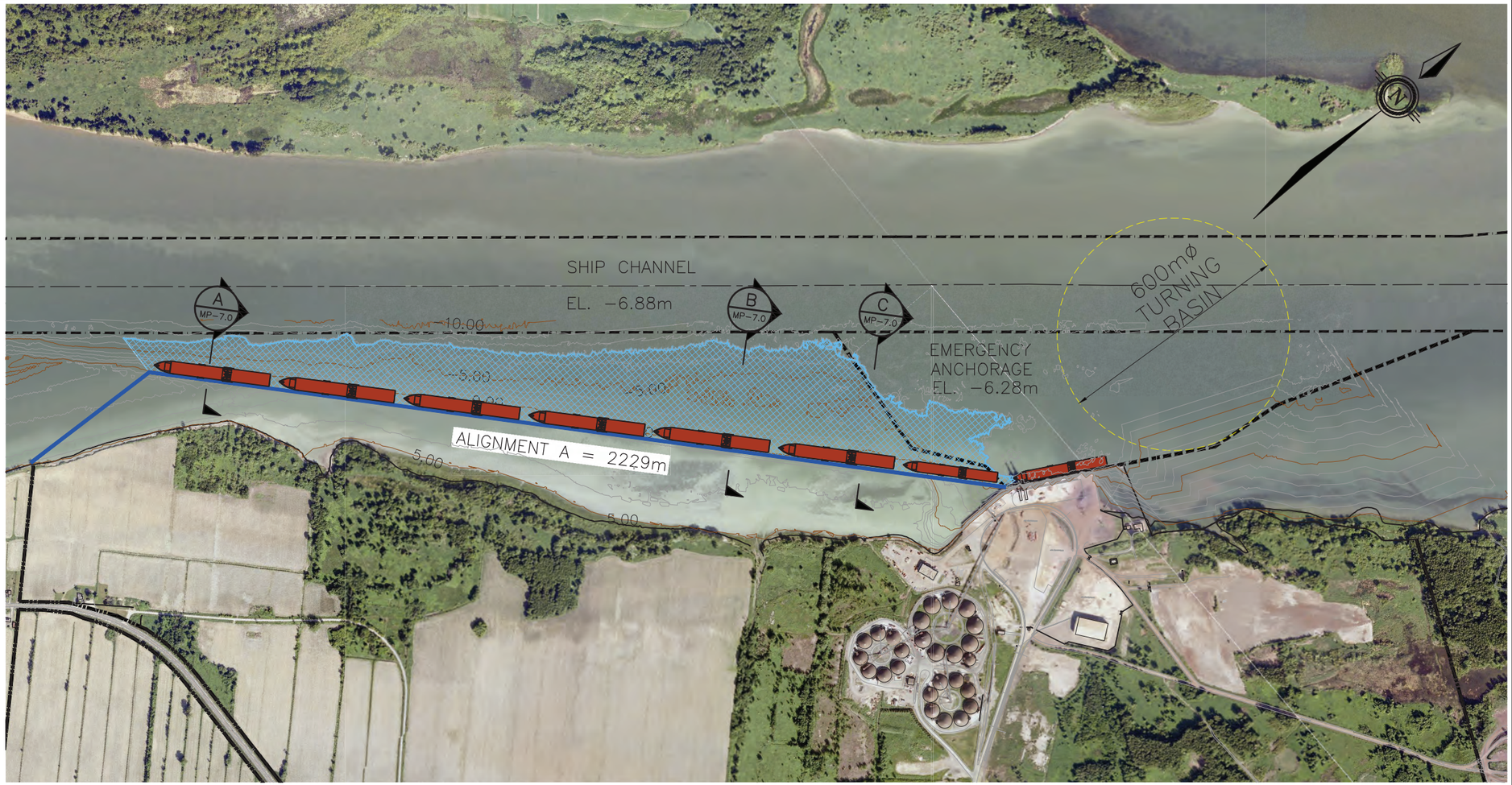
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FORMAT SIZE A-0

DESIGN No. 7114161- | Mt P- 14.10 | | | | MOD. B



NOTES

LEGEND:

- CHANNEL LIMIT
- PROPERTY BOUNDARY
- DREDGE LIMIT EL. -6.88m

VERTICAL DATUM:

ALL ELEVATIONS ARE PROVIDED IN GEODETIC DATUM

0.0m CHART DATUM (CD) = 4.42m GEODETIC DATUM (GEO.)

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SCALE: 1 : 4000

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TITRE-TITLE | No. | MOD.

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
B	JAN 18/11	ISSUED FOR FINAL REPORT	AT
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MODIFICATIONS-REVISIONS

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PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
WHARF ALIGNMENT A

SOUS-TITRE/SUB-TITLE:
PLAN

CONSULTANTS:

MOUAT & NICHOL

777 WEST BROADWAY, SUITE 301
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APPROUVÉ/APPROVED: -
CHEF DE SERVICE/DEPARTMENT HEAD

SCEAU/SEAL:

DATE: MAY 19 2010
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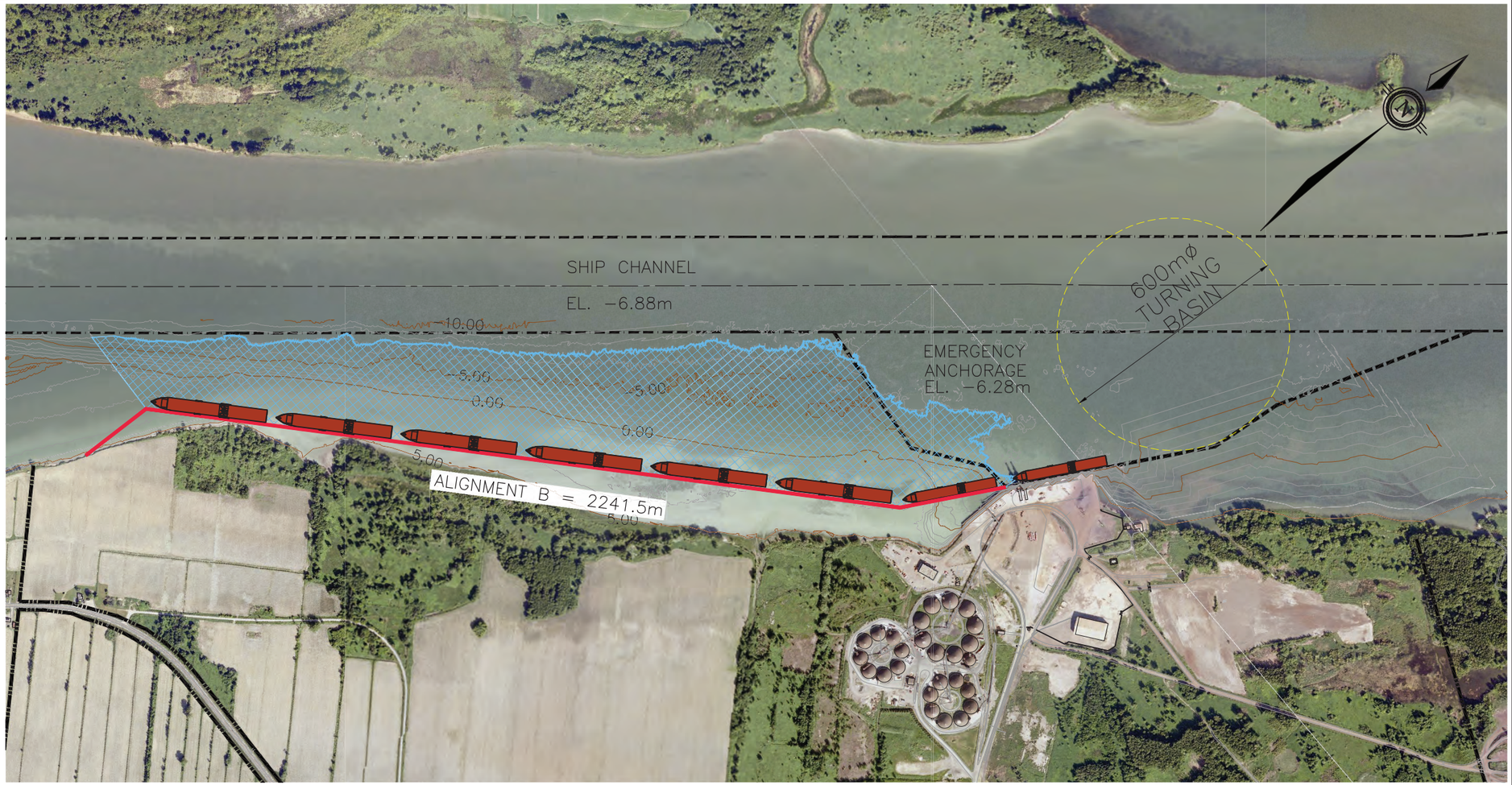
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DESIGN No. 7114161- | Mt P- 15.10 | MOD. B



NOTES

LEGEND:

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- PROPERTY BOUNDARY
- DREDGE LIMIT EL. -6.88m

VERTICAL DATUM:

ALL ELEVATIONS ARE PROVIDED IN GEODETIC DATUM

0.0m CHART DATUM (CD) = 4.42m GEODETIC DATUM (GEO.)

80m 0m 80m 160m

SCALE: 1 : 4000

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TITRE-TITLE | No. | MOD.

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

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PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
WHARF ALIGNMENT B

SOUS-TITRE/SUB-TITLE:
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CONSULTANTS:

777 WEST BROADWAY, SUITE 301
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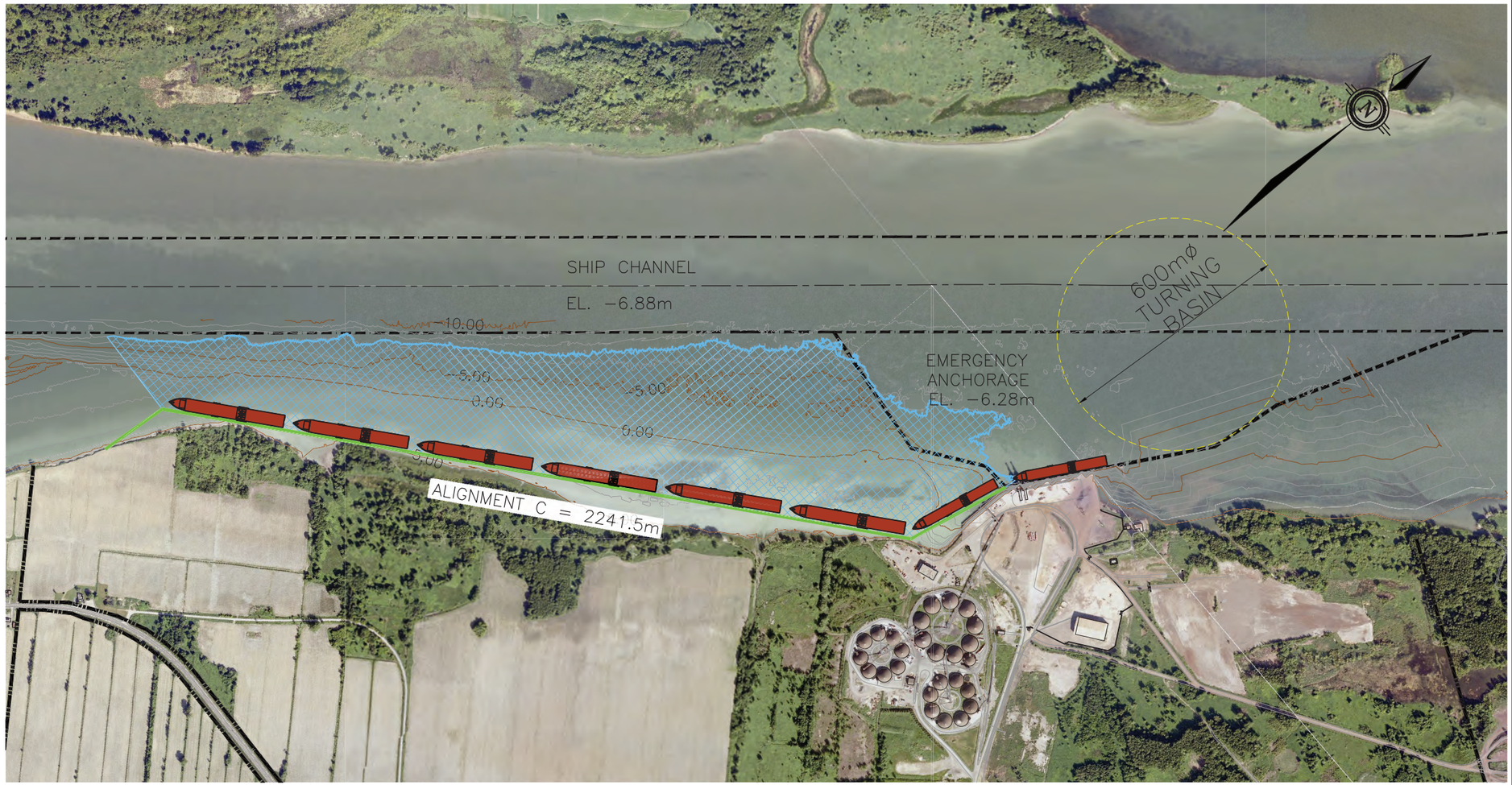
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NOTES

LEGEND:

- CHANNEL LIMIT
- PROPERTY BOUNDARY
- DREDGE LIMIT EL. -6.88m

VERTICAL DATUM:

ALL ELEVATIONS ARE PROVIDED IN GEODETIC DATUM

0.0m CHART DATUM (CD) = 4.42m GEODETIC DATUM (GEO.)

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SCALE: 1 : 4000

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TITRE-TITLE	No.	MOD.
DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS		

No.	DATE	DESCRIPTION	PAR BY
B	JAN 18/11	ISSUED FOR FINAL REPORT	AT
A	JUN 01/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS-REVISIONS

PRELIMINARY
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Port de Montréal Port of Montreal

Administration portuaire de Montréal
Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
WHARF ALIGNMENT C

SOUS-TITRE/SUB-TITLE:
PLAN

CONSULTANTS:

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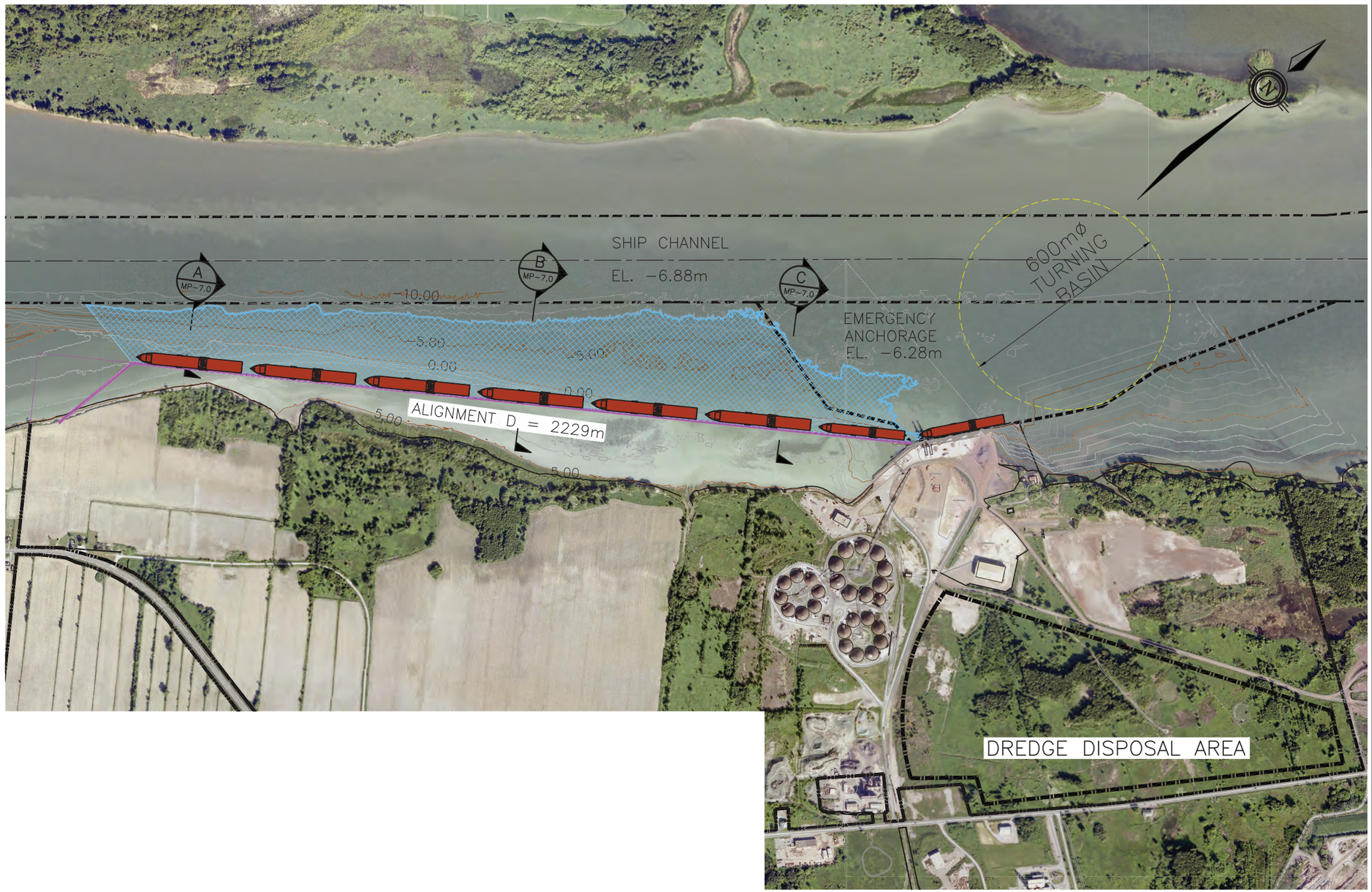
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DRAWING No.



PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

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NOTES

LEGEND:

- CHANNEL LIMIT
- PROPERTY BOUNDARY
- DREDGE LIMIT EL. -6.88m

VERTICAL DATUM:

ALL ELEVATIONS ARE PROVIDED IN GEODETIC DATUM

0.0m CHART DATUM (CD) = 4.42m GEODETIC DATUM (GEO.)

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TITRE-TITLE	No.	MOD.

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
D	JAN 18/11	ISSUED FOR FINAL REPORT	AT
C	DEC 3/10	ISSUED FOR FINAL REPORT	AT
B	JULY 7/10	REVISED FOR SECTION B	AT
A	JUN 29/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal

Administration portuaire de Montréal
Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
WHARF ALIGNMENT D

SOUS-TITRE/SUB-TITLE:
PLAN

CONSULTANTS:

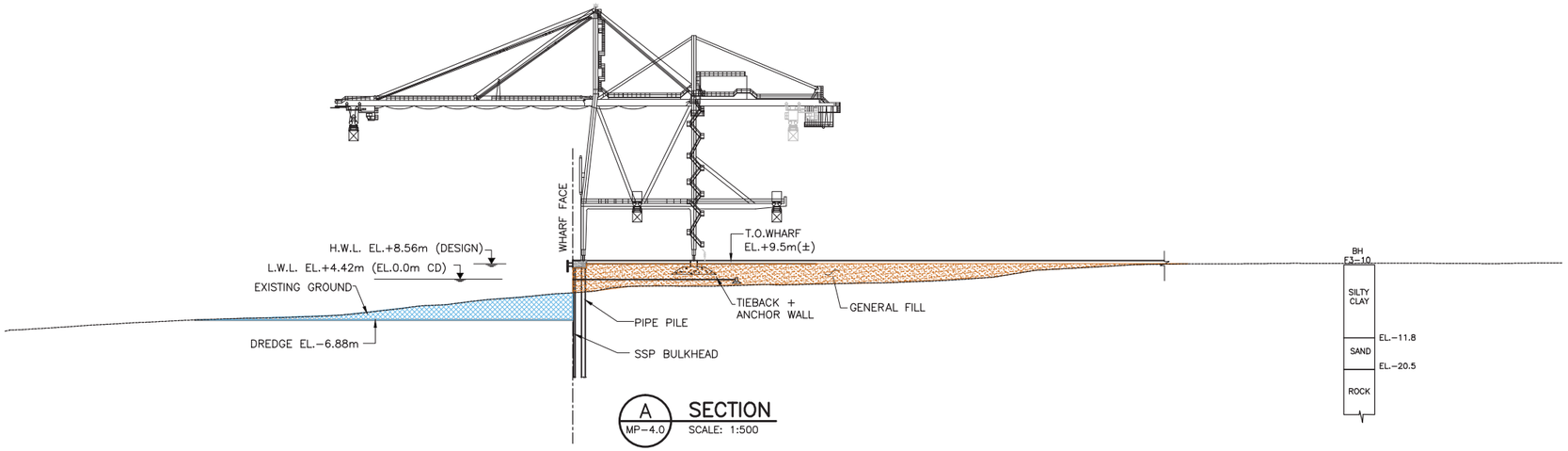
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604-707-9004

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CHEF DE SERVICE/DEPARTMENT HEAD	DATE: MAY 19 2010
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE/OF 1

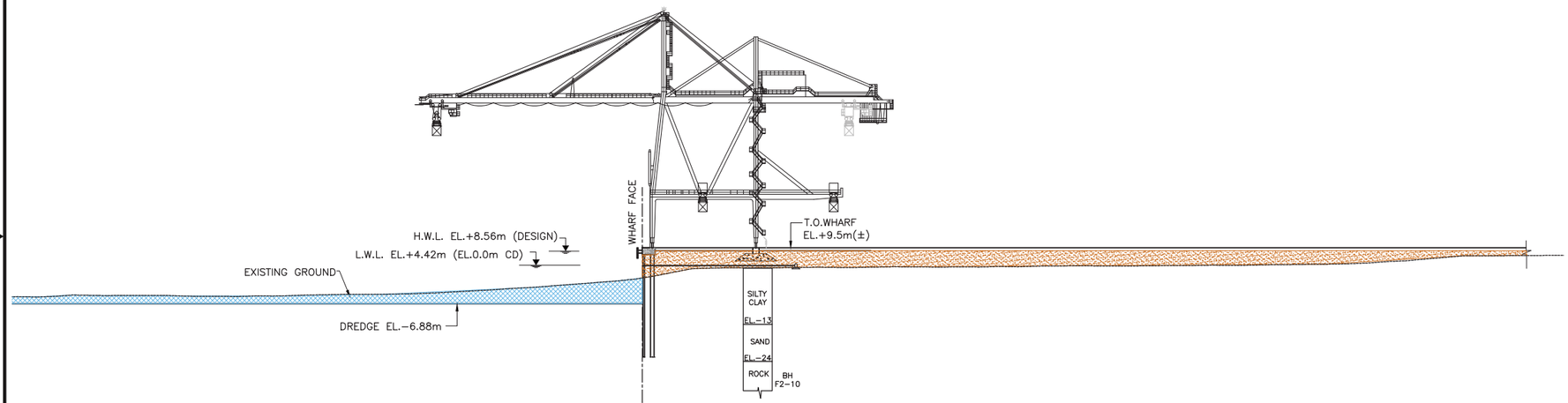
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DRAWING No.

FORMAT SIZE A-0

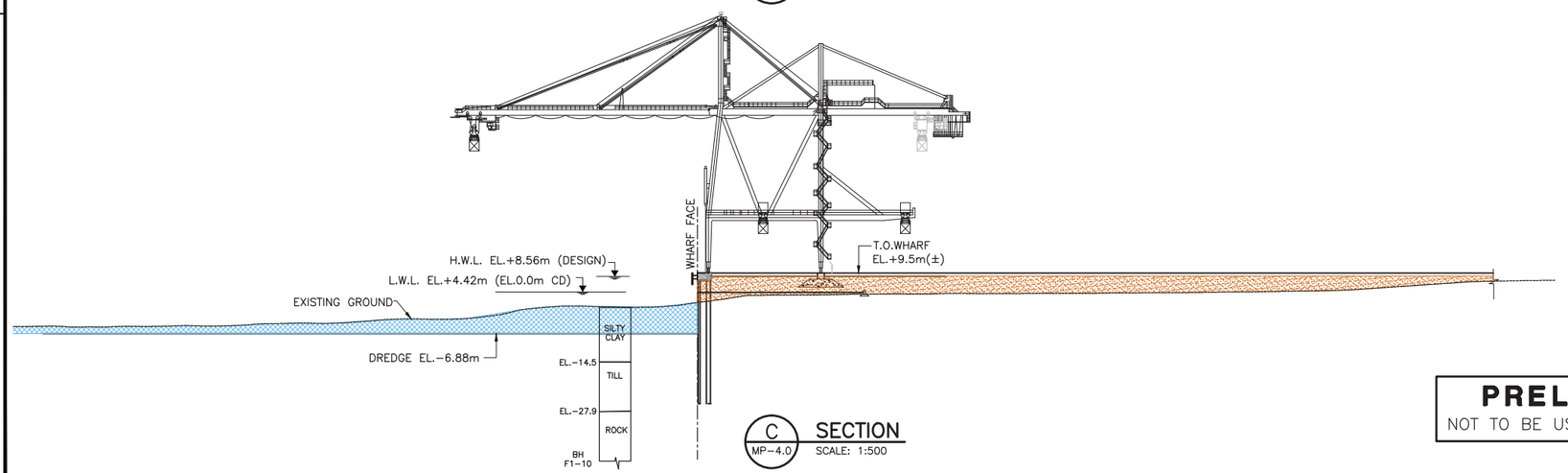
DESIGN No. 7'1'4'6'- MP -8'.0 | MOD. B
DRAWING No. 7'1'4'6'- MP -8'.0 | MOD. B



A MP-4.0 **SECTION** SCALE: 1:500



B MP-4.0 **SECTION** SCALE: 1:500



C MP-4.0 **SECTION** SCALE: 1:500

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

0 1 2 3 4 5 6 po.-in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND:

DREDGE CUT

GENERAL FILL

VERTICAL DATUM:

ALL ELEVATIONS ARE PROVIDED IN GEODETIC DATUM

0.0m CHART DATUM (CD) = 4.42m GEODETIC DATUM (GEO.)

10m 0m 10m 20m
SCALE: 1:500

AUCUN

TITRE-TITLE | No. | MOD.

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
B	JAN 18/11	ISSUED FOR FINAL REPORT	AT
A	JUN 04/10	ISSUED FOR INTERNAL USE	MC

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal

Administration portuaire de Montréal
Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
PRELIMINARY SSP BULKHEAD WHARF SECTIONS

SOUS-TITRE/SUB-TITLE:
WHARF ALIGNMENT A

CONSULTANTS:

777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

DESSINÉ/DRAWN: JL
PROJETÉ/DESIGNED: MC
VÉRIFIÉ/CHECKED: HW
APPROUVÉ/APPROVED: -

SCEAU/SEAL.

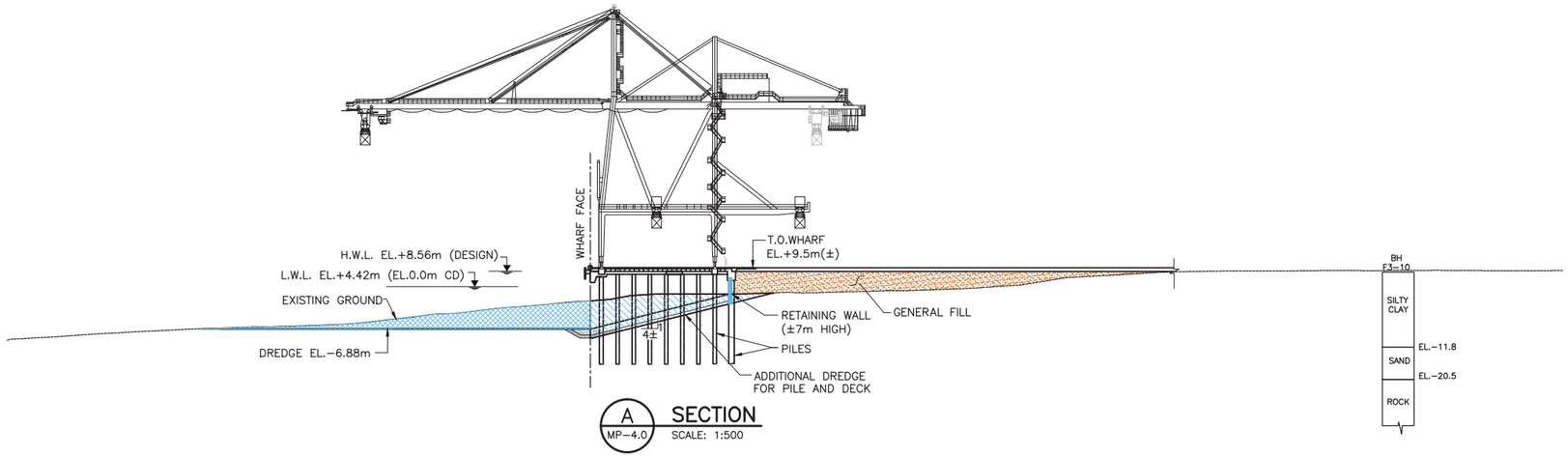
CHEF DE SERVICE/DEPARTMENT HEAD

DATE: MAY 19, 2010

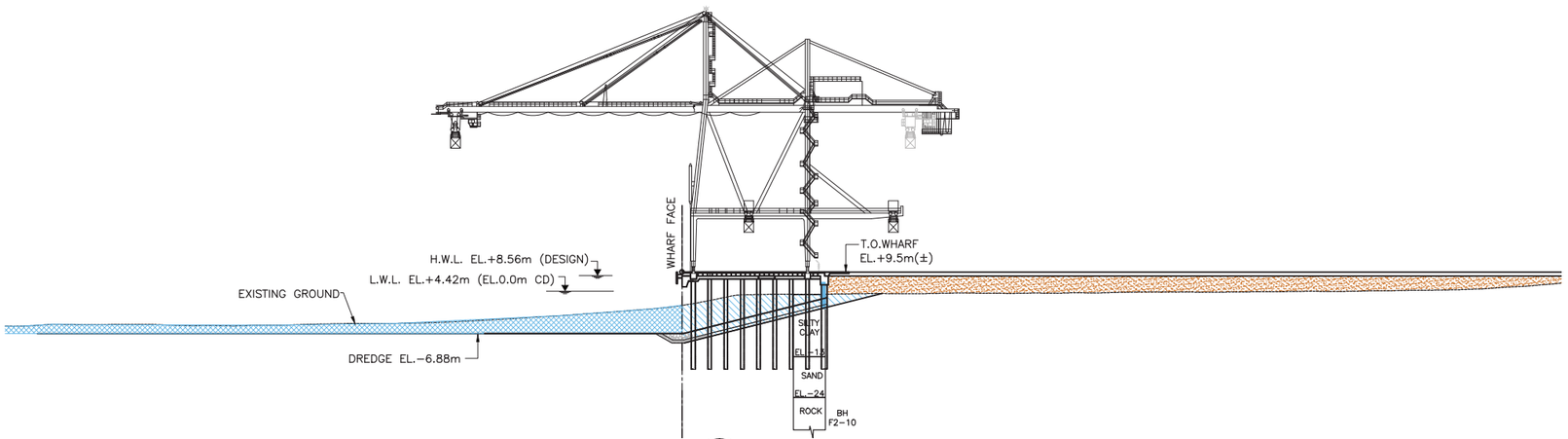
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FEUILLE/SHEET 1 DE/OF 1

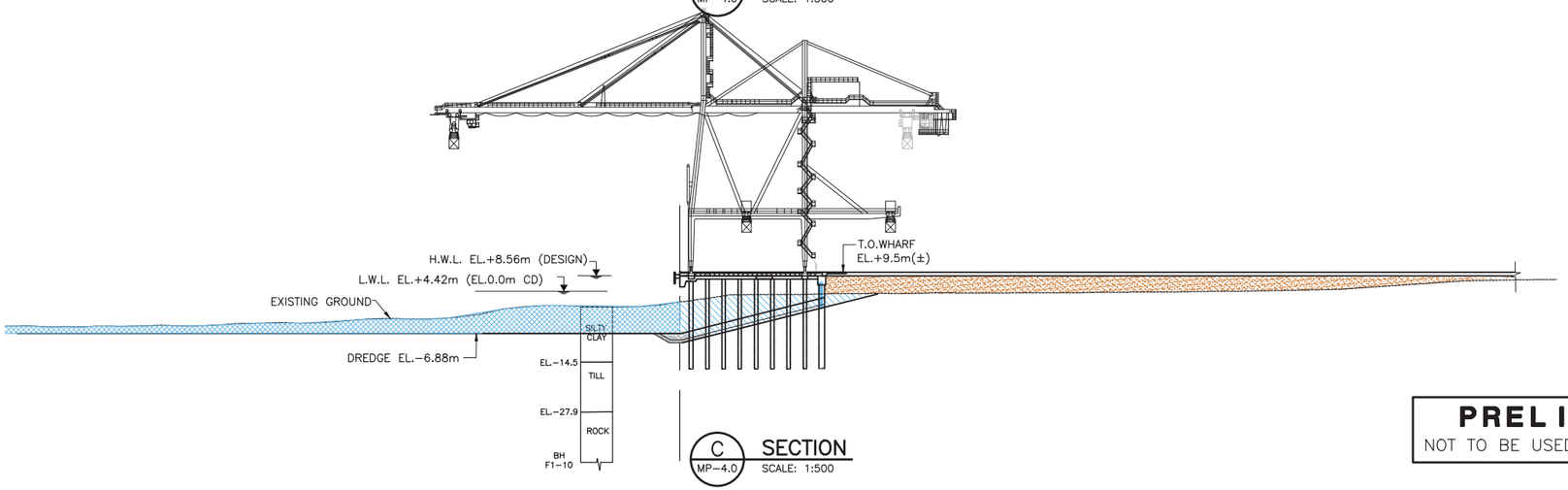
DESIGN No. 7'1'4'6'- MP -8'.0 | MOD. B
DRAWING No. 7'1'4'6'- MP -8'.0 | MOD. B



A SECTION
MP-4.0 SCALE: 1:500



B SECTION
MP-4.0 SCALE: 1:500



C SECTION
MP-4.0 SCALE: 1:500

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

0 1 2 3 4 5 6 po.-in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND:

DREDGE CUT

GENERAL FILL

VERTICAL DATUM:

ALL ELEVATIONS ARE PROVIDED IN GEODETIC DATUM

0.0m CHART DATUM (CD) = 4.42m GEODETIC DATUM (GEO.)

10m 0m 10m 20m
SCALE: 1:500

AUCUN		
TITRE-TITLE	No.	MOD.

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
B	JAN 18/11	ISSUED FOR FINAL REPORT	AT
A	JAN 04/10	ISSUED FOR INTERNAL USE	MC

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal
Administration portuaire de Montréal
Montreal Port Authority
Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
PRELIMINARY PILE & DECK WHARF SECTIONS

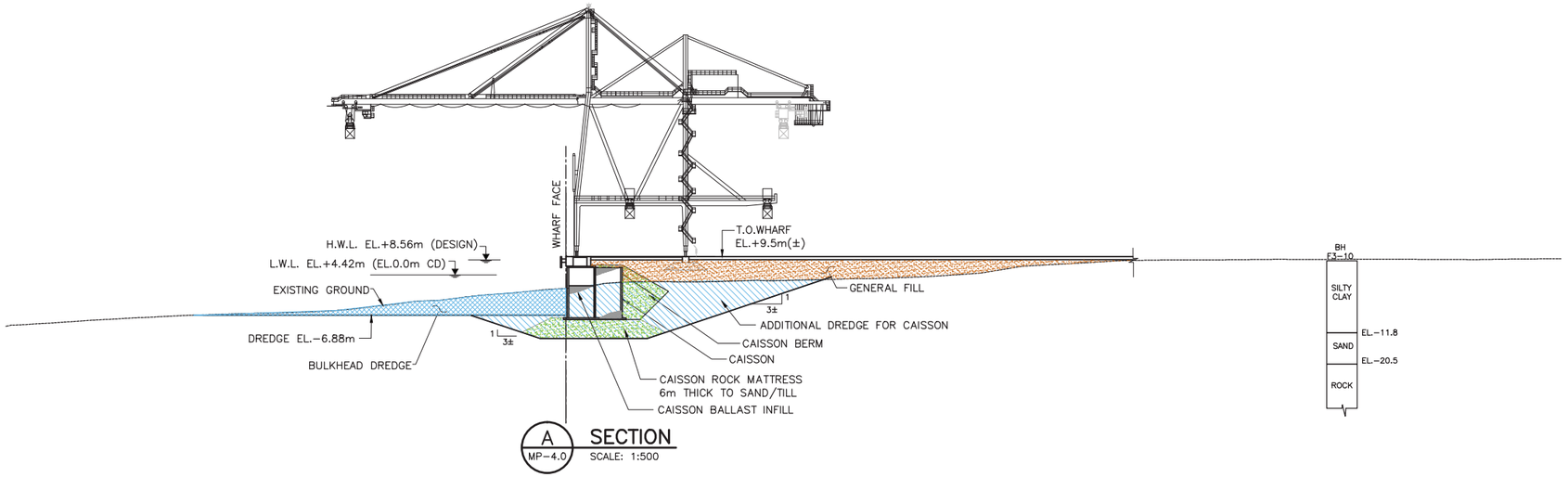
SOUS-TITRE/SUB-TITLE:
WHARF ALIGNMENT A

CONSULTANTS:
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

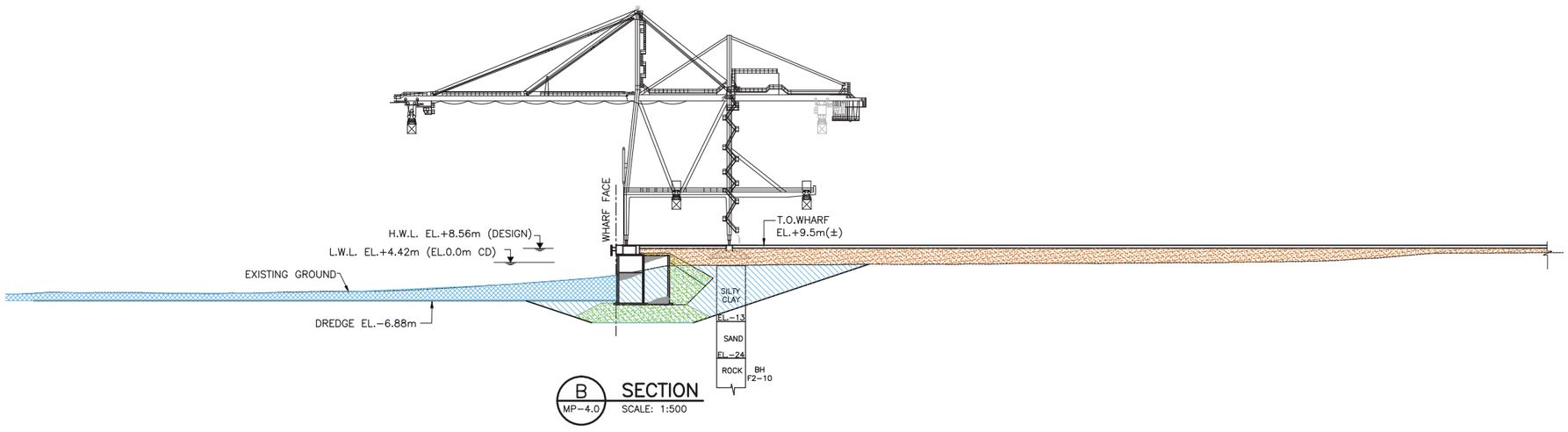
DESSINÉ/DRAWN:	SCEAU/SEAL:
JL	
PROJETÉ/DESIGNED: MC	
VÉRIFIÉ/CHECKED: HW	
APPROUVÉ/APPROVED: -	
CHEF DE SERVICE/DEPARTMENT HEAD:	DATE: MAY 19, 2010
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE OF 1

FORMAT SIZE A-0

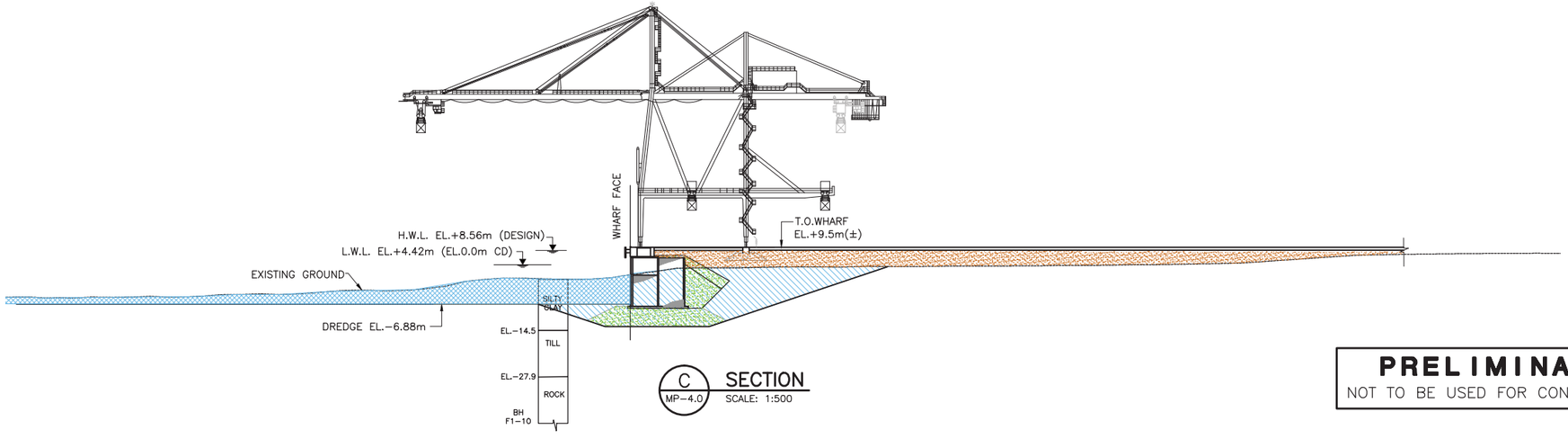
DESIGN NO. 7'1'4'6'- MP -1'0.0 | MOD. B
DRAWING NO.



A MP-4.0 **SECTION**
SCALE: 1:500



B MP-4.0 **SECTION**
SCALE: 1:500



C MP-4.0 **SECTION**
SCALE: 1:500

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

0 1 2 3 4 5 6 po.-in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND:

- DREDGE CUT
- GENERAL FILL
- ROCK FILL

VERTICAL DATUM:

ALL ELEVATIONS ARE PROVIDED IN GEODETIC DATUM

0.0m CHART DATUM (CD) = 4.42m GEODETIC DATUM (GEO.)

10m 0m 10m 20m
SCALE: 1:500

AUCUN

TITRE-TITLE | No. | MOD.

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
B	JAN 18/11	ISSUED FOR FINAL REPORT	AT
A	MAY 19/10	ISSUED FOR INTERNAL USE	MC

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal

Administration portuaire de Montréal
Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
PRELIMINARY CAISSON WHARF SECTIONS

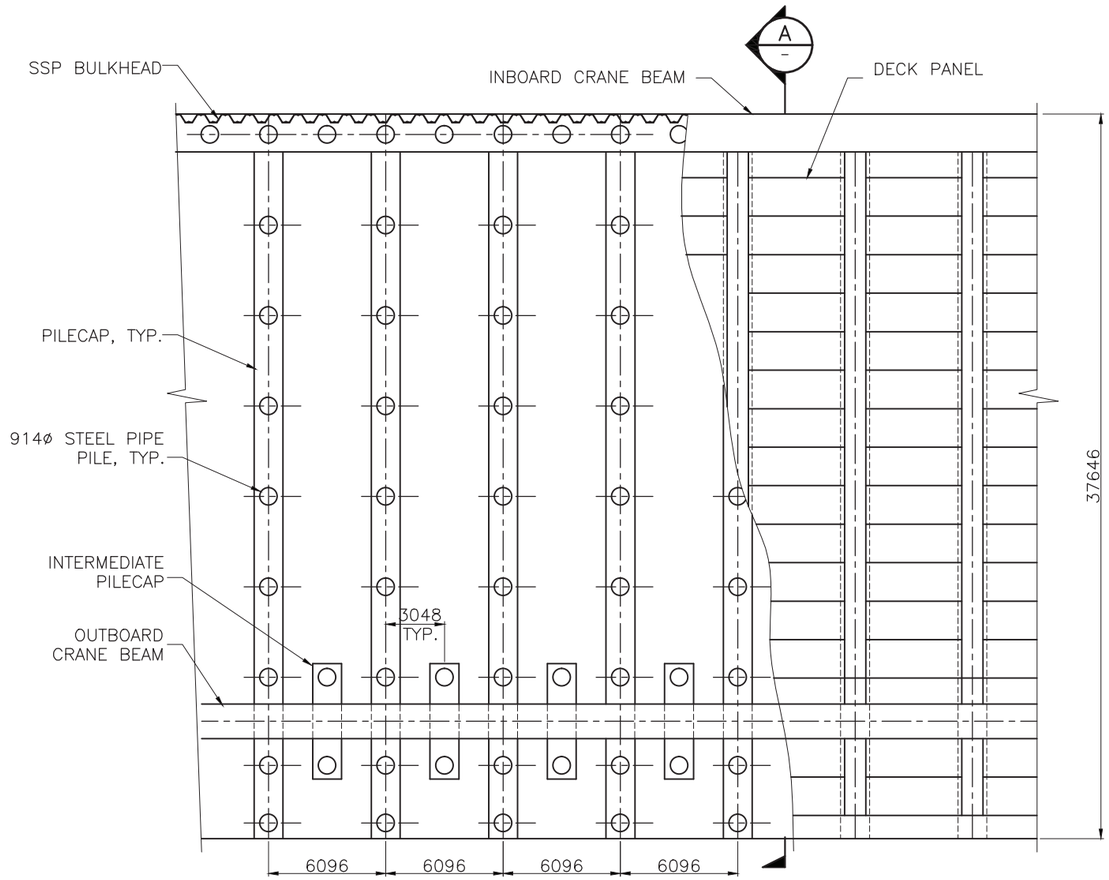
SOUS-TITRE/SUB-TITLE:
WHARF ALIGNMENT A

CONSULTANTS:

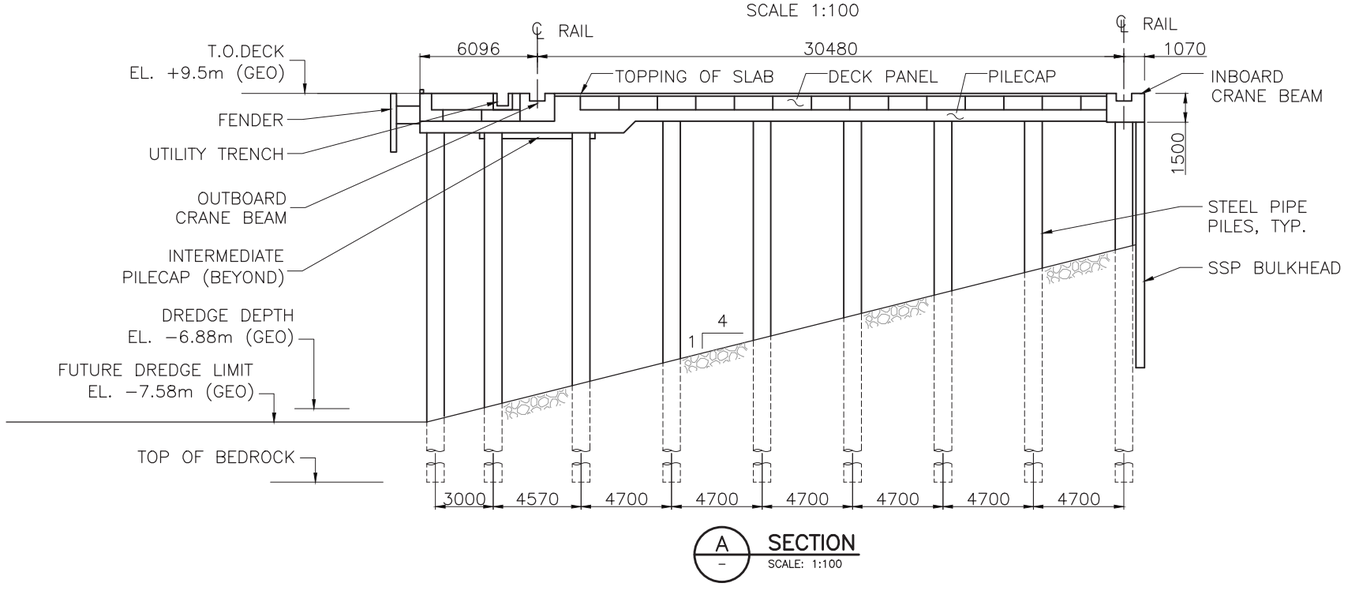
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

DESSINÉ/DRAWN: JL	SCEAU/SEAL:
PROJETÉ/DESIGNED: MC	
VÉRIFIÉ/CHECKED: HW	
APPROUVÉ/APPROVED: -	
CHEF DE SERVICE/DEPARTMENT HEAD:	DATE: MAY 19, 2010
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE OF 1

DESIGN NO. 7'1'4'6'- MP -1'0.0 | MOD. B
DRAWING NO.



PLAN
SCALE 1:100



A SECTION
SCALE: 1:100

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

FORMAT SIZE A-0

DESIGN No. 7'1'4'6'– MP –1'1'.0 | ' ' | MOD. B
DRAWING No.

NOTES

2m 0m 2m 4m
SCALE: 1 : 100

AUCUN

TITRE–TITLE	No.	MOD.
DESSINS DE RÉFÉRENCE–REFERENCE DRAWINGS		

No.	DATE	DESCRIPTION	PAR BY
B	JAN 18/11	ISSUED FOR FINAL REPORT	AT
A	JUN 4/10	ISSUED FOR CLIENT REVIEW	AL

MODIFICATIONS–REVISIONS

Port de Montréal Port of Montreal
Administration portuaire de Montréal Montreal Port Authority
Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
PILE AND DECK PLAN

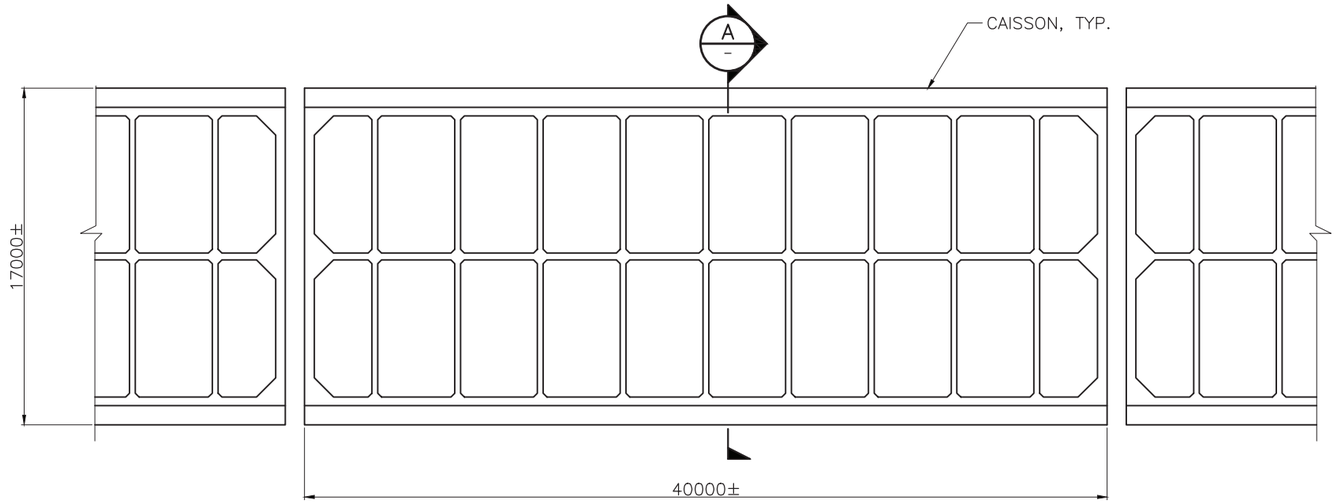
SOUS–TITRE/SUB–TITLE:
PLAN AND SECTION

CONSULTANTS:
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604–707–9004

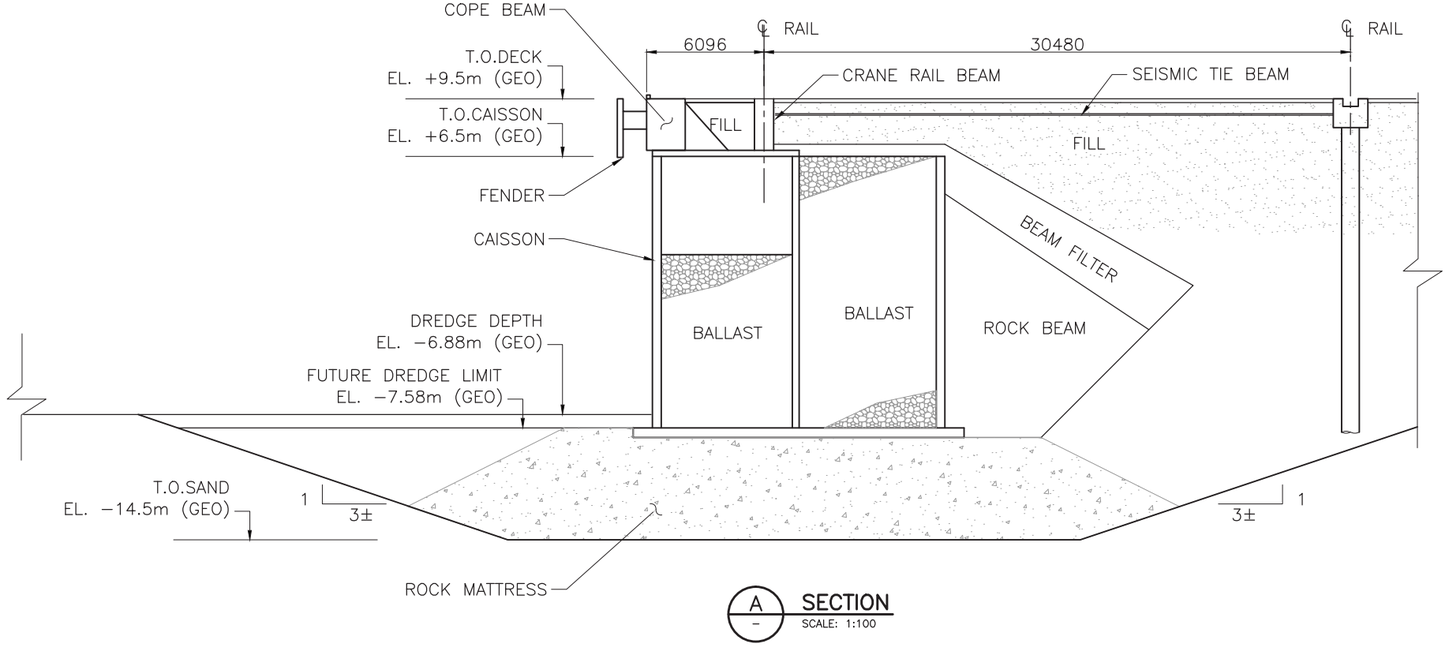
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JL	
PROJETÉ/DESIGNED: RC	
VÉRIFIÉ/CHECKED: HW	
APPROUVÉ/APPROVED: –	
CHEF DE SERVICE/DEPARTMENT HEAD	DATE: JUN 01 2010
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE OF 1

DESIGN No. 7'1'4'6'– MP –1'1'.0 | ' ' | MOD. B
DRAWING No.

0 1 2 3 4 5 6 po.–in.
0 1 2 3 4 5 6 7 8 9 10 cm.



PLAN
SCALE 1:100



A – SECTION
SCALE: 1:100

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

FORMAT SIZE A-0

DESIGN NO.: 7'1'4'6'– M° P– '1 '2 0 | MOD.: B
DRAWING NO.:

NOTES

2m 0m 2m 4m
SCALE: 1 : 100

AUCUN

TITRE–TITLE	No.	MOD.
DESSINS DE RÉFÉRENCE–REFERENCE DRAWINGS		

No.	DATE	DESCRIPTION	PAR BY
B	JAN 18/11	ISSUED FOR FINAL REPORT	AT
A	JAN 4/10	ISSUED FOR CLIENT REVIEW	JL

MODIFICATIONS–REVISIONS

Port de Montréal Port of Montreal
Administration portuaire de Montréal Montreal Port Authority
Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
CAISSON PLAN AND SECTION

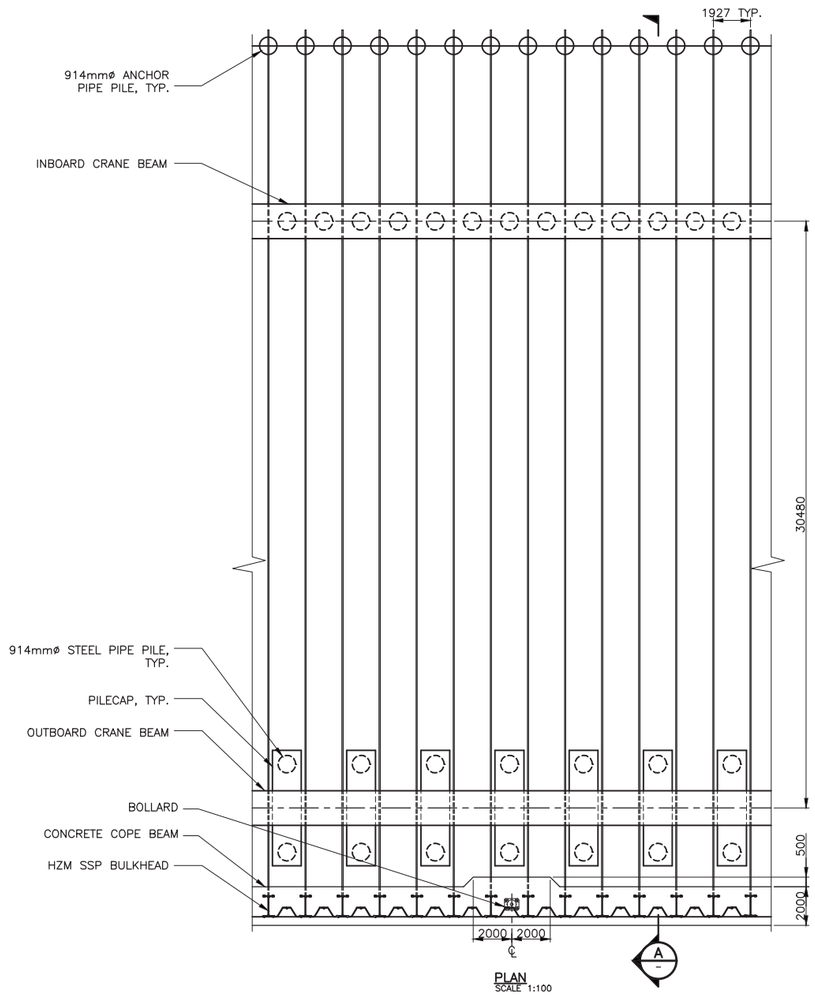
SOUS–TITRE/SUB–TITLE:

CONSULTANTS:
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604–707–9004

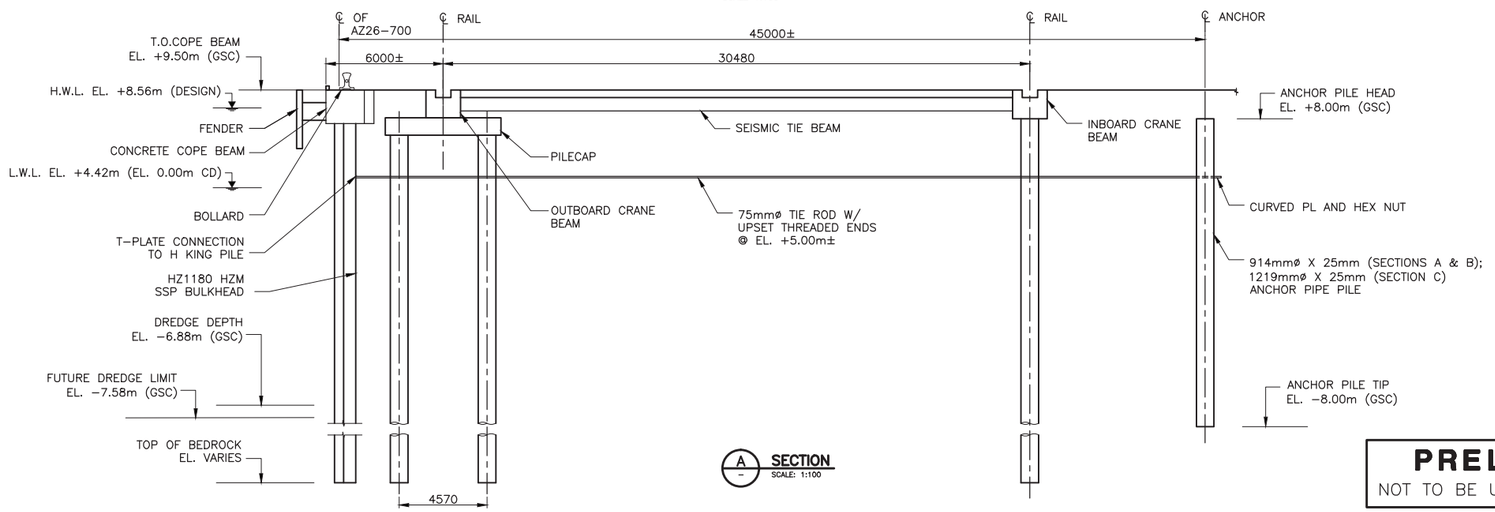
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PROJETÉ/DESIGNED: MC
VÉRIFIÉ/CHECKED: HW
APPROUVÉ/APPROVED: –
CHEF DE SERVICE/DEPARTMENT HEAD:
ÉCHELLE/SCALE: AS SHOWN
SCEAU/SEAL:
DATE: JUN 01 2010
FEUILLE/SHEET: 1 DE/OF 1

DESIGN NO.: 7'1'4'6'– M° P– '1 '2 0 | MOD.: B
DRAWING NO.:

0 1 2 3 4 5 6 po.–in.
0 1 2 3 4 5 6 7 8 9 10 cm.



PLAN
SCALE 1:100



A SECTION
SCALE: 1:100

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

FORMAT SIZE A-0

DESIGN NO./DRAWING NO. 7'1'4'6'- MP-'1'3.0 | ' ' | MOD. C

NOTES

2m 0m 2m 4m
SCALE: 1 : 100

AUCUN

TITRE-TITLE	No.	MOD.
DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS		

No.	DATE	DESCRIPTION	PAR BY
C	JAN 18/11	ISSUED FOR FINAL REPORT	AT
B	AUG 6/10	ISSUED FOR CLIENT REVIEW	AT
A	JUN 4/10	ISSUED FOR CLIENT REVIEW	JL

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal
Administration portuaire de Montréal Montreal Port Authority
Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
STEEL SHEET PILE

SOUS-TITRE/SUB-TITLE:
PLAN AND SECTION

CONSULTANTS:
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

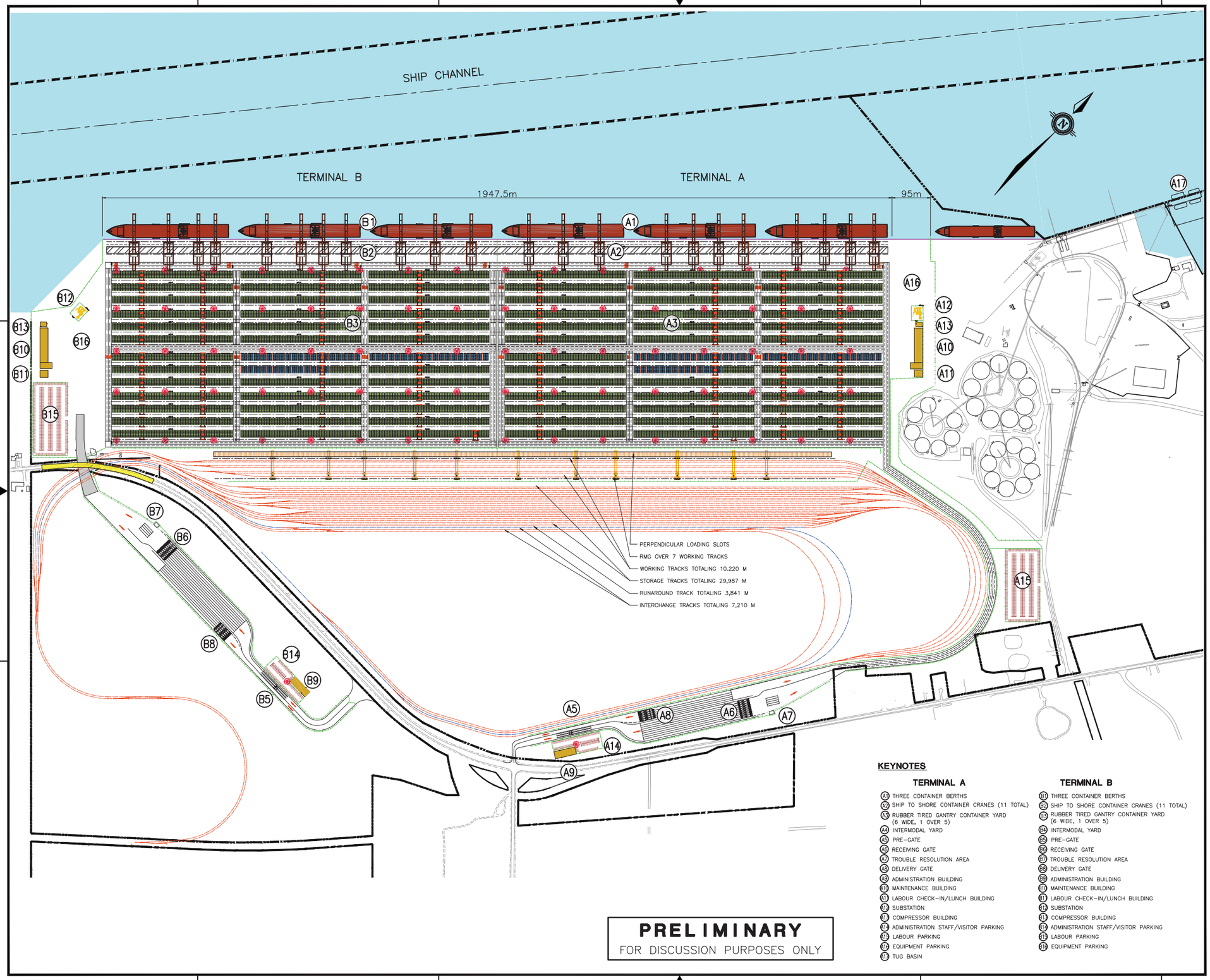
DESSINÉ/DRAWN: JL	SCEAU/SEAL:
PROJETÉ/DESIGNED: RC	
VÉRIFIÉ/CHECKED: HW	
APPROUVÉ/APPROVED: -	
CHEF DE SERVICE/DEPARTMENT HEAD:	DATE: JUN 01 2010
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET 1 DE OF 1

DESIGN NO./DRAWING NO. 7'1'4'6'- MP-'1'3.0 | ' ' | MOD. C

0 1 2 3 4 5 6 po.-in.
0 1 2 3 4 5 6 7 8 9 10 cm.

FORMAT SIZE A-0

DESIGN NO. 711416 1 — MP P- 1 1 4. 0 — MOD. C
DRAWING NO.



KEYNOTES

TERMINAL A

- A1 THREE CONTAINER BERTHS
- A2 SHIP TO SHORE CONTAINER CRANES (11 TOTAL)
- A3 RUBBER TIRED GANTRY CONTAINER YARD (6 WIDE, 1 OVER 5)
- A4 INTERMODAL YARD
- A5 PRE-GATE
- A6 RECEIVING GATE
- A7 TROUBLE RESOLUTION AREA
- A8 DELIVERY GATE
- A9 ADMINISTRATION BUILDING
- A10 MAINTENANCE BUILDING
- A11 LABOUR CHECK-IN/LUNCH BUILDING
- A12 SUBSTATION
- A13 COMPRESSOR BUILDING
- A14 ADMINISTRATION STAFF/VISITOR PARKING
- A15 LABOUR PARKING
- A16 EQUIPMENT PARKING
- A17 TUG BASIN

TERMINAL B

- B1 THREE CONTAINER BERTHS
- B2 SHIP TO SHORE CONTAINER CRANES (11 TOTAL)
- B3 RUBBER TIRED GANTRY CONTAINER YARD (6 WIDE, 1 OVER 5)
- B4 INTERMODAL YARD
- B5 PRE-GATE
- B6 RECEIVING GATE
- B7 TROUBLE RESOLUTION AREA
- B8 DELIVERY GATE
- B9 ADMINISTRATION BUILDING
- B10 MAINTENANCE BUILDING
- B11 LABOUR CHECK-IN/LUNCH BUILDING
- B12 SUBSTATION
- B13 COMPRESSOR BUILDING
- B14 ADMINISTRATION STAFF/VISITOR PARKING
- B15 LABOUR PARKING
- B16 EQUIPMENT PARKING

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

0 1 2 3 4 5 6 po.-in.
0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND

- RUBBER TIRED GANTRY (RTG) GROUNDED CONTAINERS (20,016 TGS)
- RUBBER TIRED GANTRY (RTG) GROUNDED REEFERS (1,248 TGS)
- BUILDINGS
- RAIL TRACK
- HIGH MAST LIGHT POLE
- VEHICLE OVERPASS STRUCTURE
- UNDERPASS
- TERMINAL FENCE
- MPA PROPERTY LINE

60m 0m 60m 120m
SCALE: 1 : 3000

AUCUN

TITRE-TITLE	No.	MOD.

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
C	JAN 18/11	ISSUED FOR FINAL REPORT	AT
B	JUL 16/10	ISSUED FOR CLIENT REVIEW	JL
A	JUL 2/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal
Administration portuaire de Montréal Montreal Port Authority
Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
CONVENTIONAL TERMINAL

SOUS-TITRE/SUB-TITLE:
OPTION 1 – GENERAL ARRANGEMENT

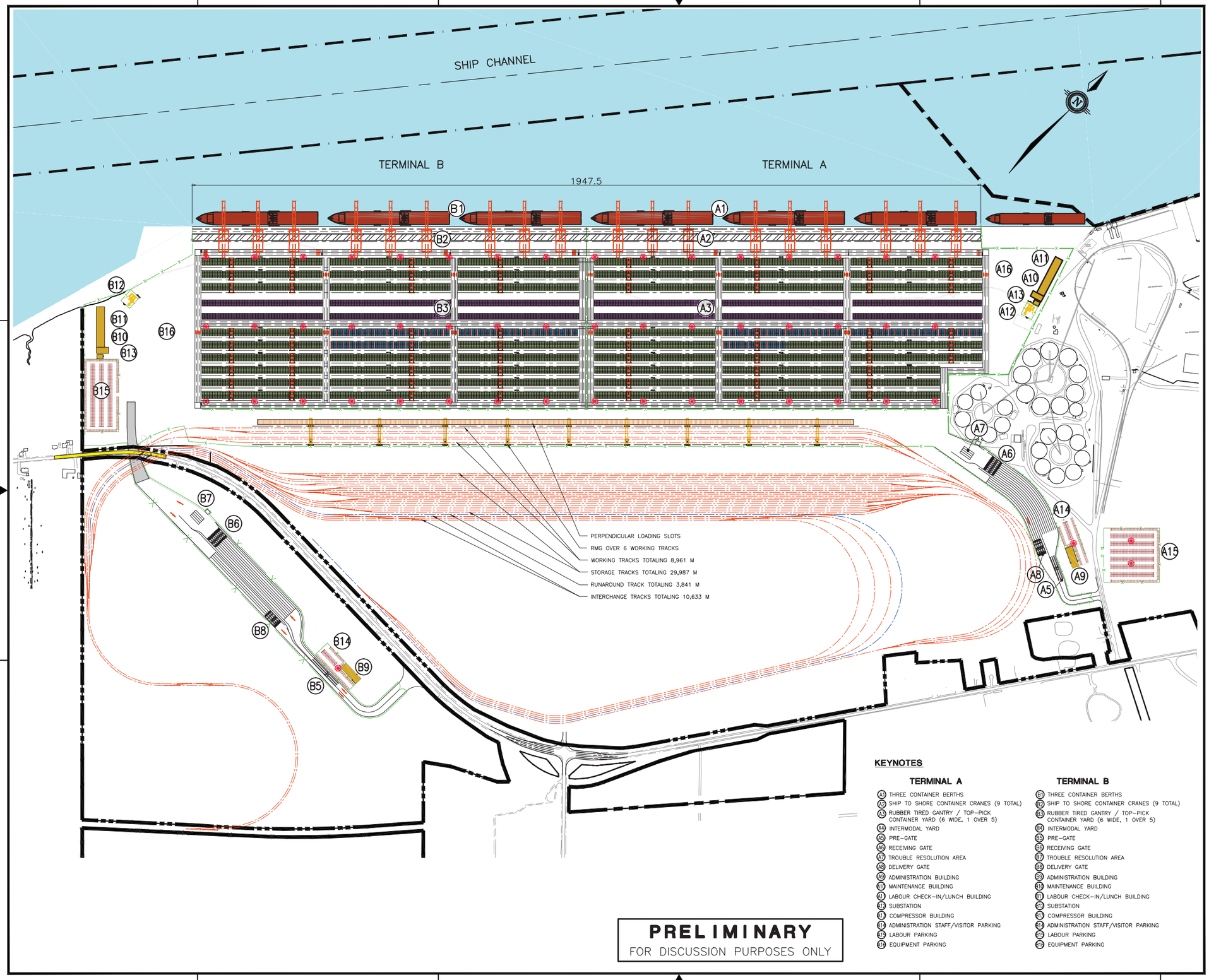
CONSULTANTS:
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

DESSINÉ/DRAWN: JL	SCEAU/SEAL:
PROJETÉ/DESIGNED: HW	
VÉRIFIÉ/CHECKED: HW	
APPROUVÉ/APPROVED: –	
CHEF DE SERVICE/DEPARTMENT HEAD:	DATE: JUNE 21, 2010
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE/OF 1

DESIGN NO. 711416 1 — MP P- 1 1 4. 0 — MOD. C
DRAWING NO.

FORMAT SIZE A-0

DESIGN No. 711416I-MP-1115.0 | MOD. B
DRAWING No.



KEYNOTES

TERMINAL A

- A1 THREE CONTAINER BERTHS
- A2 SHIP TO SHORE CONTAINER CRANES (9 TOTAL)
- A3 RUBBER TIRED GANTRY / TOP-PICK CONTAINER YARD (6 WIDE, 1 OVER 5)
- A4 INTERMODAL YARD
- A5 PRE-GATE
- A6 RECEIVING GATE
- A7 TROUBLE RESOLUTION AREA
- A8 DELIVERY GATE
- A9 ADMINISTRATION BUILDING
- A11 MAINTENANCE BUILDING
- A11 LABOUR CHECK-IN/LUNCH BUILDING
- A12 SUBSTATION
- A13 COMPRESSOR BUILDING
- A14 ADMINISTRATION STAFF/VISITOR PARKING
- A15 LABOUR PARKING
- A16 EQUIPMENT PARKING

TERMINAL B

- B1 THREE CONTAINER BERTHS
- B2 SHIP TO SHORE CONTAINER CRANES (9 TOTAL)
- B3 RUBBER TIRED GANTRY / TOP-PICK CONTAINER YARD (6 WIDE, 1 OVER 5)
- B4 INTERMODAL YARD
- B5 PRE-GATE
- B6 RECEIVING GATE
- B7 TROUBLE RESOLUTION AREA
- B8 DELIVERY GATE
- B9 ADMINISTRATION BUILDING
- B11 MAINTENANCE BUILDING
- B11 LABOUR CHECK-IN/LUNCH BUILDING
- B12 SUBSTATION
- B13 COMPRESSOR BUILDING
- B14 ADMINISTRATION STAFF/VISITOR PARKING
- B15 LABOUR PARKING
- B16 EQUIPMENT PARKING

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

0 1 2 3 4 5 6 po.-in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND

- RUBBER TIRED GANTRY (RTG) GROUNDED CONTAINERS (13,380 TGS)
- RUBBER TIRED GANTRY (RTG) TOP-PICK GROUNDED CONTAINERS (3,276 TGS)
- RUBBER TIRED GANTRY (RTG) GROUNDED REEFERS (1,200 TGS)
- BUILDINGS
- RAIL TRACK
- HIGH MAST LIGHT POLE
- VEHICLE OVERPASS STRUCTURE
- UNDERPASS
- TERMINAL FENCE
- MPA PROPERTY LINE

60m 0m 60m 120m
SCALE: 1 : 3000

AUCUN

TITRE-TITLE	No.	MOD.
DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS		

No.	DATE	DESCRIPTION	PAR BY
B	JAN 18/11	ISSUED FOR FINAL REPORT	AT
A	JUL 2/10	ISSUED FOR CLIENT REVIEW	MG

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal
Administration portuaire de Montréal
Montreal Port Authority
Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
CONVENTIONAL TERMINAL

SOUS-TITRE/SUB-TITLE:
OPTION 2 – GENERAL ARRANGEMENT

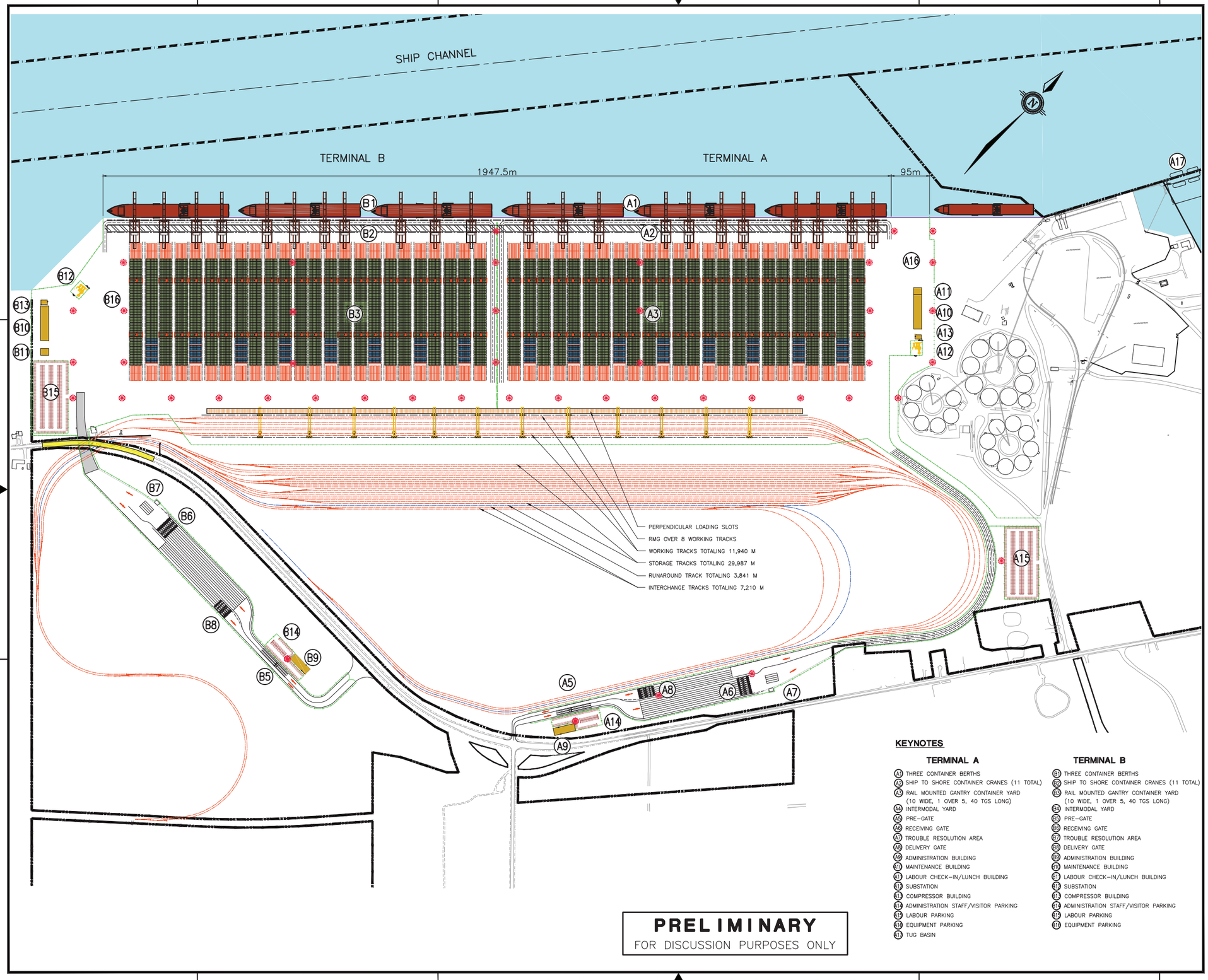
CONSULTANTS:
MOUNTAIN & NICHOL
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

DESSINÉ/DRAWN: JL
PROJETÉ/DESIGNED: HW
VÉRIFIÉ/CHECKED: HW
APPROUVÉ/APPROVED: –
CHEF DE SERVICE/DEPARTMENT HEAD:
ÉCHELLE/SCALE: AS SHOWN
SCEAU/SEAL.
DATE: JUNE 21, 2010
FEUILLE/SHEET: 1 DE/OF 1

DESIGN No. 711416I-MP-1115.0 | MOD. B
DRAWING No.

FORMAT SIZE A-0

DESIGN No. 7114161-MP-116.0 | MOD. C
DRAWING No.



PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

KEYNOTES

TERMINAL A

- A1 THREE CONTAINER BERTHS
- A2 SHIP TO SHORE CONTAINER CRANES (11 TOTAL)
- A3 RAIL MOUNTED GANTRY CONTAINER YARD (10 WIDE, 1 OVER 5, 40 TGS LONG)
- A4 INTERMODAL YARD
- A5 PRE-GATE
- A6 RECEIVING GATE
- A7 TROUBLE RESOLUTION AREA
- A8 DELIVERY GATE
- A9 ADMINISTRATION BUILDING
- A10 MAINTENANCE BUILDING
- A11 LABOUR CHECK-IN/LUNCH BUILDING
- A12 SUBSTATION
- A13 COMPRESSOR BUILDING
- A14 ADMINISTRATION STAFF/VISITOR PARKING
- A15 LABOUR PARKING
- A16 EQUIPMENT PARKING
- A17 TUG BASIN

TERMINAL B

- B1 THREE CONTAINER BERTHS
- B2 SHIP TO SHORE CONTAINER CRANES (11 TOTAL)
- B3 RAIL MOUNTED GANTRY CONTAINER YARD (10 WIDE, 1 OVER 5, 40 TGS LONG)
- B4 INTERMODAL YARD
- B5 PRE-GATE
- B6 RECEIVING GATE
- B7 TROUBLE RESOLUTION AREA
- B8 DELIVERY GATE
- B9 ADMINISTRATION BUILDING
- B10 MAINTENANCE BUILDING
- B11 LABOUR CHECK-IN/LUNCH BUILDING
- B12 SUBSTATION
- B13 COMPRESSOR BUILDING
- B14 ADMINISTRATION STAFF/VISITOR PARKING
- B15 LABOUR PARKING
- B16 EQUIPMENT PARKING

0 1 2 3 4 5 6 po.-in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND

- RAIL MOUNTED GANTRY (RMG) GROUNDED CONTAINERS (17,600 TGS)
- RAIL MOUNTED GANTRY (RMG) GROUNDED REEFERS (1,280 TGS)
- BUILDINGS
- RAIL TRACK
- HIGH MAST LIGHT POLE
- VEHICLE OVERPASS STRUCTURE
- UNDERPASS
- TERMINAL FENCE
- MPA PROPERTY LINE
- AGV ROUTES

60m 0m 60m 120m
SCALE: 1 : 3000

AUCUN

TITRE-TITLE	No.	MOD.
DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS		

No.	DATE	DESCRIPTION	PAR BY
C	JAN 18/11	ISSUED FOR FINAL REPORT	AT
B	JUL 16/10	ISSUED FOR CLIENT REVIEW	JL
A	JUL 2/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal
Administration portuaire de Montréal Montreal Port Authority
Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
SEMI AUTOMATED TERMINAL

SOUS-TITRE/SUB-TITLE:
OPTION 1 – GENERAL ARRANGEMENT

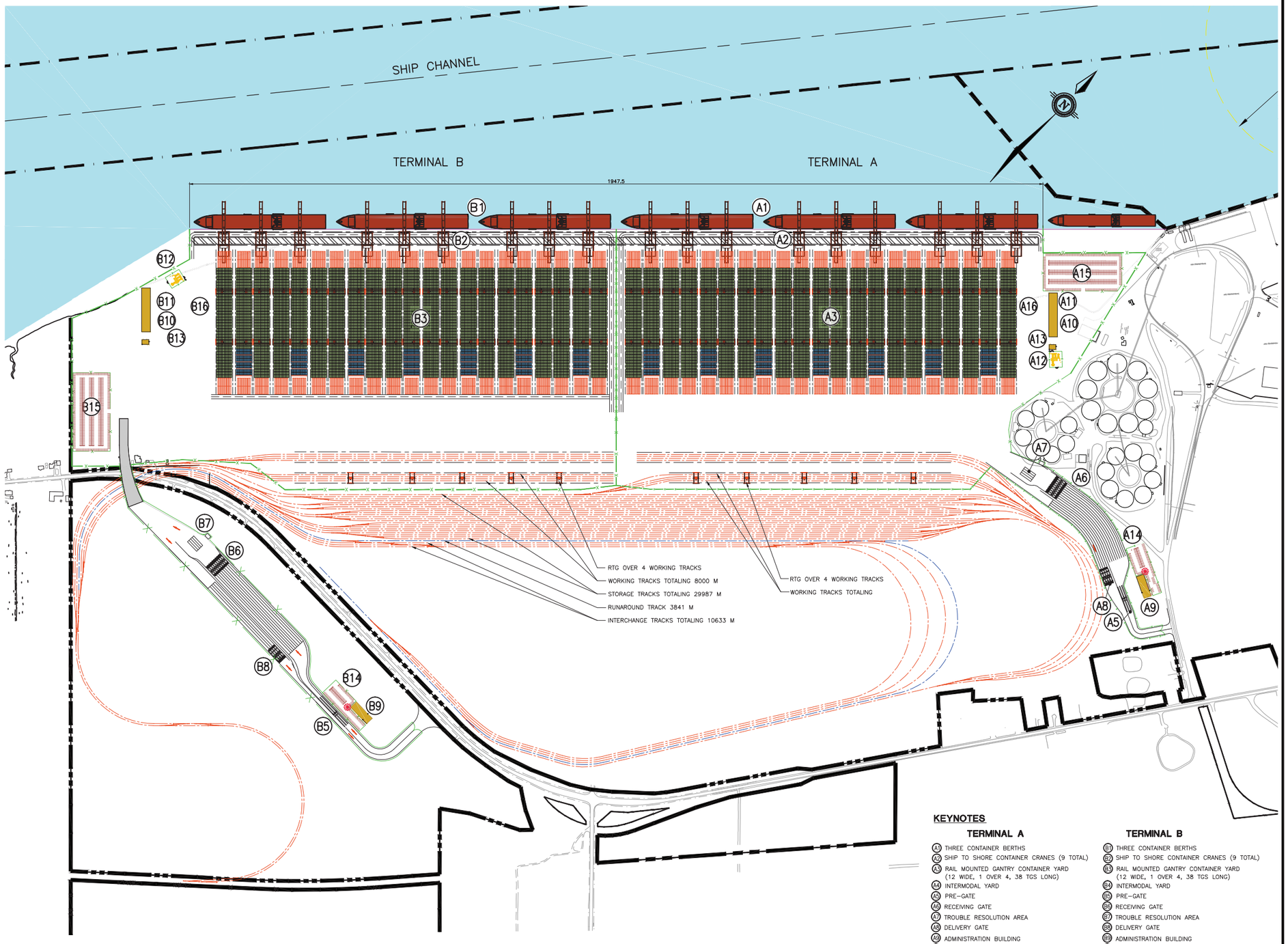
CONSULTANTS:
BURNSIDE ⊕ NICKEL
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

DESSINÉ/DRAWN: JL	SCEAU/SEAL:
PROJETÉ/DESIGNED: HW	
VÉRIFIÉ/CHECKED: HW	
APPROUVÉ/APPROVED: –	
CHEF DE SERVICE/DEPARTMENT HEAD:	DATE: JUNE 22, 2010
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE OF 1

DESIGN No. 7114161-MP-116.0 | MOD. C
DRAWING No.

FORMAT SIZE A-0

DESIGN NO. 7114161-MP-1117.0 | MOD. B
DRAWING NO.



KEYNOTES

TERMINAL A

- (A1) THREE CONTAINER BERTHS
- (A2) SHIP TO SHORE CONTAINER CRANES (9 TOTAL)
- (A3) RAIL MOUNTED GANTRY CONTAINER YARD (12 WIDE, 1 OVER 4, 38 TGS LONG)
- (A4) INTERMODAL YARD
- (A5) PRE-GATE
- (A6) RECEIVING GATE
- (A7) TROUBLE RESOLUTION AREA
- (A8) DELIVERY GATE
- (A9) ADMINISTRATION BUILDING
- (A10) MAINTENANCE BUILDING
- (A11) LABOUR CHECK-IN/LUNCH BUILDING
- (A12) SUBSTATION
- (A13) COMPRESSOR BUILDING
- (A14) ADMINISTRATION STAFF/VISITOR PARKING
- (A15) LABOUR PARKING
- (A16) EQUIPMENT PARKING

TERMINAL B

- (B1) THREE CONTAINER BERTHS
- (B2) SHIP TO SHORE CONTAINER CRANES (9 TOTAL)
- (B3) RAIL MOUNTED GANTRY CONTAINER YARD (12 WIDE, 1 OVER 4, 38 TGS LONG)
- (B4) INTERMODAL YARD
- (B5) PRE-GATE
- (B6) RECEIVING GATE
- (B7) TROUBLE RESOLUTION AREA
- (B8) DELIVERY GATE
- (B9) ADMINISTRATION BUILDING
- (B10) MAINTENANCE BUILDING
- (B11) LABOUR CHECK-IN/LUNCH BUILDING
- (B12) SUBSTATION
- (B13) COMPRESSOR BUILDING
- (B14) ADMINISTRATION STAFF/VISITOR PARKING
- (B15) LABOUR PARKING
- (B16) EQUIPMENT PARKING

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

0 1 2 3 4 5 6 po.-in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND

- RAIL MOUNTED GANTRY (RMG) GROUNDED CONTAINERS (17,472 TGS)
- RAIL MOUNTED GANTRY (RMG) GROUNDED REEFERS (1,344 TGS)
- BUILDINGS
- RAIL TRACK
- HIGH MAST LIGHT POLE
- VEHICLE OVERPASS STRUCTURE
- UNDERPASS
- TERMINAL FENCE
- MPA PROPERTY LINE
- AGV ROUTES

50m 0m 50m 100m
SCALE: 1 : 2500

AUCUN

TITRE-TITLE	No.	MOD.
DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS		

No.	DATE	DESCRIPTION	PAR BY
B	JAN 18/11	ISSUED FOR FINAL REPORT	AT
A	JUL 2/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal

Administration portuaire de Montréal Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
SEMI AUTOMATED TERMINAL

SOUS-TITRE/SUB-TITLE:
OPTION 2 – GENERAL ARRANGEMENT

CONSULTANTS:

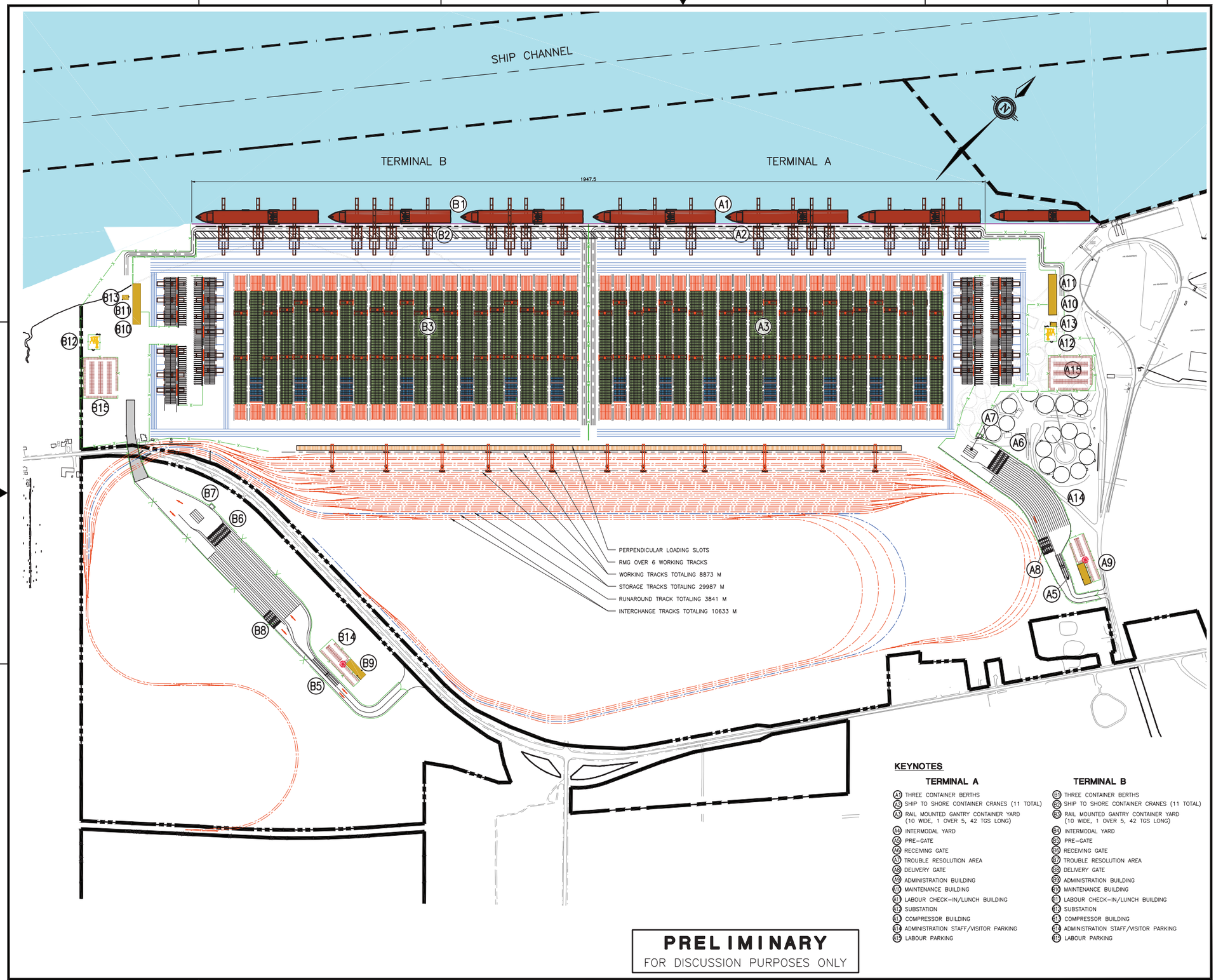
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

DESSINÉ/DRAWN: JL	SCEAU/SEAL:
PROJETÉ/DESIGNED: HW	
VÉRIFIÉ/CHECKED: HW	
APPROUVÉ/APPROVED: –	
CHEF DE SERVICE/DEPARTMENT HEAD	DATE: JUNE 22, 2010
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET 1 DE/OF 1

DESIGN NO. 7114161-MP-1117.0 | MOD. B
DRAWING NO.

FORMAT SIZE A-0

DESIGN NO./DRAWING NO. 7114161-MP-118.0 | - | MOD. C



PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

0 1 2 3 4 5 6 po.-in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND

- RAIL MOUNTED GANTRY (RMG) GROUNDED CONTAINERS (14,240 TGS)
- RAIL MOUNTED GANTRY (RMG) GROUNDED REEFERS (1,120 TGS)
- BUILDINGS
- RAIL TRACK
- HIGH MAST LIGHT POLE
- VEHICLE OVERPASS STRUCTURE
- UNDERPASS
- TERMINAL FENCE
- MPA PROPERTY LINE
- AGV ROUTES

60m 0m 60m 120m
SCALE: 1 : 3000

KEYNOTES

TERMINAL A

- A1 THREE CONTAINER BERTHS
- A2 SHIP TO SHORE CONTAINER CRANES (11 TOTAL)
- A3 RAIL MOUNTED GANTRY CONTAINER YARD (10 WIDE, 1 OVER 5, 42 TGS LONG)
- A4 INTERMODAL YARD
- A5 PRE-GATE
- A6 RECEIVING GATE
- A7 TROUBLE RESOLUTION AREA
- A8 DELIVERY GATE
- A9 ADMINISTRATION BUILDING
- A10 MAINTENANCE BUILDING
- A11 LABOUR CHECK-IN/LUNCH BUILDING
- A12 SUBSTATION
- A13 COMPRESSOR BUILDING
- A14 ADMINISTRATION STAFF/VISITOR PARKING
- A15 LABOUR PARKING

TERMINAL B

- B1 THREE CONTAINER BERTHS
- B2 SHIP TO SHORE CONTAINER CRANES (11 TOTAL)
- B3 RAIL MOUNTED GANTRY CONTAINER YARD (10 WIDE, 1 OVER 5, 42 TGS LONG)
- B4 INTERMODAL YARD
- B5 PRE-GATE
- B6 RECEIVING GATE
- B7 TROUBLE RESOLUTION AREA
- B8 DELIVERY GATE
- B9 ADMINISTRATION BUILDING
- B10 MAINTENANCE BUILDING
- B11 LABOUR CHECK-IN/LUNCH BUILDING
- B12 SUBSTATION
- B13 COMPRESSOR BUILDING
- B14 ADMINISTRATION STAFF/VISITOR PARKING
- B15 LABOUR PARKING

AUCUN

TITRE-TITLE	No.	MOD.
DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS		

No.	DATE	DESCRIPTION	PAR BY
C	JAN. 18/11	ISSUED FOR FINAL REPORT	AT
B	OCT. 8/11	ISSUED FOR CLIENT REVIEW	MC
A	JUL. 2/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal

Administration portuaire de Montréal Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
AUTOMATED TERMINAL

SOUS-TITRE/SUB-TITLE:
OPTION 1 – GENERAL ARRANGEMENT

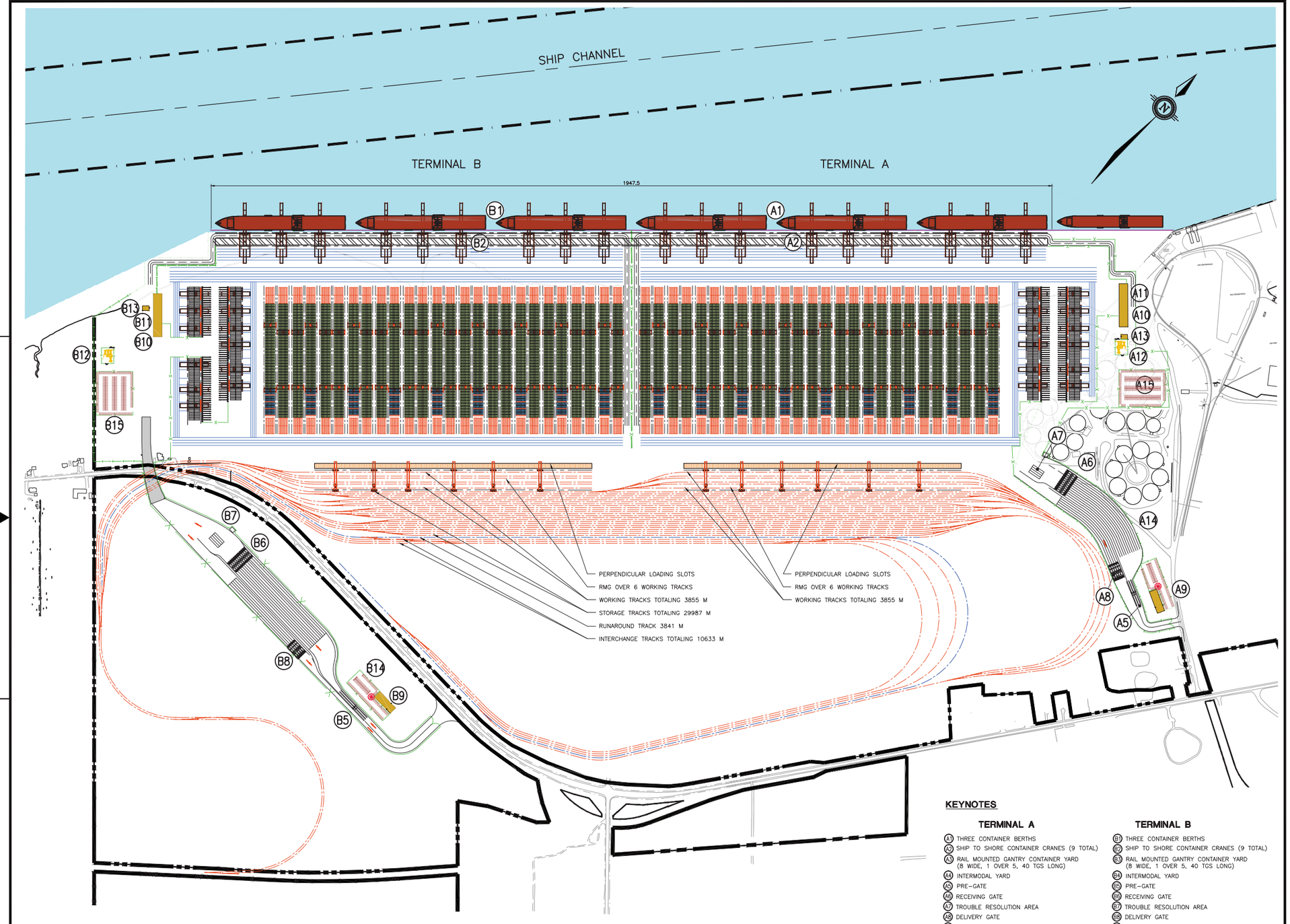
CONSULTANTS:
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

DESSINÉ/DRAWN: JL	SCEAU/SEAL:
PROJETÉ/DESIGNED: MC	
VÉRIFIÉ/CHECKED: HW	
APPROUVÉ/APPROVED: -	
CHEF DE SERVICE/DEPARTMENT HEAD:	DATE: JUNE 22, 2010
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE 1 OF

DESIGN NO./DRAWING NO. 7114161-MP-118.0 | - | MOD. C

FORMAT SIZE A-0

DESIGN NO. 7114161-MP-1119.0 | - | MOD. B
DRAWING NO.



KEYNOTES

TERMINAL A

- A1 THREE CONTAINER BERTHS
- A2 SHIP TO SHORE CONTAINER CRANES (9 TOTAL)
- A3 RAIL MOUNTED GANTRY CONTAINER YARD (8 WIDE, 1 OVER 5, 40 TGS LONG)
- A4 INTERMODAL YARD
- A5 PRE-GATE
- A6 RECEIVING GATE
- A7 TROUBLE RESOLUTION AREA
- A8 DELIVERY GATE
- A9 ADMINISTRATION BUILDING
- A10 MAINTENANCE BUILDING
- A11 LABOUR CHECK-IN/LUNCH BUILDING
- A12 SUBSTATION
- A13 COMPRESSOR BUILDING
- A14 ADMINISTRATION STAFF/VISITOR PARKING
- A15 LABOUR PARKING

TERMINAL B

- B1 THREE CONTAINER BERTHS
- B2 SHIP TO SHORE CONTAINER CRANES (9 TOTAL)
- B3 RAIL MOUNTED GANTRY CONTAINER YARD (8 WIDE, 1 OVER 5, 40 TGS LONG)
- B4 INTERMODAL YARD
- B5 PRE-GATE
- B6 RECEIVING GATE
- B7 TROUBLE RESOLUTION AREA
- B8 DELIVERY GATE
- B9 ADMINISTRATION BUILDING
- B10 MAINTENANCE BUILDING
- B11 LABOUR CHECK-IN/LUNCH BUILDING
- B12 SUBSTATION
- B13 COMPRESSOR BUILDING
- B14 ADMINISTRATION STAFF/VISITOR PARKING
- B15 LABOUR PARKING

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

0 1 2 3 4 5 6 po.-in.
0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND

- RAIL MOUNTED GANTRY (RMG) GROUNDED CONTAINERS (15,200 TGS)
- RAIL MOUNTED GANTRY (RMG) GROUNDED REEFERS (1,152 TGS)
- BUILDINGS
- RAIL TRACK
- HIGH MAST LIGHT POLE
- VEHICLE OVERPASS STRUCTURE
- UNDERPASS
- TERMINAL FENCE
- MPA PROPERTY LINE
- AGV ROUTES

60m 0m 60m 120m
SCALE: 1 : 3000

AUCUN

TITRE-TITLE	No.	MOD.
DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS		

No.	DATE	DESCRIPTION	PAR BY
B	JAN. 18/11	ISSUED FOR FINAL REPORT	AT
A	JUL. 2/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal
Administration portuaire de Montréal Montreal Port Authority
Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
AUTOMATED TERMINAL

SOUS-TITRE/SUB-TITLE:
OPTION 2 – GENERAL ARRANGEMENT

CONSULTANTS:
BURNSIDE SCHEEL
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

DESSINÉ/DRAWN: JL	SCEAU/SEAL:
PROJETÉ/DESIGNED: MC	
VÉRIFIÉ/CHECKED: HW	
APPROUVÉ/APPROVED: -	
CHEF DE SERVICE/DEPARTMENT HEAD:	DATE: JUNE 22, 2010
ECHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE/OF 1

DESIGN NO. 7114161-MP-1119.0 | - | MOD. B
DRAWING NO.

FORMAT SIZE A-0

DESIGN NO. 7114161-
DRAWING NO. MP-210-0 | - | -
MOD. C

SHIP CHANNEL

SAINT – LAWRENCE RIVER

TERMINAL A

1597.5m
FUTURE BERTHS

350m
PHASE A – ONE BERTH

FUTURE BULK BERTH

PERPENDICULAR LOADING SLOTS
3 RMG OVER 4 WORKING TRACKS
WORKING TRACKS TOTALLING 3,660 M
STORAGE TRACKS TOTALLING 3,596 M
RUNAROUND TRACK TOTALLING 3,841 M
INTERCHANGE TRACKS TOTALLING 7,210 M

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

KEYNOTES

TERMINAL A

- (A1) ONE CONTAINER BERTH
- (A2) SHIP TO SHORE CONTAINER CRANES (4 TOTAL)
- (A3) RUBBER TIRED GANTRY CONTAINER YARD (6 WIDE, 1 OVER 5)
- (A4) INTERMODAL YARD
- (A5) PRE-GATE (2 LANES)
- (A6) RECEIVING GATE (3 LANES)
- (A7) TROUBLE RESOLUTION AREA
- (A8) DELIVERY GATE (2 LANES)
- (A9) ADMINISTRATION BUILDING
- (A10) MAINTENANCE BUILDING
- (A11) LABOUR CHECK-IN/LUNCH BUILDING
- (A12) SUBSTATION
- (A13) COMPRESSOR BUILDING
- (A14) ADMINISTRATION STAFF/VISITOR PARKING
- (A15) LABOUR PARKING
- (A16) EQUIPMENT PARKING
- (A17) TUG BASIN

0 1 2 3 4 5 6 po.–in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND

- RUBBER TIRED GANTRY (RTG) GROUNDED CONTAINERS (2,800 TGS)
- RUBBER TIRED GANTRY (RTG) GROUNDED REEFERS (192 TGS)
- BUILDINGS
- RAIL TRACK
- HIGH MAST LIGHT POLE
- VEHICLE OVERPASS STRUCTURE
- TERMINAL FENCE
- MPA PROPERTY LINE

60m 0m 60m 120m
SCALE: 1 : 3000

AUCUN

TITRE–TITLE | No. | MOD.

DESSINS DE RÉFÉRENCE–REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
C	JAN 18/11	ISSUED FOR FINAL REPORT	AT
B	SEPT 10/10	ISSUED FOR CLIENT REVIEW	MC
A	AUG 5/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS–REVISIONS

Port de Montréal Port of Montreal

Administration portuaire de Montréal
Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
CONVENTIONAL TERMINAL

SOUS–TITRE/SUB–TITLE:
OPTION 1 – GENERAL ARRANGEMENT
PHASE A – ONE BERTH

CONSULTANTS:

777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604–707–9004

DESSINÉ/DRAWN: JL	SCEAU/SEAL:
PROJETÉ/DESIGNED: HW	
VÉRIFIÉ/CHECKED: HW	
APPROUVÉ/APPROVED: –	
CHEF DE SERVICE/DEPARTMENT HEAD:	DATE: JULY 21, 2010
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE OF 1

DESIGN No. 7114161-
DRAWING No. MP-210-0 | - | -
MOD. C

File: P:\1748 Contrecoeur Development Master Plan\CAD\Submittal \1748–MP–20.0, Plotted: 1/18/2011 11:15 AM by TSENG, ALICE Saved: 1/18/2011 10:23 AM by ATSENG

FORMAT SIZE A-0

DESIGN NO. 711416 1 — MP — 1210 — 0 — B 1 MOD. B
DRAWING NO.

SHIP CHANNEL

SAINT – LAWRENCE RIVER

TERMINAL A

1272.5m
FUTURE BERTHS

675m
PHASE A–2 – TWO BERTHS

FUTURE BULK BERTH

PERPENDICULAR LOADING SLOTS
3 RMG OVER 4 WORKING TRACKS
WORKING TRACKS TOTALLING 3,660 M
STORAGE TRACKS TOTALLING 3,596 M
RUNAROUND TRACK TOTALLING 3,841 M
INTERCHANGE TRACKS TOTALLING 7,210 M

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

KEYNOTES

TERMINAL A

- A1 TWO CONTAINER BERTHS
- A2 SHIP TO SHORE CONTAINER CRANES (5 TOTAL)
- A3 RUBBER TIRED GANTRY CONTAINER YARD (6 WIDE, 1 OVER 5)
- A4 INTERMODAL YARD
- A5 PRE–GATE (2 LANES)
- A6 RECEIVING GATE (3 LANES)
- A7 TROUBLE RESOLUTION AREA
- A8 DELIVERY GATE (2 LANES)
- A9 ADMINISTRATION BUILDING
- A10 MAINTENANCE BUILDING
- A11 LABOUR CHECK–IN/LUNCH BUILDING
- A12 SUBSTATION
- A13 COMPRESSOR BUILDING
- A14 ADMINISTRATION STAFF/VISITOR PARKING
- A15 LABOUR PARKING
- A16 EQUIPMENT PARKING
- A17 TUG BASIN

0 1 2 3 4 5 6 po.–in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND

- RUBBER TIRED GANTRY (RTG) GROUNDED CONTAINERS (2,800 TGS)
- RUBBER TIRED GANTRY (RTG) GROUNDED REEFERS (192 TGS)
- BUILDINGS
- RAIL TRACK
- HIGH MAST LIGHT POLE
- VEHICLE OVERPASS STRUCTURE
- TERMINAL FENCE
- MPA PROPERTY LINE

60m 0m 60m 120m
SCALE: 1 : 3000

AUCUN

TITRE–TITLE | No. | MOD.

DESSINS DE RÉFÉRENCE–REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
B	JAN 18/11	ISSUED FOR FINAL REPORT	AT
A	SEPT 10/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS–REVISIONS

Port de Montréal Port of Montreal

Administration portuaire de Montréal
Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
CONVENTIONAL TERMINAL

SOUS–TITRE/SUB–TITLE:
OPTION 1 – GENERAL ARRANGEMENT
PHASE A–2 – TWO BERTHS

CONSULTANTS:

777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604–707–9004

DESSINÉ/DRAWN: JL	SCEAU/SEAL:
PROJETÉ/DESIGNED: HW	
VÉRIFIÉ/CHECKED: HW	
APPROUVÉ/APPROVED: –	
CHEF DE SERVICE/DEPARTMENT HEAD:	DATE: JULY 21, 2010
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE OF 1

DESIGN No. 711416 1 — MP — 1210 — 0 — B 1 MOD. B
DRAWING No.

File: P:\1746 Contrecoeur Development Master Plan\CAD\Submittal\1746–MP–20.0–B; Plotted: 1/18/2011 11:15 AM by TSENG, ALEX; Saved: 1/18/2011 10:48 AM by TSENG

FORMAT SIZE A-0

DESIGN No. 7114161- | Mᵀ P- 211. 0 | - | - | MOD. C
DRAWING No.

SHIP CHANNEL

SAINT – LAWRENCE RIVER

TERMINAL A

1272.5m
FUTURE BERTHS

675m
PHASE B – TWO BERTHS

FUTURE BULK BERTH

A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14 A15 A16 A17

PERPENDICULAR LOADING SLOTS
5 RMG OVER 8 WORKING TRACKS
WORKING TRACKS TOTALLING 7,320 M
STORAGE TRACKS TOTALLING 8,970 M
RUNAROUND TRACK TOTALLING 3,841 M
INTERCHANGE TRACKS TOTALLING 7,210 M

KEYNOTES

TERMINAL A

(A1) TWO CONTAINER BERTHS
(A2) SHIP TO SHORE CONTAINER CRANES (8 TOTAL)
(A3) RUBBER TIRED GANTRY CONTAINER YARD (6 WIDE, 1 OVER 5)
(A4) INTERMODAL YARD
(A5) PRE-GATE (2 LANES)
(A6) RECEIVING GATE (6 LANES)
(A7) TROUBLE RESOLUTION AREA
(A8) DELIVERY GATE (3 LANES)
(A9) ADMINISTRATION BUILDING
(A10) MAINTENANCE BUILDING
(A11) LABOUR CHECK-IN/LUNCH BUILDING
(A12) SUBSTATION
(A13) COMPRESSOR BUILDING
(A14) ADMINISTRATION STAFF/VISITOR PARKING
(A15) LABOUR PARKING
(A16) EQUIPMENT PARKING
(A17) TUG BASIN

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

0 1 2 3 4 5 6 po.–in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND

- RUBBER TIRED GANTRY (RTG) GROUNDED CONTAINERS (6,624 TGS)
- RUBBER TIRED GANTRY (RTG) GROUNDED REEFERS (456 TGS)
- BUILDINGS
- RAIL TRACK
- HIGH MAST LIGHT POLE
- VEHICLE OVERPASS STRUCTURE
- TERMINAL FENCE
- MPA PROPERTY LINE

60m 0m 60m 120m
SCALE: 1 : 3000

AUCUN		
TITRE–TITLE	No.	MOD.

DESSINS DE RÉFÉRENCE–REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
C	JAN 18/11	ISSUED FOR FINAL REPORT	AT
B	SEPT 10/10	ISSUED FOR CLIENT REVIEW	MC
A	AUG 5/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS–REVISIONS

Port de Montréal Port of Montreal
Administration portuaire de Montréal Montreal Port Authority
Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
CONVENTIONAL TERMINAL

SOUS–TITRE/SUB–TITLE:
OPTION 1 – GENERAL ARRANGEMENT
PHASE B – TWO BERTHS

CONSULTANTS:
MOUNT SNOWDON
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604–707–9004

DESSINÉ/DRAWN:	SCEAU/SEAL:
JL	
PROJETÉ/DESIGNED:	
HW	
VÉRIFIÉ/CHECKED:	
HW	
APPROUVÉ/APPROVED:	
–	
CHEF DE SERVICE/DEPARTMENT HEAD:	DATE: JULY 21, 2010
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE OF 1

DESIGN No. 7114161- | Mᵀ P- 211. 0 | - | - | MOD. C
DRAWING No.

File: P:\1746 Contrecoeur Development Master Plan\CADD\Submittal\1746-MP-21.0; Plotted: 1/18/2011 11:18 AM by TSENG, ALICE; Saved: 1/18/2011 10:28 AM by ATSENG

FORMAT SIZE A-0

DESIGN NO. 7114161- | M P- 12 12. 0 | - - | MOD. C
DRAWING NO.

SHIP CHANNEL

SAINT – LAWRENCE RIVER

TERMINAL A

1597.5m
FUTURE BERTHS

350m
PHASE A – ONE BERTH

FUTURE BULK BERTH

A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14 A15 A16 A17

PERPENDICULAR LOADING SLOTS
3 RMG's OVER 4 WORKING TRACKS
WORKING TRACKS TOTALLING 3,972 M
STORAGE TRACKS TOTALLING 4,861 M
RUNAROUND TRACK TOTALLING 3,841 M
INTERCHANGE TRACKS TOTALLING 7,210 M

KEYNOTES

TERMINAL A

(A1) ONE CONTAINER BERTH
(A2) SHIP TO SHORE CONTAINER CRANES (4 TOTAL)
(A3) RAIL MOUNTED GANTRY CONTAINER YARD (10 WIDE, 1 OVER 5, 40 TGS LONG)
(A4) INTERMODAL YARD
(A5) PRE-GATE (2 LANES)
(A6) RECEIVING GATE (3 LANES)
(A7) TROUBLE RESOLUTION AREA
(A8) DELIVERY GATE (2 LANES)
(A9) ADMINISTRATION BUILDING
(A10) MAINTENANCE BUILDING
(A11) LABOUR CHECK-IN/LUNCH BUILDING
(A12) SUBSTATION
(A13) COMPRESSOR BUILDING
(A14) ADMINISTRATION STAFF/VISITOR PARKING
(A15) LABOUR PARKING
(A16) EQUIPMENT PARKING
(A17) TUG BASIN

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

0 1 2 3 4 5 6 po.-in.

0 1 2 3 4 5 6 7 8 9 10 cm.

File: P:\1748 Contrecoeur Development Master Plan\CAD01\Submittal\1748-MP-23.0. Plotted: 1/18/2011 11:16 AM by TSENG, ALICE Saved: 1/18/2011 10:29 AM by ATSENG

NOTES

LEGEND

- RAIL MOUNTED GANTRY (RMG) GROUNDED CONTAINERS (2,200 TGS)
- RAIL MOUNTED GANTRY (RMG) GROUNDED REEFERS (160 TGS)
- BUILDINGS
- RAIL TRACK
- HIGH MAST LIGHT POLE
- VEHICLE OVERPASS STRUCTURE
- TERMINAL FENCE
- MPA PROPERTY LINE

60m 0m 60m 120m
SCALE: 1 : 3000

AUCUN

TITRE-TITLE | No. | MOD.

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
C	JAN 18/11	ISSUED FOR FINAL REPORT	AT
B	SEPT 10/10	ISSUED FOR CLIENT REVIEW	MC
A	AUG 5/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal
Administration portuaire de Montréal Montreal Port Authority
Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
SEMI AUTOMATED TERMINAL

SOUS-TITRE/SUB-TITLE:
OPTION 1 – GENERAL ARRANGEMENT
PHASE A – ONE BERTH

CONSULTANTS:

777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

DESSINÉ/DRAWN: JL
PROJETÉ/DESIGNED: HW
VÉRIFIÉ/CHECKED: HW
APPROUVÉ/APPROVED: -
CHEF DE SERVICE/DEPARTMENT HEAD: -
ÉCHELLE/SCALE: AS SHOWN

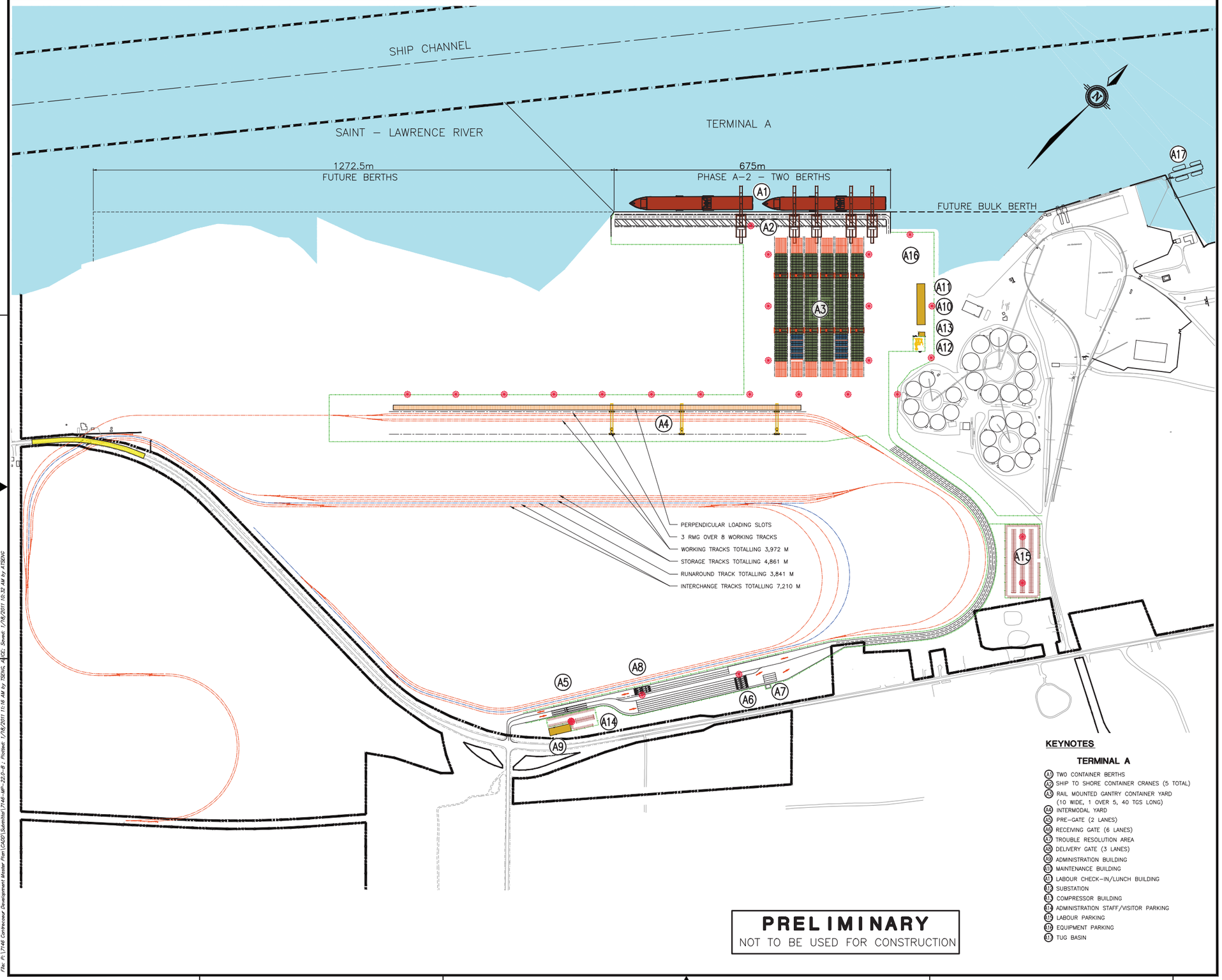
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DATE: JULY 22, 2010
FEUILLE/SHEET: 1 DE/OF 1

DESIGN No. 7114161- | M P- 12 12. 0 | - - | MOD. C
DRAWING No.

FORMAT SIZE A-0

DESIGN NO. 7114161-MP-1212.0-B1 MOD. B
DRAWING NO.



KEYNOTES

TERMINAL A

(A1) TWO CONTAINER BERTHS
(A2) SHIP TO SHORE CONTAINER CRANES (5 TOTAL)
(A3) RAIL MOUNTED GANTRY CONTAINER YARD (10 WIDE, 1 OVER 5, 40 TGS LONG)
(A4) INTERMODAL YARD
(A5) PRE–GATE (2 LANES)
(A6) RECEIVING GATE (6 LANES)
(A7) TROUBLE RESOLUTION AREA
(A8) DELIVERY GATE (3 LANES)
(A9) ADMINISTRATION BUILDING
(A10) MAINTENANCE BUILDING
(A11) LABOUR CHECK–IN/LUNCH BUILDING
(A12) SUBSTATION
(A13) COMPRESSOR BUILDING
(A14) ADMINISTRATION STAFF/VISITOR PARKING
(A15) LABOUR PARKING
(A16) EQUIPMENT PARKING
(A17) TUG BASIN

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

0 1 2 3 4 5 6 po.–in.
0 1 2 3 4 5 6 7 8 9 10 cm.

File: P:\1146 Contrecoeur Development Master Plan\CAD\Submittal\1146-MP-23.0-B ; Plotted: 1/18/2011 11:18 AM by TSENG, ALICE; Saved: 1/18/2011 10:32 AM by ATSENG

NOTES

LEGEND

- RAIL MOUNTED GANTRY (RMG) GROUNDED CONTAINERS (5,500 TGS)
- RAIL MOUNTED GANTRY (RMG) GROUNDED REEFERS (400 TGS)
- BUILDINGS
- RAIL TRACK
- HIGH MAST LIGHT POLE
- VEHICLE OVERPASS STRUCTURE
- TERMINAL FENCE
- MPA PROPERTY LINE

60m 0m 60m 120m
SCALE: 1 : 3000

AUCUN

TITRE–TITLE | No. | MOD.

DESSINS DE RÉFÉRENCE–REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
B	JAN 18/11	ISSUED FOR FINAL REPORT	AT
A	SEPT 10/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS–REVISIONS

Port de Montréal Port of Montreal
Administration portuaire de Montréal Montreal Port Authority
Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
SEMI AUTOMATED TERMINAL

SOUS–TITRE/SUB–TITLE:
OPTION 1 – GENERAL ARRANGEMENT
PHASE A–2 – TWO BERTHS

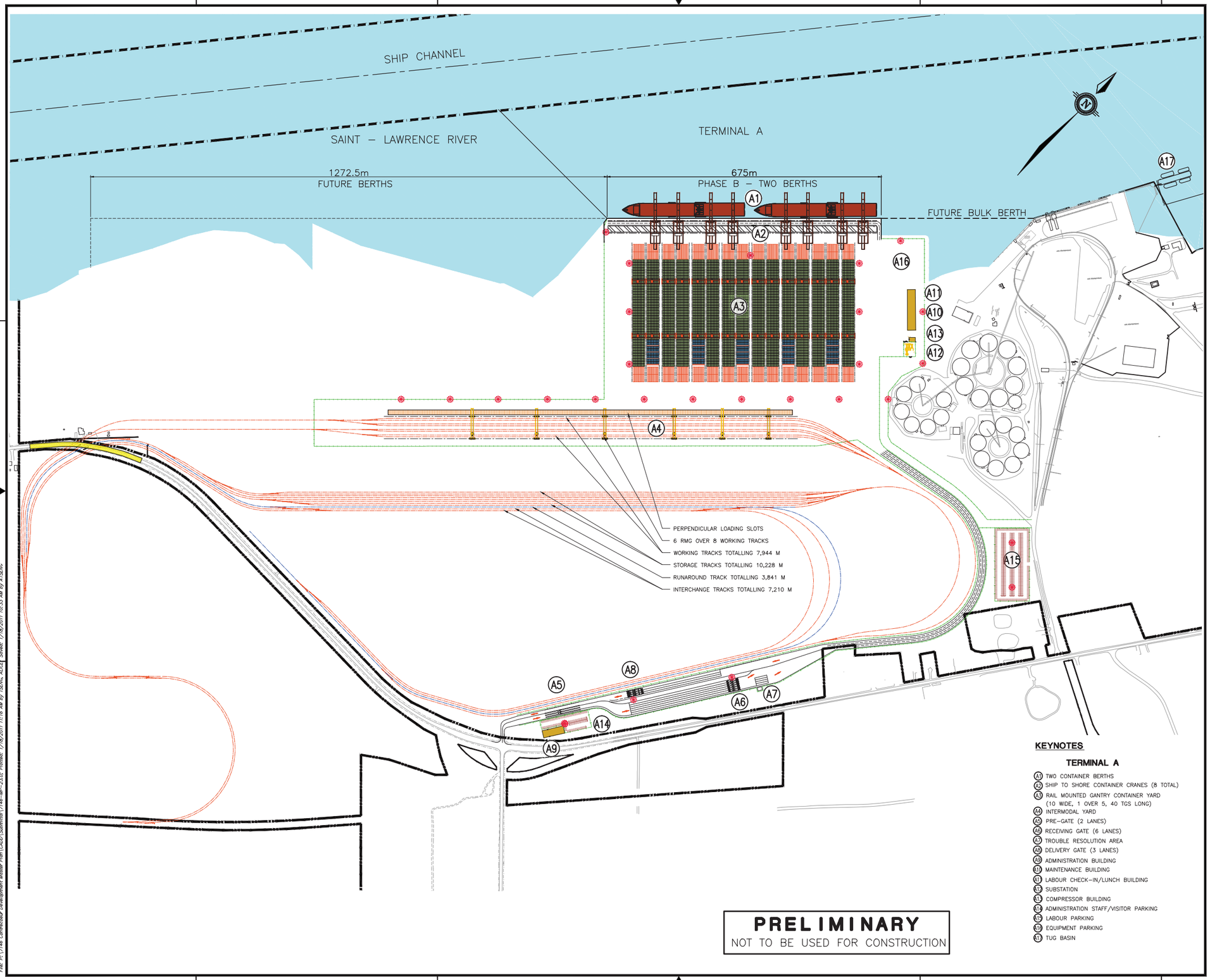
CONSULTANTS:
KOMEX ⊕ SCHOLL
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604–707–9004

DESSINÉ/DRAWN: JL
PROJETÉ/DESIGNED: HW
VÉRIFIÉ/CHECKED: HW
APPROUVÉ/APPROVED: –
SCEAU/SEAL:
CHEF DE SERVICE/DEPARTMENT HEAD: –
ÉCHELLE/SCALE: AS SHOWN
DATE: JULY 22, 2010
FEUILLE/SHEET: 1 DE/OF 1

DESIGN NO. 7114161-MP-1212.0-B1 MOD. B
DRAWING NO.

FORMAT SIZE A-0

DESIGN NO. 7114161- | M P- 12 3. 0 | | | MOD. C
DRAWING NO.



PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

KEYNOTES

TERMINAL A

(A1) TWO CONTAINER BERTHS
(A2) SHIP TO SHORE CONTAINER CRANES (8 TOTAL)
(A3) RAIL MOUNTED GANTRY CONTAINER YARD (10 WIDE, 1 OVER 5, 40 TGS LONG)
(A4) INTERMODAL YARD
(A5) PRE–GATE (2 LANES)
(A6) RECEIVING GATE (6 LANES)
(A7) TROUBLE RESOLUTION AREA
(A8) DELIVERY GATE (3 LANES)
(A9) ADMINISTRATION BUILDING
(A11) MAINTENANCE BUILDING
(A13) LABOUR CHECK–IN/LUNCH BUILDING
(A12) SUBSTATION
(A16) COMPRESSOR BUILDING
(A14) ADMINISTRATION STAFF/VISITOR PARKING
(A15) LABOUR PARKING
(A16) EQUIPMENT PARKING
(A17) TUG BASIN

0 1 2 3 4 5 6 po.–in.
0 1 2 3 4 5 6 7 8 9 10 cm.

File: P-1714I Contrecoeur Development Master Plan\CAD\Submittal 1714I–MP–23.0; Plotted: 1/18/2011 11:18 AM by TSENG, ALICE; Saved: 1/18/2011 10:33 AM by ATSENG

NOTES

LEGEND

- RAIL MOUNTED GANTRY (RMG) GROUNDED CONTAINERS (5,500 TGS)
- RAIL MOUNTED GANTRY (RMG) GROUNDED REEFERS (400 TGS)
- BUILDINGS
- RAIL TRACK
- HIGH MAST LIGHT POLE
- VEHICLE OVERPASS STRUCTURE
- TERMINAL FENCE
- MPA PROPERTY LINE

60m 0m 60m 120m
SCALE: 1 : 3000

AUCUN

TITRE–TITLE | No. | MOD.

DESSINS DE RÉFÉRENCE–REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
C	JAN 18/11	ISSUED FOR FINAL REPORT	AT
B	SEPT 10/10	ISSUED FOR CLIENT REVIEW	MC
A	AUG 5/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS–REVISIONS

Port de Montréal Port of Montreal
Administration portuaire de Montréal
Montreal Port Authority
Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
SEMI AUTOMATED TERMINAL

SOUS–TITRE/SUB–TITLE:
OPTION 1 – GENERAL ARRANGEMENT
PHASE B – TWO BERTHS

CONSULTANTS:

777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604–707–9004

DESSINÉ/DRAWN: JL	SCEAU/SEAL:
PROJETÉ/DESIGNED: HW	
VÉRIFIÉ/CHECKED: HW	
APPROUVÉ/APPROVED: –	
CHEF DE SERVICE/DEPARTMENT HEAD:	DATE: JULY 22, 2010
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE OF 1

DESIGN NO. 7114161- | MP- 12 3. 0 | | | MOD. C
DRAWING NO.

FORMAT SIZE A-0

DESIGN NO. 711416 | DRAWING NO. MP-1214.0 | MOD. C

TERMINAL B

TERMINAL A

U1 U11 U2 U3 U6 U10 U12 U13 U3 U7 U8 U4 U5 U9

KEYNOTES

(U1) FIRE PROTECTION PUMP STATION (RIVER INTAKE)
(U2) SANITARY SEWER TREATMENT UNIT AND RIVER OUTFALL
(U3) STORM DRAINAGE TREATMENT AND RIVER OUTFALL
(U4) DOMESTIC WATER CONNECTION
(U5) ELECTRICAL CONNECTION TO HYDRO-QUEBEC NETWORK
(U6) MAIN ELECTRICAL SUBSTATION INCLUDING STS CRANES
(U7) REEFER SUBSTATION
(U8) TRACK RMG SUBSTATION
(U9) GATE SUBSTATION
(U10) BUILDING AND LIGHTING SUBSTATION
(U11) ELECTRICAL AND COMMUNICATION DUCTBANK TO CRANE VAULTS
(U12) DATA HUB ROOM
(U13) COLD IRONING VAULT

0 1 2 3 4 5 6 po.-in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND

- W — DOMESTIC WATER MAIN
- F — FIRE PROTECTION WATER MAIN
- SD — STORM DRAINAGE MAIN
- UD — STORM TRENCH/UNDER DRAIN
- SS — SANITARY SEWER MAIN
- UE — ELECTRICAL SUPPLY
- EC — EC — ELECTRICAL AND COMMUNICATION DUCTBANK
- HIGH MAST LIGHT POLE
- FIRE HYDRANT

50m 0m 50m 100m

SCALE: 1 : 2500

AUCUN

TITRE-TITLE | No. | MOD.

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
C	JAN 18/11	ISSUED FOR FINAL REPORT	AT
B	SEPT 17/10	ISSUED FOR CLIENT REVIEW	AT
A	AUG 17/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal

Administration portuaire de Montréal Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
CONVENTIONAL TERMINAL

SOUS-TITRE/SUB-TITLE:
FULL BUILD OUT – UTILITY PLAN

CONSULTANTS:

777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

DESSINÉ/DRAWN: JL
PROJETÉ/DESIGNED: MC
VÉRIFIÉ/CHECKED: HW
APPROUVÉ/APPROVED: -
CHEF DE SERVICE/DEPARTMENT HEAD:
ÉCHELLE/SCALE: AS SHOWN

SCEAU/SEAL.

DATE: AUG. 09, 2010
FEUILLE/SHEET: 1 DE/OF 1

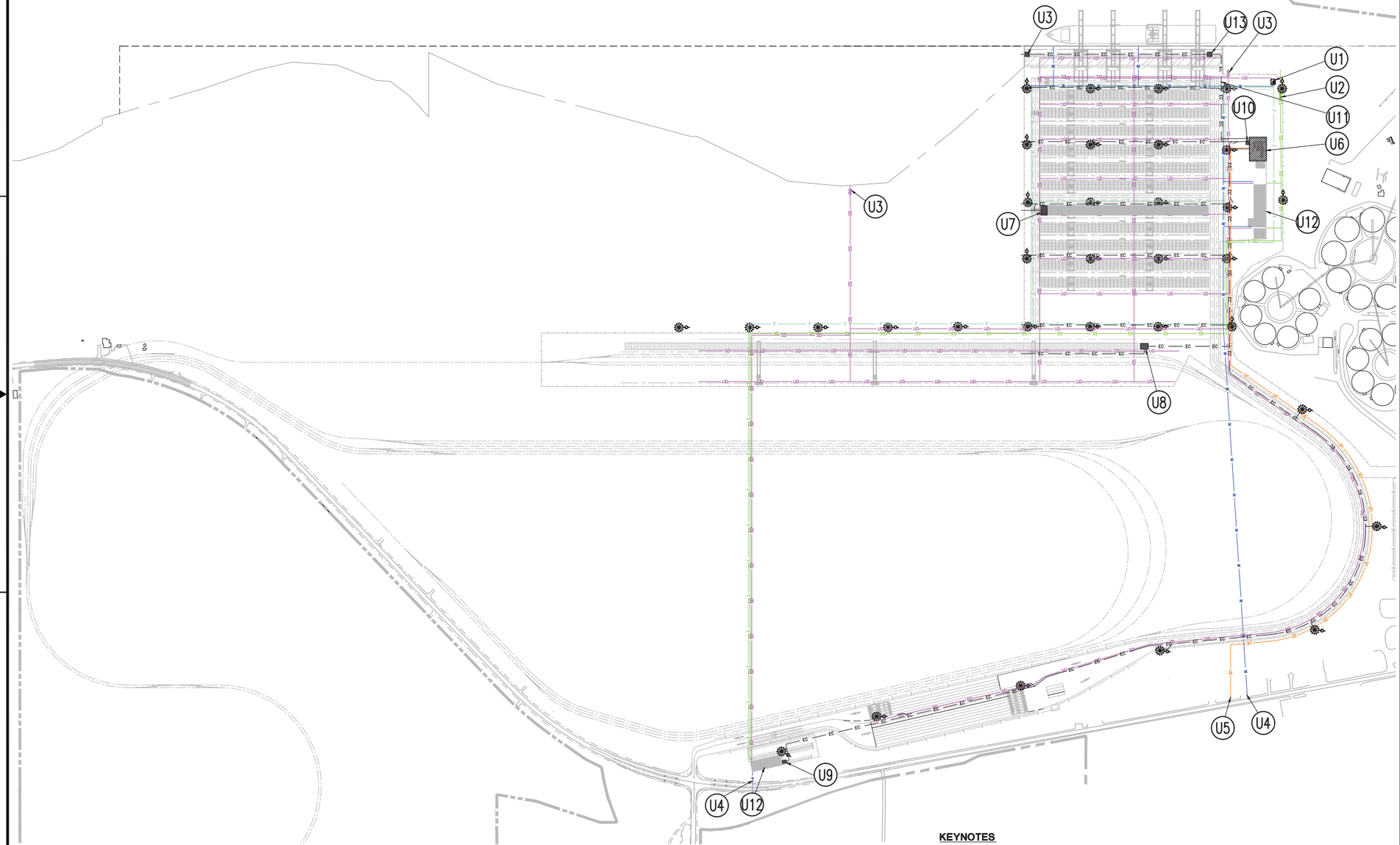
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FORMAT SIZE A-0

DESIGN NO. 7114161- | DRAWING NO. MP-1215.0 | - | MOD. C

SAINT – LAWRENCE RIVER

TERMINAL A



KEYNOTES

(U1) FIRE PROTECTION PUMP STATION (RIVER INTAKE)
(U2) SANITARY SEWER TREATMENT UNIT AND RIVER OUTFALL
(U3) STORM DRAINAGE TREATMENT AND RIVER OUTFALL
(U4) DOMESTIC WATER CONNECTION
(U5) ELECTRICAL CONNECTION TO HYDRO–QUEBEC NETWORK
(U6) MAIN ELECTRICAL SUBSTATION INCLUDING STS CRANES
(U7) REEFER SUBSTATION
(U8) TRACK RMG SUBSTATION
(U9) GATE SUBSTATION
(U10) BUILDING AND LIGHTING SUBSTATION
(U11) ELECTRICAL AND COMMUNICATION DUCTBANK TO CRANE VAULTS
(U12) DATA HUB ROOM
(U13) COLD IRONING VAULT

0 1 2 3 4 5 6 po.–in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND

- W — DOMESTIC WATER MAIN
- F — FIRE PROTECTION WATER MAIN
- SD — STORM DRAINAGE MAIN
- UD — STORM TRENCH/UNDER DRAIN
- SS — SANITARY SEWER MAIN
- UE — ELECTRICAL SUPPLY
- EC — EC — ELECTRICAL AND COMMUNICATION DUCTBANK
- HIGH MAST LIGHT POLE
- FIRE HYDRANT

50m 0m 50m 100m

SCALE: 1 : 2500

AUCUN

TITRE–TITLE | No. | MOD.

DESSINS DE RÉFÉRENCE–REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
C	JAN 18/11	ISSUED FOR FINAL REPORT	AT
B	SEPT 17/10	ISSUED FOR CLIENT REVIEW	AT
A	AUG 17/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS–REVISIONS

Port de Montréal Port of Montreal

Administration portuaire de Montréal Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
CONVENTIONAL TERMINAL

SOUS–TITRE/SUB–TITLE:
PHASE A – UTILITY PLAN

CONSULTANTS:

777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604–707–9004

DESSINÉ/DRAWN: JL
PROJETÉ/DESIGNED: MC
VÉRIFIÉ/CHECKED: HW
APPROUVÉ/APPROVED: –
CHEF DE SERVICE/DEPARTMENT HEAD: –

SCEAU/SEAL:

DATE: AUG. 09, 2010

ÉCHELLE/SCALE: AS SHOWN

FEUILLE/SHEET: 1 DE OF 1

DESIGN No. 7114161- | DRAWING No. MP-1215.0 | - | MOD. C

FORMAT SIZE A-0

DESIGN NO./DRAWING NO. 7114161-MP-1216.0 | MOD. C

SAINT – LAWRENCE RIVER

TERMINAL A

U13 U3 U13 U3 U1 U2 U11 U10 U6 U12 U7 U7 U8 U5 U4 U4 U12 U9

KEYNOTES

- U1 FIRE PROTECTION PUMP STATION (RIVER INTAKE)
- U2 SANITARY SEWER TREATMENT UNIT AND RIVER OUTFALL
- U3 STORM DRAINAGE TREATMENT AND RIVER OUTFALL
- U4 DOMESTIC WATER CONNECTION
- U5 ELECTRICAL CONNECTION TO HYDRO–QUEBEC NETWORK
- U6 MAIN ELECTRICAL SUBSTATION INCLUDING STS CRANES
- U7 REEFER SUBSTATION
- U8 TRACK RMG SUBSTATION
- U9 GATE SUBSTATION
- U10 BUILDING AND LIGHTING SUBSTATION
- U11 ELECTRICAL AND COMMUNICATION DUCTBANK TO CRANE VAULTS
- U12 DATA HUB ROOM
- U13 COLD IRONING VAULT

0 1 2 3 4 5 6 po.–in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND

- W DOMESTIC WATER MAIN
- F FIRE PROTECTION WATER MAIN
- SD STORM DRAINAGE MAIN
- UD STORM TRENCH/UNDER DRAIN
- SS SANITARY SEWER MAIN
- UE ELECTRICAL SUPPLY
- EC EC ELECTRICAL AND COMMUNICATION DUCTBANK
- HIGH MAST LIGHT POLE
- FIRE HYDRANT

50m 0m 50m 100m

SCALE: 1 : 2500

AUCUN

TITRE–TITLE | No. | MOD.

DESSINS DE RÉFÉRENCE–REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
C	JAN 18/11	ISSUED FOR FINAL REPORT	AT
B	SEPT 17/10	ISSUED FOR CLIENT REVIEW	AT
A	AUG 17/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS–REVISIONS

Port de Montréal Port of Montreal

Administration portuaire de Montréal Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
CONVENTIONAL TERMINAL

SOUS–TITRE/SUB–TITLE:
PHASE B – UTILITY PLAN

CONSULTANTS:

777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604–707–9004

DESSINÉ/DRAWN: JL
PROJETÉ/DESIGNED: MC
VÉRIFIÉ/CHECKED: HW
APPROUVÉ/APPROVED: –
CHEF DE SERVICE/DEPARTMENT HEAD

SCEAU/SEAL:

DATE: AUG. 09, 2010
ÉCHELLE/SCALE: AS SHOWN
FEUILLE/SHEET: 1 DE OF 1

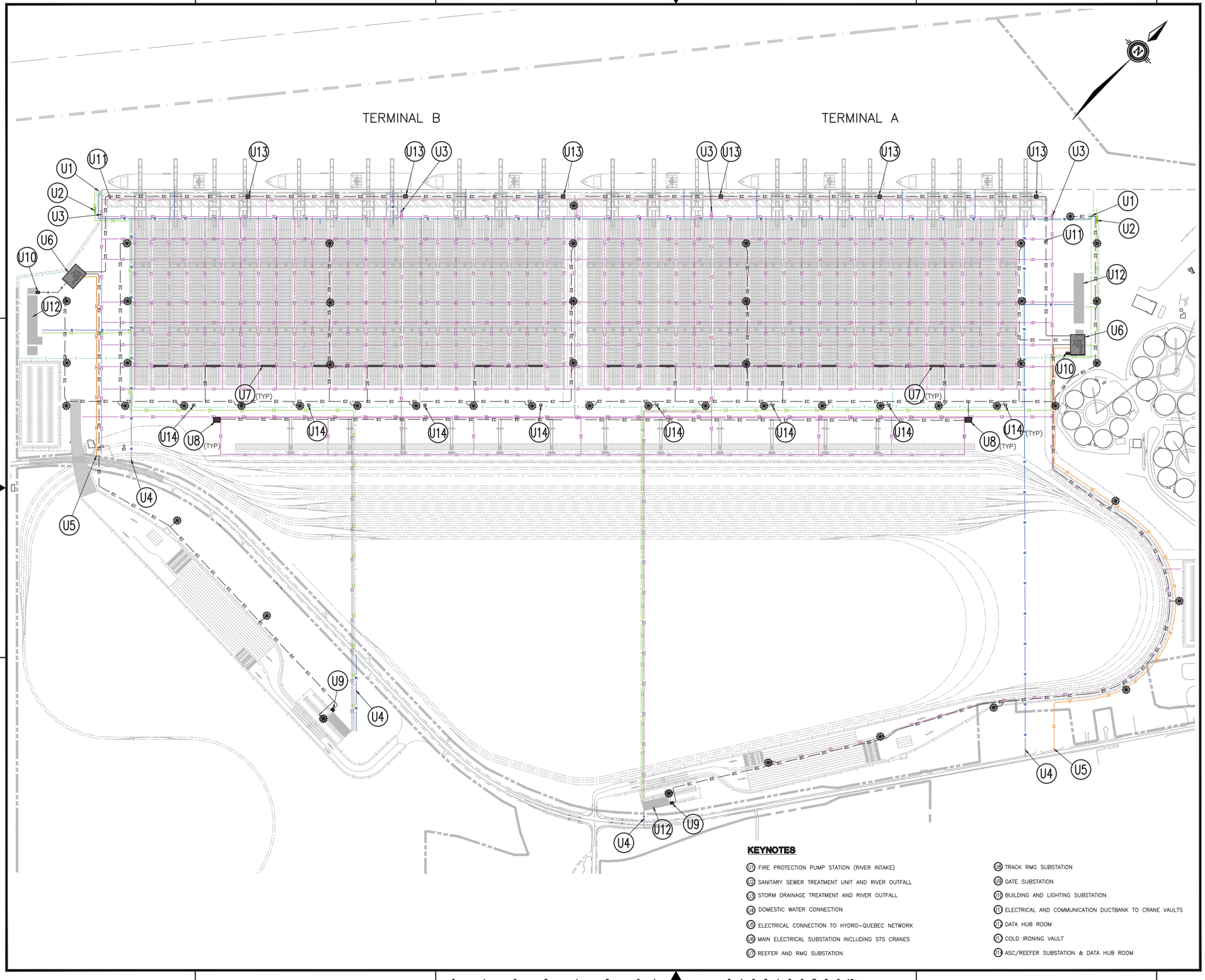
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FORMAT SIZE A-0

DESIGN NO. 711416 1 — MP- 12 17. 0 | - - | MOD. C
DRAWING NO.

TERMINAL B

TERMINAL A



KEYNOTES

U1 FIRE PROTECTION PUMP STATION (RIVER INTAKE)
U2 SANITARY SEWER TREATMENT UNIT AND RIVER OUTFALL
U3 STORM DRAINAGE TREATMENT AND RIVER OUTFALL
U4 DOMESTIC WATER CONNECTION
U5 ELECTRICAL CONNECTION TO HYDRO-QUEBEC NETWORK
U6 MAIN ELECTRICAL SUBSTATION INCLUDING STS CRANES
U7 REEFER AND RMG SUBSTATION
U8 TRACK RMG SUBSTATION
U9 GATE SUBSTATION
U10 BUILDING AND LIGHTING SUBSTATION
U11 ELECTRICAL AND COMMUNICATION DUCTBANK TO CRANE VAULTS
U12 DATA HUB ROOM
U13 COLD IRONING VAULT
U14 ASC/REEFER SUBSTATION & DATA HUB ROOM

0 1 2 3 4 5 6 po.-in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND

- W — DOMESTIC WATER MAIN
- F — FIRE PROTECTION WATER MAIN
- SD — STORM DRAINAGE MAIN
- UD — STORM TRENCH/UNDER DRAIN
- SS — SANITARY SEWER MAIN
- UE — ELECTRICAL SUPPLY
- EC — EC — ELECTRICAL AND COMMUNICATION DUCTBANK
- HIGH MAST LIGHT POLE

50m 0m 50m 100m
SCALE: 1 : 2500

AUCUN		
TITRE-TITLE	No.	MOD.

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
C	JAN 18/11	ISSUED FOR FINAL REPORT	AT
B	SEPT 17/10	ISSUED FOR CLIENT REVIEW	AT
A	AUG 17/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal
Administration portuaire de Montréal Montreal Port Authority
Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
SEMI AUTOMATED TERMINAL

SOUS-TITRE/SUB-TITLE:
FULL BUILD OUT – UTILITY PLAN

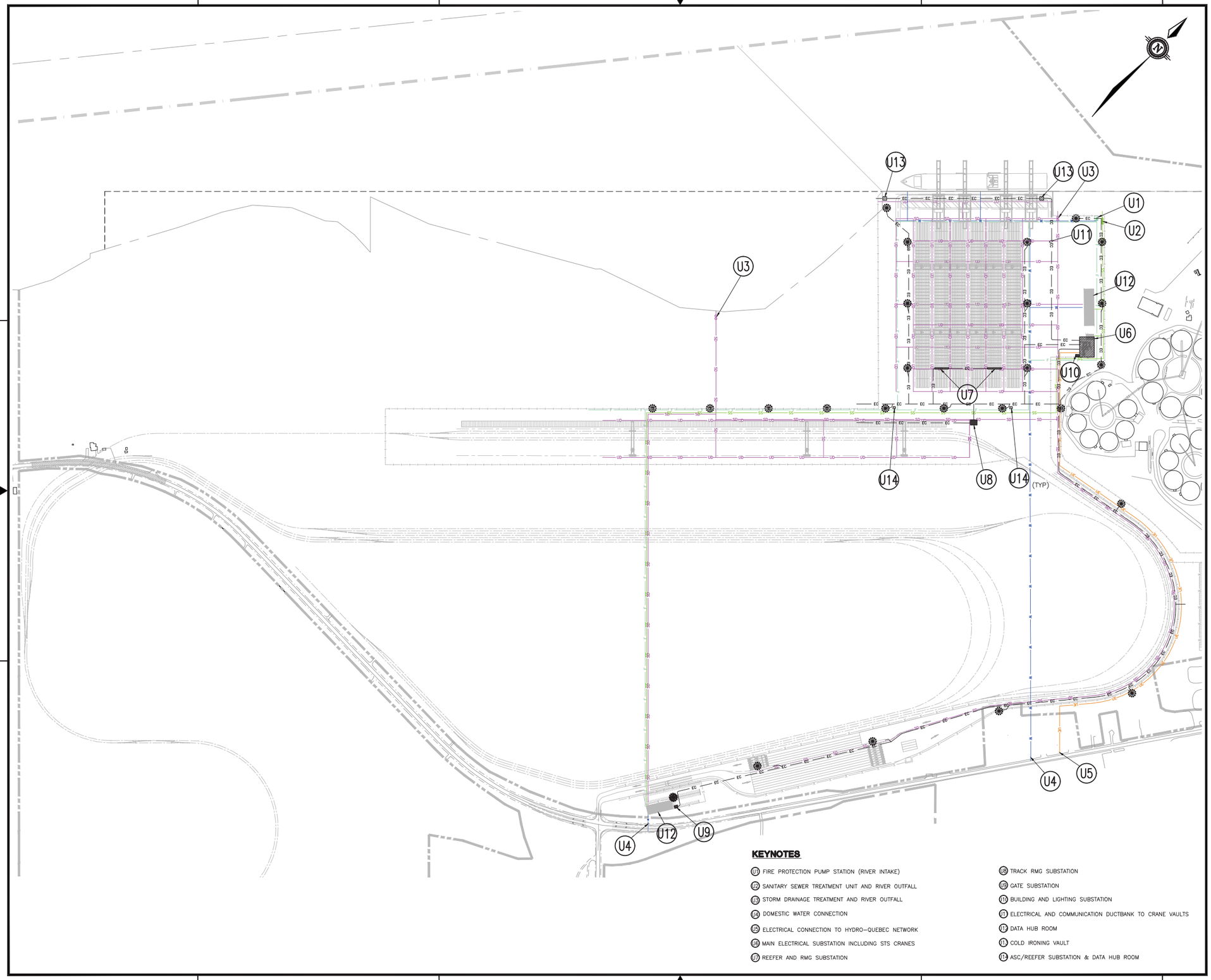
CONSULTANTS:
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

DESSINÉ/DRAWN: JL	SCEAU/SEAL:
PROJETÉ/DESIGNED: MC	
VÉRIFIÉ/CHECKED: HW	
APPROUVÉ/APPROVED: -	
CHEF DE SERVICE/DEPARTMENT HEAD	DATE: AUG. 09, 2010
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE OF 1

DESIGN NO. 711416 1 — MP- 12 17. 0 | - - | MOD. C
DRAWING NO.

FORMAT SIZE A-0

DESIGN NO./DRAWING NO. 7114161-MP-128.0 | - | REV. C



KEYNOTES

U1 FIRE PROTECTION PUMP STATION (RIVER INTAKE)
U2 SANITARY SEWER TREATMENT UNIT AND RIVER OUTFALL
U3 STORM DRAINAGE TREATMENT AND RIVER OUTFALL
U4 DOMESTIC WATER CONNECTION
U5 ELECTRICAL CONNECTION TO HYDRO-QUEBEC NETWORK
U6 MAIN ELECTRICAL SUBSTATION INCLUDING STS CRANES
U7 REEFER AND RMG SUBSTATION
U8 TRACK RMG SUBSTATION
U9 GATE SUBSTATION
U10 BUILDING AND LIGHTING SUBSTATION
U11 ELECTRICAL AND COMMUNICATION DUCTBANK TO CRANE VAULTS
U12 DATA HUB ROOM
U13 COLD IRONING VAULT
U14 ASC/REEFER SUBSTATION & DATA HUB ROOM

0 1 2 3 4 5 6 po.-in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND

- W — DOMESTIC WATER MAIN
- F — FIRE PROTECTION WATER MAIN
- SD — STORM DRAINAGE MAIN
- UD — STORM TRENCH/UNDER DRAIN
- SS — SANITARY SEWER MAIN
- UE — ELECTRICAL SUPPLY
- EC — EC — ELECTRICAL AND COMMUNICATION DUCTBANK
- HIGH MAST LIGHT POLE

50m 0m 50m 100m
SCALE: 1 : 2500

AUCUN

TITRE-TITLE | No. | MOD.

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
C	JAN 18/11	ISSUED FOR FINAL REPORT	AT
B	SEPT 17/10	ISSUED FOR CLIENT REVIEW	AT
A	AUG 17/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal

Administration portuaire de Montréal Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
SEMI AUTOMATED TERMINAL

SOUS-TITRE/SUB-TITLE:
PHASE A – UTILITY PLAN

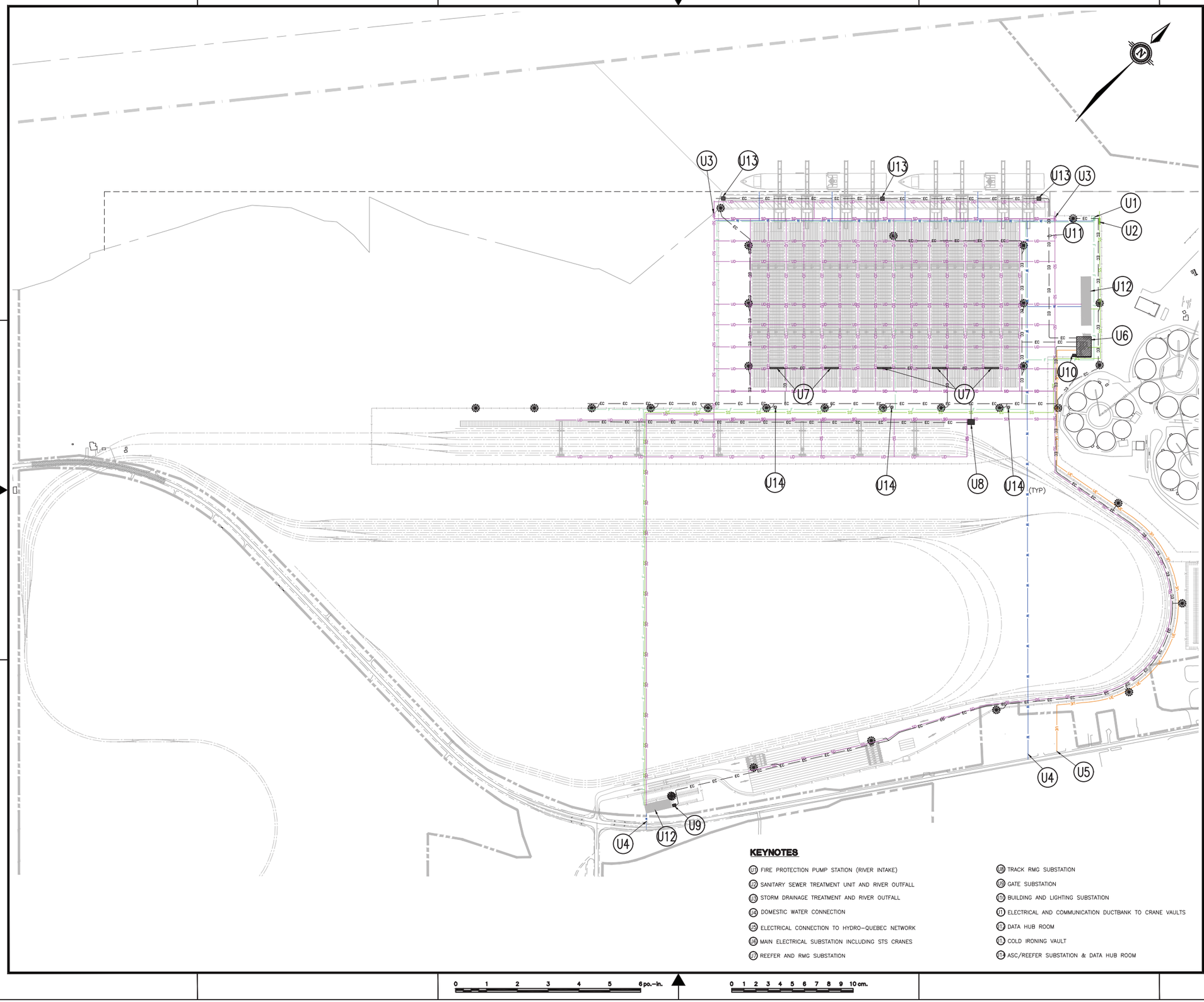
CONSULTANTS:
777 WEST BROADWAY, SUITE 301
VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

DESSINÉ/DRAWN: JL	SCEAU/SEAL:
PROJETÉ/DESIGNED: MC	
VÉRIFIÉ/CHECKED: HW	
APPROUVÉ/APPROVED: -	
CHEF DE SERVICE/DEPARTMENT HEAD:	DATE: AUG. 09, 2010
ÉCHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE OF 1

DESIGN NO./DRAWING NO. 7114161-MP-128.0 | - | MOD. C

FORMAT SIZE A-0

DESIGN NO./DRAWING NO. 711461-MP-219.0 | - | MOD. C



KEYNOTES

U1 FIRE PROTECTION PUMP STATION (RIVER INTAKE)
U2 SANITARY SEWER TREATMENT UNIT AND RIVER OUTFALL
U3 STORM DRAINAGE TREATMENT AND RIVER OUTFALL
U4 DOMESTIC WATER CONNECTION
U5 ELECTRICAL CONNECTION TO HYDRO-QUEBEC NETWORK
U6 MAIN ELECTRICAL SUBSTATION INCLUDING STS CRANES
U7 REEFER AND RMG SUBSTATION
U8 TRACK RMG SUBSTATION
U9 GATE SUBSTATION
U10 BUILDING AND LIGHTING SUBSTATION
U11 ELECTRICAL AND COMMUNICATION DUCTBANK TO CRANE VAULTS
U12 DATA HUB ROOM
U13 COLD IRONING VAULT
U14 ASC/REEFER SUBSTATION & DATA HUB ROOM

0 1 2 3 4 5 6 po.-in.

0 1 2 3 4 5 6 7 8 9 10 cm.

NOTES

LEGEND

- W — DOMESTIC WATER MAIN
- F — FIRE PROTECTION WATER MAIN
- SD — STORM DRAINAGE MAIN
- UD — STORM TRENCH/UNDER DRAIN
- SS — SANITARY SEWER MAIN
- UE — ELECTRICAL SUPPLY
- EC — EC — ELECTRICAL AND COMMUNICATION DUCTBANK
- HIGH MAST LIGHT POLE

50m 0m 50m 100m
SCALE: 1 : 2500

AUCUN

TITRE-TITLE | No. | MOD.

DESSINS DE RÉFÉRENCE-REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	PAR BY
C	JAN 18/11	ISSUED FOR FINAL REPORT	AT
B	SEPT 17/10	ISSUED FOR CLIENT REVIEW	AT
A	AUG 17/10	ISSUED FOR CLIENT REVIEW	MC

MODIFICATIONS-REVISIONS

Port de Montréal Port of Montreal

Administration portuaire de Montréal
Montreal Port Authority

Canada

PROJET/PROJECT:
CONTRECOEUR DEVELOPMENT MASTER PLAN

TITRE/TITLE:
SEMI AUTOMATED TERMINAL

SOUS-TITRE/SUB-TITLE:
PHASE B – UTILITY PLAN

CONSULTANTS:

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VANCOUVER, BC, CANADA, V5Z 4J7
604-707-9004

DESSINÉ/DRAWN: JL	SCEAU/SEAL:
PROJETÉ/DESIGNED: MC	
VÉRIFIÉ/CHECKED: HW	
APPROUVÉ/APPROVED: –	
CHEF DE SERVICE/DEPARTMENT HEAD:	DATE: AUG. 09, 2010
ECHELLE/SCALE: AS SHOWN	FEUILLE/SHEET: 1 DE/OF 1

DESIGN NO./DRAWING NO. 711461-MP-219.0 | - | MOD. C

APPENDIX B

GEOTECHNICAL STUDIES

Golder Associates

TECHNICAL MEMORANDUM

CELEBRATING 50 YEARS in 2010

DATE September 22, 2010 **PROJECT No.** 10-1447-0122

TO Charles Rosner/ Harold Westerman
Moffatt & Nichol

CC

FROM Viji Fernando/Upul Atukorala **EMAIL** uatukorala@golder.com

SOIL AND STEEL SHEET PILE WALL INTERACTION ANALYSES CONTRECOEUR TERMINAL, PORT OF MONTREAL

We have carried out two dimensional soil-structure interaction analyses to confirm that a "single" HZ pile system is adequate at the east end of the site to resist seismic loadings under the design ground motions corresponding to a return period of 2,475-years.

Detailed soil-structure interaction analyses were not part of Golder's initially agree upon scope of work, however, they were necessary to confirm the steel sheet pile system required to support the design surcharge and seismic loads in light of the differences in costs among the different wharf options.

A brief summary of the modelling procedure, structural parameters used, and the conclusions of the analyses are presented herein.

1.0 BACKGROUND

An HZ type steel sheet piling system consisting of a series of specially designed H-piles alternating with standard Z-pile pairs has been proposed to support the berthing facilities at the Contrecoeur terminal. M&N has carried out preliminary sheet pile analyses to identify a suitable steel sheet pile (SSP) wall system based on the lateral earth pressures estimated for the static and the three levels of seismic loading conditions (i.e. 100-year, 475-year, and 2,475-year return periods) provided by Golder.

The results of the preliminary analyses carried out by M&N indicated that the greater depth to till encountered in the east end of the site controlled the sectional requirements for the SSP wall. The analyses indicated that a "single" HZ pile system consisting of H-piles alternating with standard Z-pile pairs would not be sufficient for the eastern end of the proposed bulkhead structure under the design ground motions corresponding to 2,475-year return period and that a 'double" HZ pile system consisting of pairs of H-piles alternating with pairs of Z-piles would be required.

Considering that the preliminary analyses were based on the force equilibrium method without taking into account the soil-sheet pile wall interaction effects, two dimensional soil-structure interaction analyses of the SSP bulkhead have been carried out using the computer program FLAC (Version 5.0, Itasca International Inc.) to further evaluate the adequacy of a "single" HZ pile system at the east end of the site.

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2.0 SOIL-STRUCTURE INTERACTION ANALYSES

Static and dynamic soil-structure interaction (SSI) analyses of the SSP bulkhead structure proposed for the Contrecoeur terminal were carried out using the computer code FLAC. The dynamic analyses were carried out for the design ground motions corresponding to a 2,475-year return period. The proposed SSP bulkhead structure with tie-backs was modeled using a series of structural elements, which interact with the soil medium through interfaces. The analyses were carried out considering that the H-piles would be driven onto bedrock, while the sheet piles would be driven about 2 m into till. The properties of the different structural elements (i.e. SSP wall, H-piles, tie-backs, anchor piles) provided by M&N in an email dated July 29 and a Technical Memorandum, dated August 6 are summarized in Table 1 below. The soil stratigraphy at Section C-C' was used to develop the model domain.

Table 1: Properties of Structural Elements

Structural Elements	Sectional Area	Moment of Inertia	Spacing
SSP Section (HZ1180M-14/AZ 26-700)	4.78E-02 m^2/m (22.56 in^2/ft)	7.62E-03 m^4/m 5582.2 in^4/ft	-
H PILE (HZ 1180 MD-14)	6.59E-02 m^2 102.22 in^2	1.39E-02 m^4 33337.1 in^4	1.927 m 75.9 inch
Tie Rods (3.5 inch diameter)	6.21E-03 m^2 9.62 in^2	-	1.927 m 75.9 inch
Deadman Anchor (36 inch diameter Steel Pipe)	7.09E-02 m^2 109.96 in^2	7.01E-03 m^4 16850.7 in^4	1.927 m 75.9 inch

The modeling procedure considered the following sequence:

1) Compute the initial stress state of the soil mass under the gravity loads;
2) Incorporate the SSP bulkhead structure model (SSP wall, H-piles, tie-backs, and anchor piles);
3) Place backfill soil to elevation of +9.5 m;
4) Dredge material in front of SSP wall down to elevation -7.5 m;
5) Apply the surcharge loads (60 kPa under static loads and a reduced 24 kPa under seismic loads. Two separate simulations were carried out for these surcharge loads); and
6) Apply earthquake loads in the form of base acceleration records.

The seismic simulations were carried out with the peak in-situ undrained shear strengths (without any reduction for cyclic or loading or shear strain-induced degadation of strength) as well as a 50% reduction in strength due to cyclic loading-induced degradation to explore the effects of sensitivity of strength parameters on the maximum bending moments and tie rod forces.

3.0 RESULTS OF THE ANALYSES

The results of the SSI analyses indicate that the computed maximum bending moments and tie rod forces developed in the "single" HZ-pile system are lower than their yield capacities, and the proposed system is adequate to resist the surcharge and seismic loads under the design ground motions corresponding to a return period of 2,475-years.

4.0 CLOSURE

We trust that the contents of this Technical Memorandum meet with your immediate requirements. If you have any questions or need further information, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD.

Viji Fernando, M.E.Sc., P.Eng.
Senior Geotechnical Engineer

Upul Atukorala, Ph.D., P.Eng.
Principal, Senior Geotechnical Engineer

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TECHNICAL MEMORANDUM

DATE December 3, 2010 **PROJECT No.** 10-1447-0122/1100

TO Michael Cho/Harold Westerman
Moffatt & Nichol

FROM Upul Atukorala/Abouzar Sadrekarimi **EMAIL** uatukorala@golder.com

GEOTECHNICAL INPUT
DEVELOPMENT MASTER PLAN STUDY OF MONTREAL PORT AUTHORITY'S CONTRECOEUR LAND BANK AS CONTAINER TERMINALS, CONTRECOEUR, QUEBEC

This Technical Memorandum presents the results of the geotechnical assessments completed along with design input for a Development Master Plan Study for the development of the Contrecoeur land bank site as future container terminals and intermodal transport infrastructure. The geotechnical assessments were completed utilizing available data on subsurface conditions compiled from the subsurface investigations completed by others supplemented with specialized laboratory testing of clay soils to explore their behaviour under seismic loading conditions.

Golder Associates' scope of work included development of foundation concepts for wharfs, providing site development and foundation recommendations for uplands structures and infrastructure facilities and limited input for dredging of site soils. Our scope of work also includes some limited involvement on environmental aspects of site development as input to a risk assessment prior to project completion.

Unless otherwise specifically noted, all elevations referenced in the Technical Memorandum are with respect to the Geodetic Datum.

This memorandum should be read in conjunction with the "Important Information and Limitations of this Report" which is appended following the text.

1.0 PROJECT DESCRIPTION

The Contrecoeur land bank is located in the Town of Contrecoeur, on the south bank of St. Lawrence River, some 30 km downstream of Port of Montreal. The Port of Montreal has retained the services of Moffatt & Nichol to develop a Master Planning Study to develop the site as future container terminals comprising some 2.6 km of wharfs and 470 ha of onshore land. The site location is shown in Figure 1-1.

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Figure 1-1: Site Location Plan

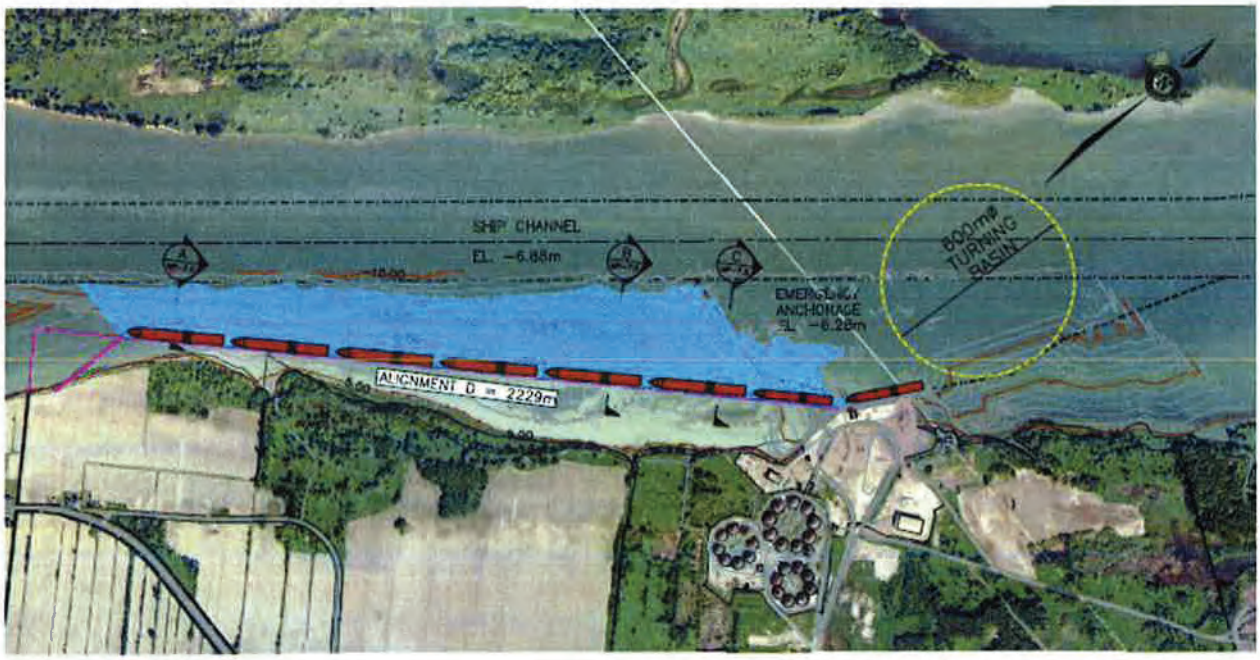


Figure 1-2: Proposed Berth Alignment for Contrecoeur Terminals

The proposed new container terminals are to be built in several stages based on market growth trends over the years. An existing dry bulk cargo storage and handling terminal, built in the 1950s, is located at the east end of the site. This existing terminal constructed using an anchored steel sheet pile wall that has undergone movement and rotation over the years of operation, and will be incorporated into the overall terminal at the Contrecoeur land bank. At present, the site upstream of the existing terminal is undeveloped. Future rail and road access will be via the existing infrastructure that supports the dry bulk storage and handling terminal.

The proposed new development will consist of two terminal areas, each comprising three container terminal berths, a rubber-tyred or rail mounted gantry container yard, an intermodal yard, and affiliated infrastructure such as administration and maintenance buildings. Figure 1-2 shows the berth alignment considered by Moffatt & Nichol as well as Sections A-A', B-B', and C-C' for which the analyses presented in this memorandum are carried out.

We understand that the wharf apron areas will be designed to support both 40 ft and 20 ft containers stacked 4 high.

The marine structures will be designed for three levels of seismic ground shaking associated with an 1-100 yr Operating Level Earthquake (OLE), 1:475-yr Contingency Level Earthquake (CLE) and 1:2475 yr Life Safety Earthquake (LSE). The expected seismic performance of the marine structures is as follows:

- After the OLE – minimal damage and interruptions to terminal operations;
- After the CLE – repairable damage with possible loss of terminal operations; and
- After the LSE – non repairable damage with complete loss of terminal operations, but with life safety.

Detailed design criteria for the proposed development are contained in the Contrecoeur Development Master Plan Design Criteria dated August 4, 2010.

2.0 SITE SOIL CONDITIONS, SEISMIC GROUND MOTIONS, AND LIQUEFACTION POTENTIAL OF SOILS

This section summarizes the site soil conditions and seismic ground motion parameters established for the subject site.

2.1 Site Soil Conditions

Several onshore and offshore geotechnical investigations have been completed (by others) to characterize the site soils underlying the Contrecoeur land bank. These include:

- An offshore and laboratory investigation completed by Les Laboratoires Ville Marie Inc. in 1981 (Boreholes C-1 and C-2);
- An offshore investigation completed by Terratech in 1996 (Boreholes F-1-96, F-2-96);
- Onshore investigations completed by Lupen Rosenberg et Associes Inc. for the Fertilizer Storage Domes in 1993 (BH-101, VA-101, VA-102, VA-103) and in 1985 (BH-1, BH-2, BH-3);
- Offshore and onshore investigations completed by Qualitas in 2009 (Boreholes F-1-09 through F-6-09); and
- Offshore and onshore investigations completed by Qualitas in 2010 (Boreholes F-1-10 through F-7-10).

According to these investigations, the subsurface conditions at the site can be broadly categorized into four types:

- Fill Materials;
- Marine Silty Clay;
- Glacial till; and
- Bedrock (shale).

Brief descriptions of the above-noted broad soil stratigraphic units are provided below. A graphical illustration of the SPT penetration resistance data compiled from the different geotechnical investigations completed at the site is shown on Figure 2-1.

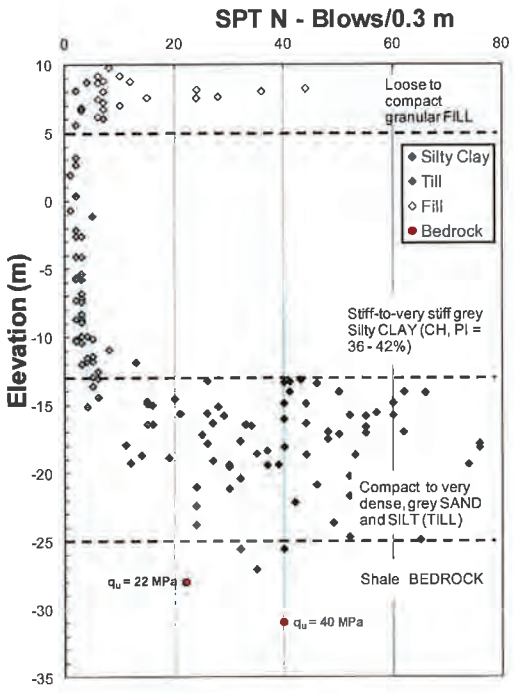


Figure 2-1: Summary of Penetration Resistance Data for the Major Soil Stratigraphic Units

2.1.1 Fill Materials

Fill materials consisting of brown black very loose to dense (N_{SPT} 10 to > 20 blows/0.3 m) silty sand and gravel, crushed rock and some metal debris (underlain by about 0.2 to 0.3 m of asphalt or concrete in some localities) have been encountered at the site. The thickness of the fill materials varies from about 4.5 to 5.3 m in the southern part of the site near the stockpile area (*i.e.*, domes) and reduces to about 1 m in the northern part of the site approaching the St. Lawrence River.

2.1.2 Marine Silty Clay

A stiff marine silty clay deposit with horizontal laminations of fine sand and silt underlies the fill materials. The thickness of this deposit varies from about 18 to 26 m and becomes thinner towards the shoreline.

In an undisturbed state, the clay has a peak undrained shear strength varying from about 50 kPa near surface to about 90 kPa at elevation -10 m (*i.e.*, 20 m depth from surface). In a highly disturbed or a remoulded state, the strength and stiffness of the clay degrades quickly into that of a soft clay. The clay exhibits an average sensitivity (expressed as the ratio of peak undrained shear strength to remoulded undrained shear strength) of about 10 with values as low as 4 and as high as 18 at some locations.

Typical peak and remoulded undrained shear strength characteristics of the clay are illustrated in Figure 2-2.

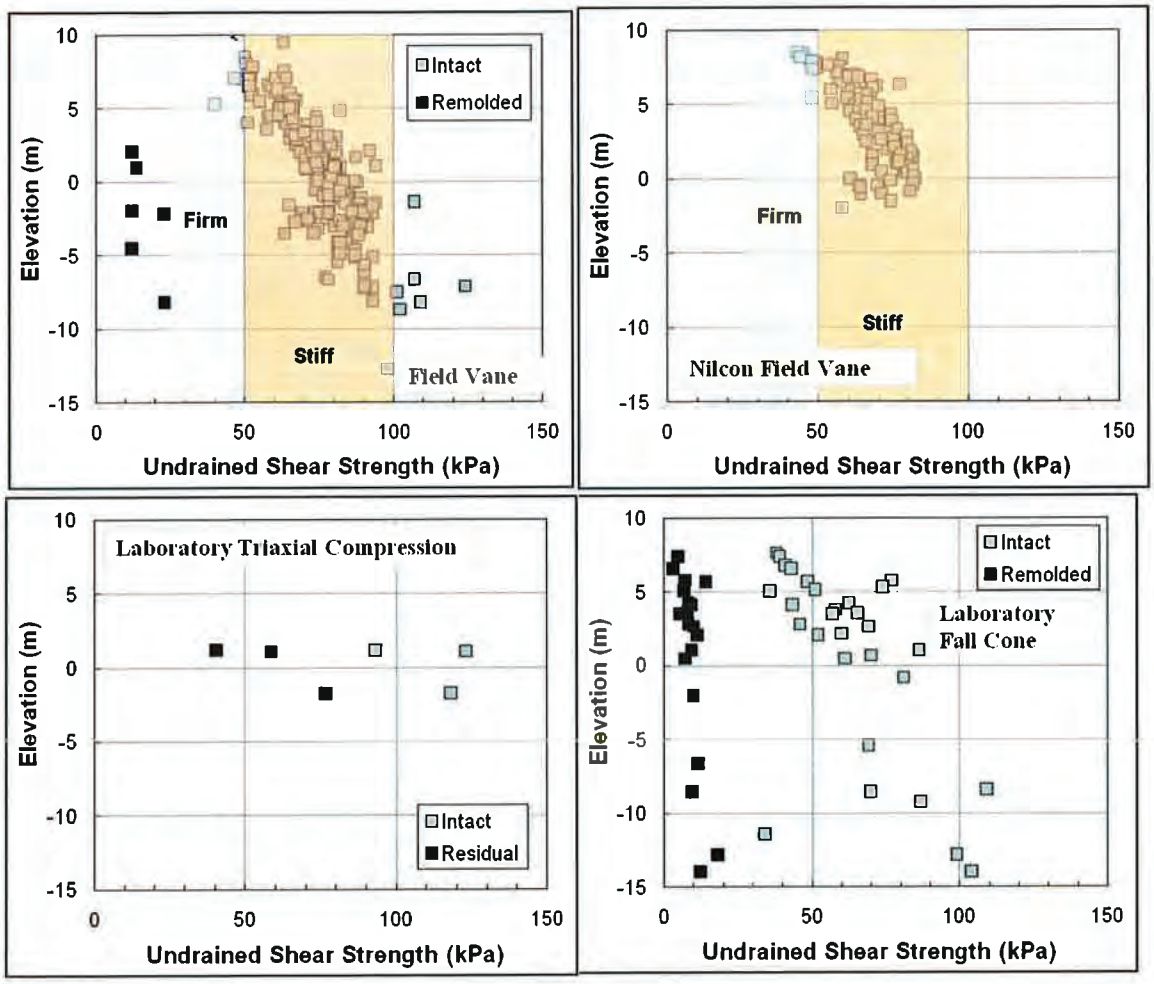


Figure 2-2: Summary of Undrained Shear Strength Data From In-Situ and Laboratory Testing of Clay

The clay has high plasticity with a liquid limit that is in excess of 60% and a plasticity index varying from about 20 to 40%. The liquidity index (LI), which is a measure of the mobility of clay upon loading, varies from 0.6 to 0.9. Fine-grained soils with a LI ≥ 1 are considered to have high mobility when disturbed.

The upper 10 m of the clay deposit is moderately over-consolidated whereas the lower 10 m is lightly overconsolidated. The variation in the over consolidation ratio (expressed as the ratio of the pre-consolidation pressure to current overburden stress) with elevation, estimated exclusively from laboratory consolidation tests, is shown in Figure 2-3.

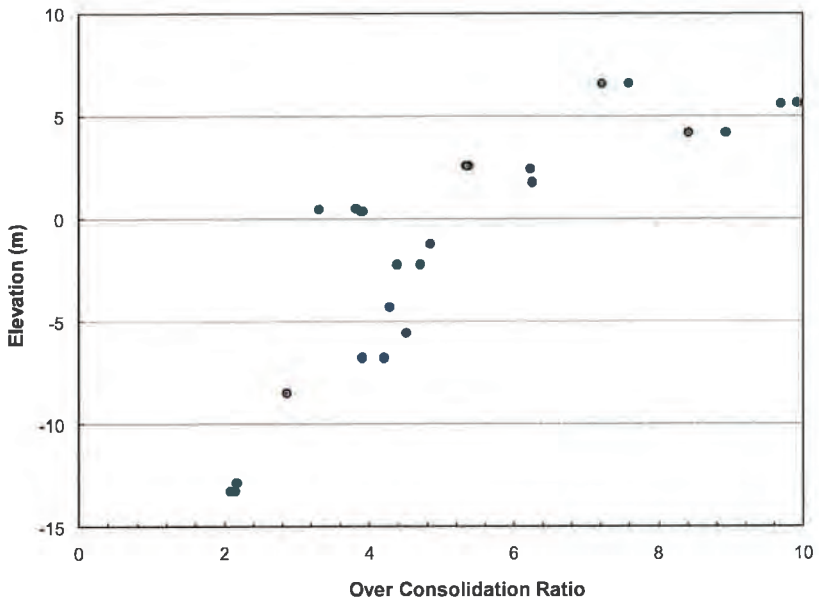


Figure 2-3: Estimated Overconsolidation Ratio of Clay

This clay is commonly referred to as "Leda clay" and has been deposited during the post-glacial era and subsequently leached leading to its sensitivity. It is extensively found in the Ottawa and St. Lawrence River lowlands ranging from Kingston, Ontario to east of Quebec City and south into New York state around Lake Champlain and beyond. The sensitive behaviour of the clay makes it difficult to measure its engineering strength and deformation characteristics from both laboratory tests and in-situ field measurements. Retrogressive slope failures are common in Leda clays when its peak shear strength is exceeded, such as in the slip surface failure that occurred in Saint Jude on May 11, 2010 near Contrecoeur.

In order to assess the behaviour of the clay soils encountered at the site during earthquakes, a series of monotonic and cyclic direct simple shear tests were carried out on samples recovered from borehole F-5-10 drilled by Qualitas as part of the geotechnical field investigations completed for the Contrecoeur site. The simple shear tests were carried out at Carleton University under the supervision of Prof. Siva Sivathayalan as per test parameters provided by Golder. The results of the testing are contained in Appendix A following the text of this Technical Memorandum. The results confirm that the clay soils exhibit strain softening behaviour when subjected to both static, cyclic, and post-cyclic shearing in the "simple shear mode". The overall strength reduction at shear strain levels of the order of 10 to 20% is estimated to be close to 30% of the peak strength. Post-cyclic monotonic loading of the samples indicate undrained shear strengths of the order of 35 to 40 kPa at about 10 to 20% shear strains. At larger shear strain levels the undrained shear strength of clay is predicted to be lower than the above limits (*i.e.,* by extrapolation of data).

2.1.3 Glacial Till

Beneath the silty clay, there exists a layer of medium dense to very dense, grey, silty fine sand some silt with trace gravel and clay and occasional pebbles at depth. Some localized zones of loose to compact soils exist within the overall dense deposit. The thickness of this layer varies from about 8 m to 16 m. It is herein inferred that these soils form the natural glacial till deposits that are known to exist in this area. High SPT penetration resistance values in the range of 20 to 60 blows/0.3 m are generally reported in the borehole logs for glacial till.

2.1.4 Bedrock

Dark grey, shale bedrock has been encountered at elevations varying from -21 m to -29 m. Based on laboratory strength measurements, the bedrock has uniaxial compressive strengths (q_u) of q_u = 5 – 25 MPa and q_u = 25 - 50 MPa.

2.2 Site Seismicity

Site-specific seismic ground motion parameters were obtained from the interactive website maintained by the Geological Survey of Canada (GSC) for Class C ground conditions and for return periods corresponding to 1:100-yrs, 1:475-yrs, and 1:2,475-yrs. The peak firm-ground acceleration (PGA) values along with the spectral accelerations at 0.2s, 0.5s, 1.0s and 2.0s periods established for the site (45.8241° North, 73.2861° West) are summarized in Table 2-1.

Table 2-1: Site-Specific Ground Motion Parameters - Class C Soil Conditions

Return Period	PGA	Sa (0.2s)	Sa (0.5s)	Sa (1.0s)	Sa (2.0s)
1:100-yr (40% Exceedance in 50 yrs)	0.07 g	0.10 g	0.04 g	0.02 g	0.01 g
1:475-yr (10% Exceedance in 50 yrs)	0.18 g	0.28 g	0.12 g	0.05 g	0.02 g
1:2,475-yr (2% Exceedance in 50 yrs)	0.42 g	0.67 g	0.33 g	0.13 g	0.05 g

The characteristic earthquake magnitudes for the assessment of liquefaction potential of site soils were established based on de-aggregation results provided by GSC for a site in Port of Montreal some 30 km upstream of the Contrecoeur terminal site. Considering the plate tectonic set up that controls the seismic risk and ground motions at the subject site, it is inferred that the de-aggregation results can be used to estimate the likely characteristic earthquake magnitude for the Contrecoeur site. The selected characteristic earthquake magnitudes are summarized in Table 2-2 and they were conservatively established by examining the range in the "mean" earthquake magnitudes computed over the period range extending from 0.0 s to 2.0 s.

Table 2-2: Characteristic Earthquake Magnitudes for Liquefaction Analysis

Return Period	Characteristic Earthquake Magnitude	Remarks
1:100-yr (40% Exceedance in 50 yrs)	M6.4	Range of contributing mean magnitude: M5.6 to M6.4
1:475-yr (10% Exceedance in 50 yrs)	M6.7	Range of contributing mean magnitude: M5.6 to M6.7
1:2,475-yr (2% Exceedance in 50 yrs)	M6.9	Range of contributing mean magnitude: M6.5 to M6.9

As per National Building Code of Canada (2005), short period amplification factors (F_a) of 2.1, 2.0, and 1.3 were used to convert the Class C PGAs summarized in Table 2-1 to the anticipated ground surface accelerations for the 1:100 yr, 1:475-yr, and 1:2475-yr return periods earthquake ground motions, respectively.

2.3 Liquefaction Potential of Site Soils

The liquefaction potential of site soils was evaluated using the Seed's simplified method of analysis by comparing the cyclic resistance of soils with cyclic stress ratio induced by the earthquake ground motions. The cyclic resistance of soils was estimated using profiles of SPT $(N_1)_{60\text{-}cs}$ values obtained from selected boreholes near each section shown on Figure 1-2 and the empirical liquefaction resistance chart developed by Idriss & Boulanger (2008). The Idriss & Boulanger empirical cyclic resistance data that are applicable for an M7.5 earthquake and an overburden stress of 100 kPa, were corrected to reflect the design earthquake magnitudes established in Table 2-1 and site-specific overburden stress conditions using the correction factors proposed by Idriss & Boulanger (2008).

In the liquefaction analysis, the average fines content (finer than USS Sieve 200) of the fill and till materials was assumed to be 10%. The penetration resistance values, presented as profiles of SPT $(N_1)_{60\text{-}cs}$ varying with ground elevation, are shown in Figure 2-5 for all available borehole data. In these analyses, the mean water table was taken at an elevation of + 8.6 m.

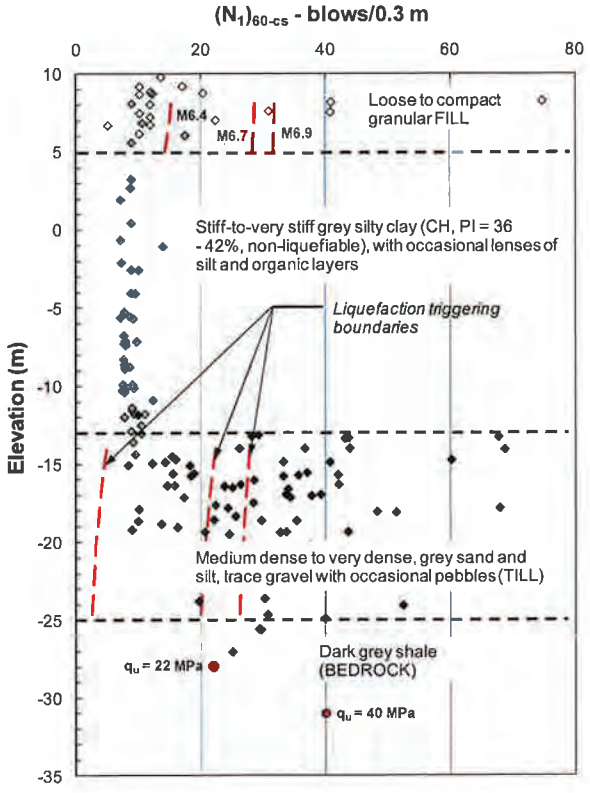


Figure 2-5: Profiles of all SPT $(N_1)_{60\text{-}cs}$ Values

Profiles of the $(N_1)_{60\text{-}cs}$ values required to trigger liquefaction for the different return period ground motions are also presented in Figure 2-5. In the absence of detailed information on hammer type, borehole diameter, rod lengths, SPT sampler liner, *etc.*, no specific corrections were applied to standardize the SPT N values.

The results indicate that the existing fill materials located below the water table have a high liquefaction potential particularly for 1:475-yr and 1:2,475-yr ground motions.

The underlying high plastic silty clays have a low risk of liquefaction. Specialized cyclic simple shear tests carried out at varying shear stress ratios indicate that on average the undrained shear strength may decrease by about 30% of its peak value due to the application of cyclic loads. The test results also confirm that catastrophic and sudden failure occurring in or through these materials at this specific site is likely to be low.

The penetration resistance values measured in some zones encountered within native till appear to contain locally weaker or looser pockets of lower than the penetration resistance required to trigger liquefaction. These zones are unlikely to be a significant concern on the overall stability of the wharfs under seismic loading conditions.

3.0 WHARF OPTIONS ANALYSIS

Three foundation alternatives were considered for the proposed wharfs comprising the container terminals. These included a sheet piled wharf with tie backs, a pile supported wharf and deck, and a concrete caisson wharf.

Based on information provided to us by Moffatt & Nichol, we understand that the existing seabed will be dredged to an elevation of about -6.9 m with possible future deepening to -7.6 m to accommodate the post Panamex ships that will be transporting the containers. The berth alignment and wharf structure layouts considered by Moffatt & Nichol are shown in Figures 1-2 and 3-1, respectively.

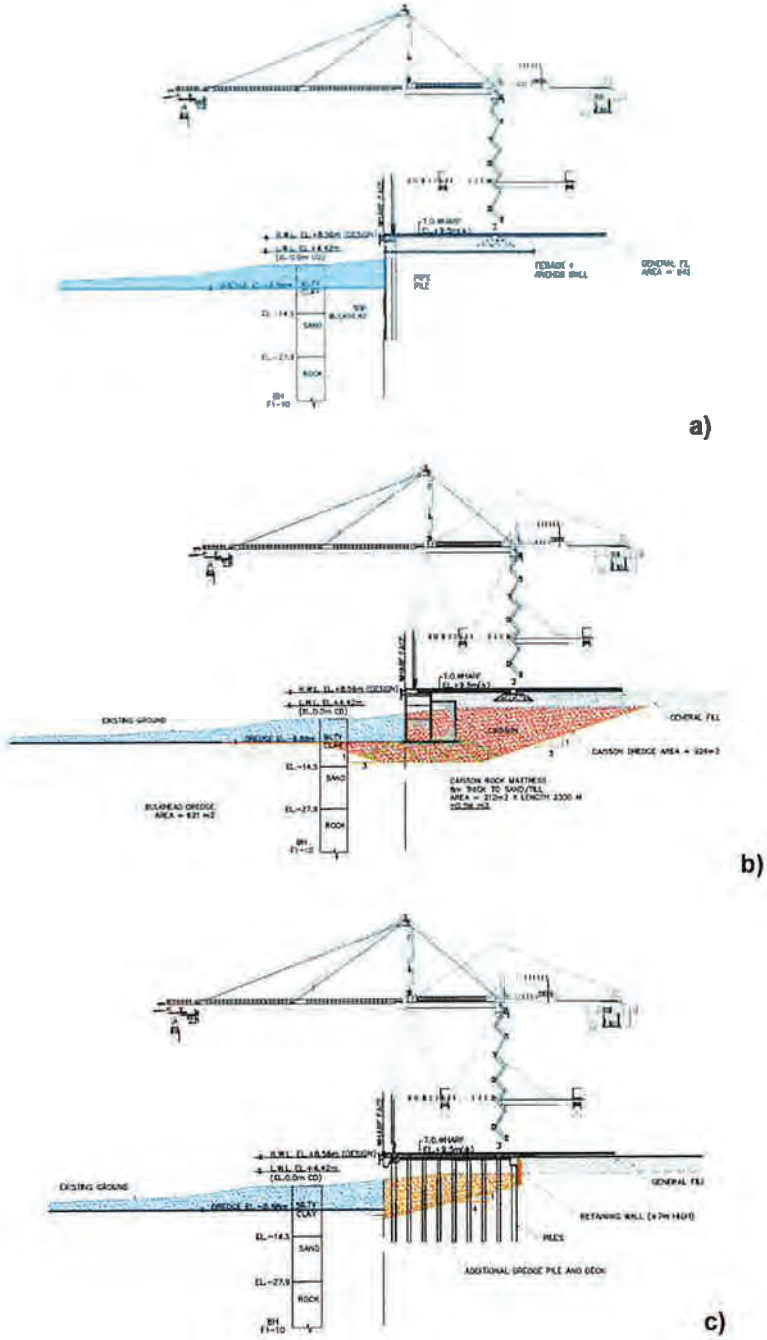


Figure 3-1: Wharf Options Considered
a) SSP Wharf Option, b) Caisson Wharf Option, c) Piled Wharf & Deck Option

3.1 Analysis Methodology

Geotechnical engineering analyses were carried out to provide the input necessary to size and cost the different wharf options described above. These analyses provide sufficient details that are appropriate for a master planning study and utilized simplified analytical procedures and tools. The methodology used is briefly described in this section. More detailed engineering analyses are required at a later stage to finalize the design details.

Wharf Deck Loads

It is understood that the wharf deck will be subjected to a uniformly distributed container storage and handling loads (UDLs). Two separate load cases have been considered:

For static analyses: UDL of 24 kPa within the first 6 m from berth face and 60 kPa thereafter.

For seismic (pseudo-static) analyses: UDL of 24 kPa within the first 34 m from berth face to crane rail and 48 kPa thereafter.

Considering the variations in container storage and handling load distributions and the probability of occurrence of a seismic event that would cause strong ground shaking at the site, a reduced UDL has been considered for seismic design and analysis.

Seismic Lateral Earth Pressures

The seismic lateral earth pressures on the marine structures were computed using the Mononobe-Okabe method of analysis, assuming that these would experience lateral movements or rotations that are sufficient to mobilize an active state in the backfill soils. A seismic coefficient equal to the peak horizontal ground acceleration times the amplification factors noted in Section 2.2 was used in these analyses. In the case of caisson structures, the interface wall friction was taken as ½ of the angle of friction of densified fill and rock mattress till (38^0).

It was considered that the repeated application of shear loads such as those resulting from strong ground shaking would result in degradation of the clayey soils that are left in place. Average undrained shear strength of 70 kPa, and 35 kPa were used when estimating the static, and seismic lateral soil pressures, respectively. A conservative shear strength reduction of 50% was used to compute the seismic lateral earth pressures. A factor of safety equal to 2 is used for the passive lateral pressure on the water side of the sheet-piles.

The cyclic simple shear tests completed as part of this study confirm that higher strengths may be relied upon in the clay soils when subjected to the design earthquake-induced ground motions. These higher post-cyclic undrained shear strength values have been considered in the more detailed soil-structure interaction analyses considered for the selected steel sheet pile option described in detail in Section 5.0.

The hydro-dynamic forces acting on the free face of the sheet-pile and caisson walls were computed using the Westergaard formulae and guidelines given in published literature. For static analyses, a ground water table that corresponds to the Low Water (*i.e.*, Elev. +4.4 m) was considered. For seismic analyses, a ground water table that corresponds to the Mean Water (*i.e.*, Elev. +6.5 m) was considered when calculating the seismic lateral stresses.

Global Slope Stability

The global stability of the various wharf options was assessed by developing a series of slope stability models that were generated using the computer program SLOPE/w. Both static and seismic stability of the wharfs at Sections A-A', B-B', and C-C' have been assessed.

For the static stability analyses, a lower ground water table (at Elev. +4.42 m) was considered. For the seismic stability analyses, a mean ground water table (at Elev. +6.49 m) was considered. For global stability, the slip surfaces were forced to be located below the base of the sheet pile or caissons.

Details of the different wharf structure/foundation systems considered for the Development Master Plan Study are briefly described below.

3.2 Steel Sheet Pile Wharf Option

Steel sheet piles with a single row of deadman anchors driven to the top of bedrock with their toes well-anchored into till may be considered to develop the wharf. The design of the sheet pile section, tie rods, and the anchor wall system are completed by Moffatt & Nichol. It has been assumed that the seabed soils in front of the sheet pile wall will be dredged to a maximum elevation of -7.6 m to facilitate ship berthing.

The static and seismic lateral earth pressures to be used as input to the design of the steel sheet pile wall wharf option are presented in Figures 3-2. Figures 3-2a correspond to an average UDL of 60 kPa (*i.e.*, as per for the static loading) applied throughout the deck area whereas Figure 3-2b corresponds to an average UDL of 36 kPa (*i.e.*, average of 24 kPa and 48 kPa as per for the seismic loading distribution).

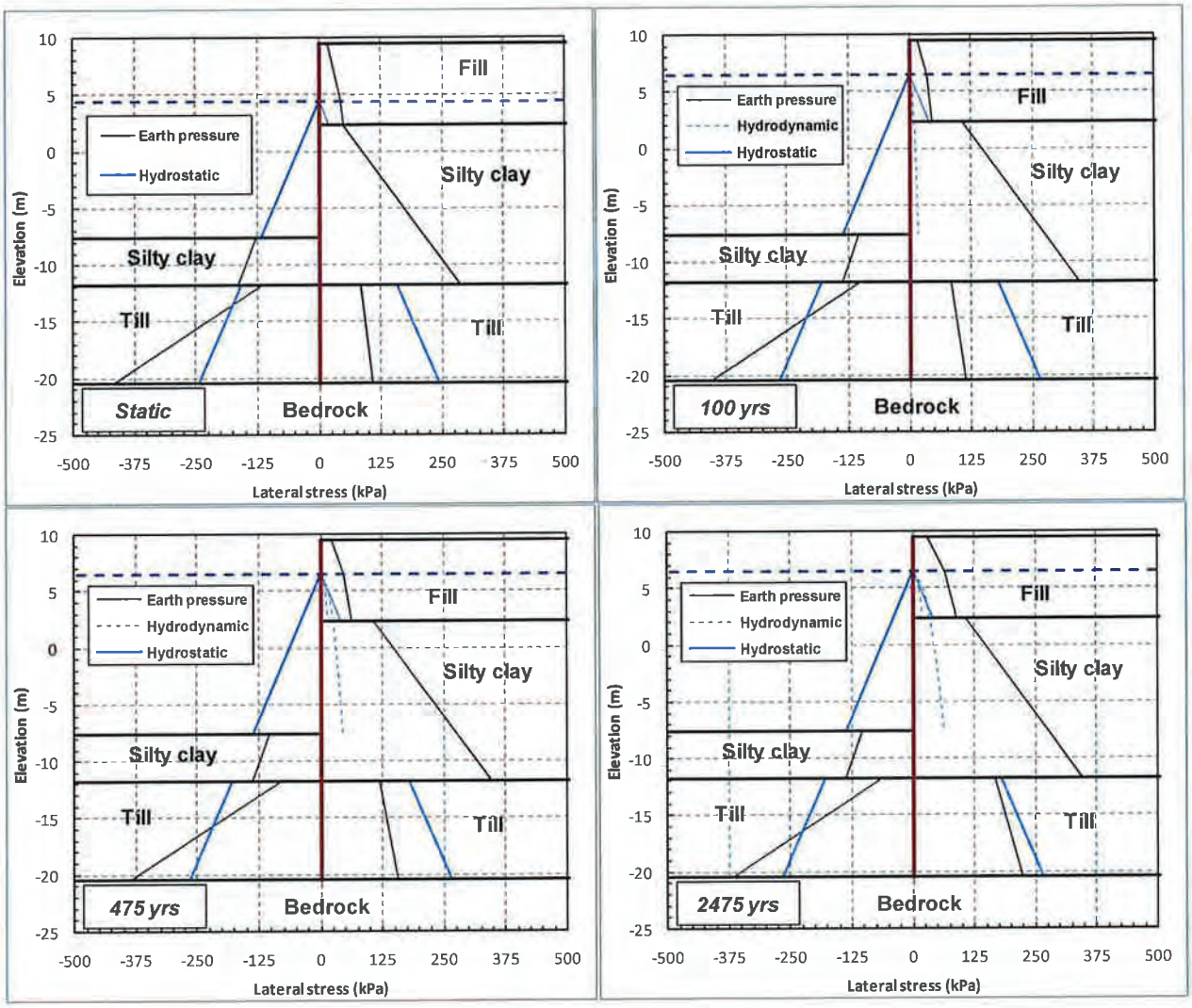


Figure 3-2a: Static and Seismic Lateral Earth Pressures (Sheet Pile Wall at Section A-A')

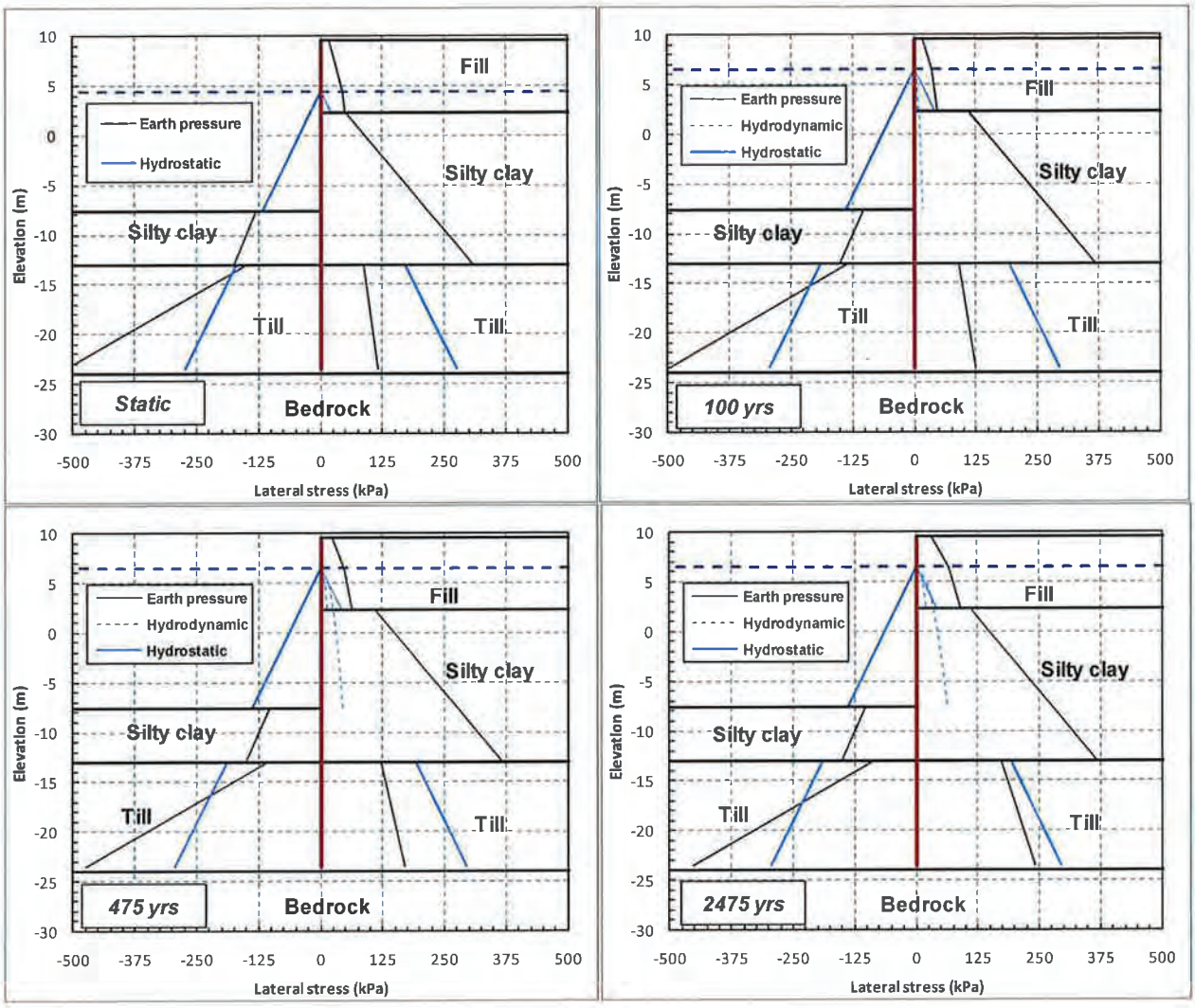


Figure 3-2b: Static and Seismic Lateral Earth Pressures (Sheet Pile Wall at Section B-B')

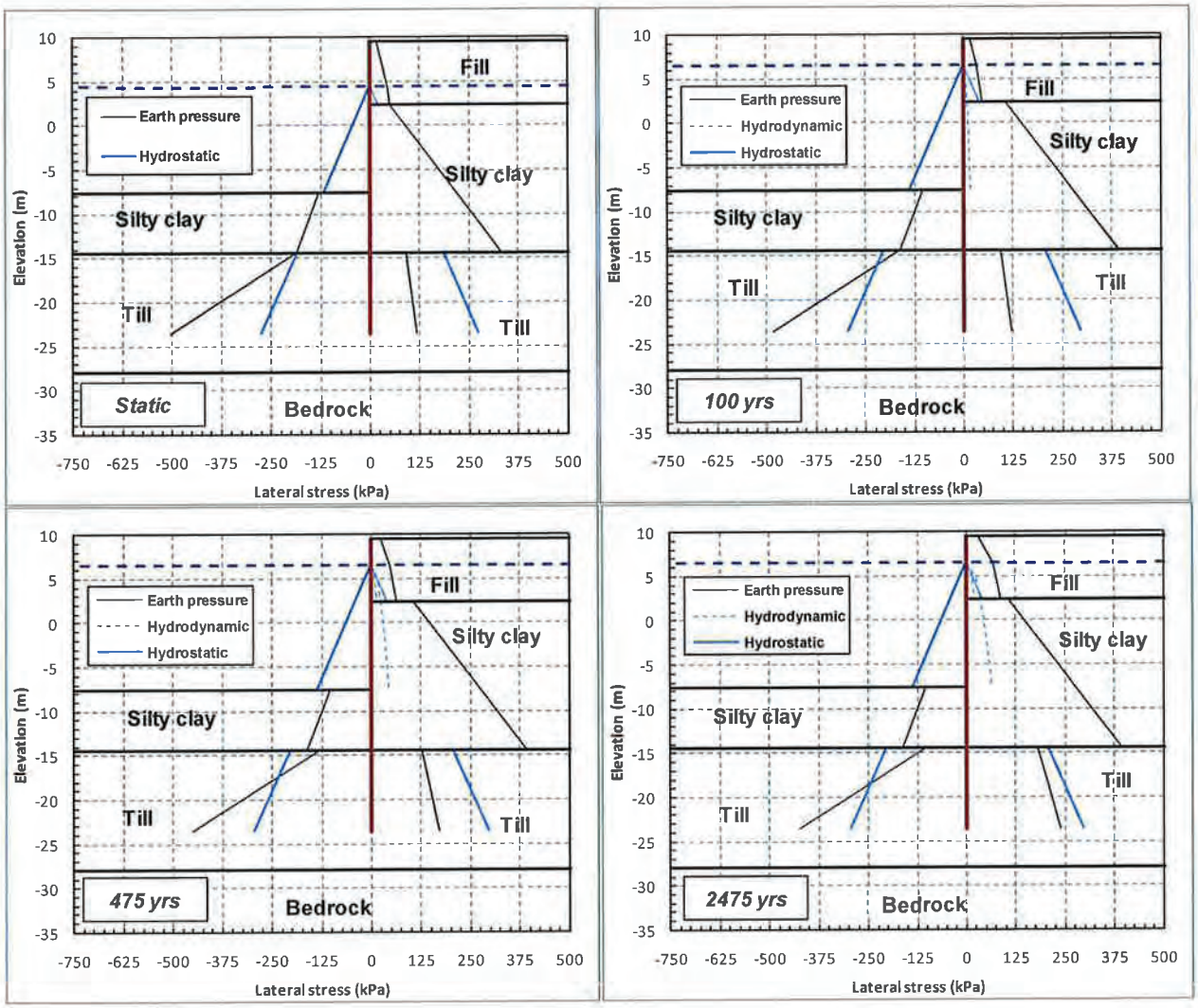


Figure 3-2c: Static and Seismic Lateral Earth Pressures (Sheet Pile Wall at Section C-C')

Results of global slope stability analyses completed for the steel sheet pile option are summarized in Table 3-1. The slip surfaces analyzed are shown graphically in Appendix B.

Table 3-1: Summary of Global Slope Stability Results - Sheet Pile Wharf Option

Section Reference	Static Stability Factors of Safety	Seismic Stability Factors of Safety			
		100-yr Earthquake	475-yr Earthquake	2475-yr Earthquake	k_y (g)
Section A-A'	2.1	1.5	1.0	0.8	0.36
Section B-B'	2.4	1.6	1.0	0.9	0.40
Section C-C'	2.3	1.5	1.0	0.8	0.37

The factors of safety computed for the slip surfaces considered for static global slope stability are in excess of 1.5, the generally acceptable value for static loading conditions. For seismic stability, a factor of safety less than unity, computed for rare loading such as that resulting from the 1:2475-yr ground motions, does not imply catastrophic failure of the structures. Instead, in these situations, these structures would undergo permanent lateral deformations and rotations. k_y denotes the yield acceleration or the seismic coefficient that is required to be applied to have a factor of safety of 1.0 against slip surface failure. Seismic accelerations in excess of the yield acceleration result in permanent displacements.

3.3 Caisson Wharf Option

Reinforced concrete caissons that are approximately 14 m high (from the base of the slab to underside of the cope wall) and 17 m wide and filled with rock fill may be considered to construct the wharf. As the clay layer would not be able to carry the weight of these heavy caissons and would settle, it is recommended that the clay layer underneath the caissons be dredged to the top of the till and the caissons be constructed on top of a densified rockfill mattress. It was further assumed that the backfill soils retained by the caissons will be densified over a minimum lateral distance of 20 m.

Historical evidence suggests that slopes excavated in the sensitive marine clays underlying the site would have a high risk of experiencing failure or movement within 1 to 2 years of construction if they are steeper than 2.5H:1V. Assuming a construction window of about 6 months, it is considered feasible to develop a temporary dredged slope at 3H:1V to facilitate construction of the caissons.

The static and seismic lateral earth pressures to be used as input to the design of the caisson wharf option are presented in Figure 3-5.

Results of static and seismic global slope stability analyses completed for the caisson wharf option are summarized in Table 3-3. Details of the slip surfaces analyzed are presented in Appendix C.

Table 3-3: Summary of Global Slope Stability Results - Caisson Wall Wharf Option[2]

Section Reference	Static Stability Factors of Safety	Seismic Stability Factors of Safety			
		100-yr Earthquake	475-yr Earthquake	2475-yr Earthquake	k_y (g)
Section A-A'	1.8	1.4	0.9	0.7	0.29
Section B-B'	1.8	1.3	0.8	0.6	0.28
Section C-C'	1.8	1.3	0.7	0.5	0.24

[2] The results shown here correspond to a dredged seabed elevation of -6.9 m

The factors of safety computed for the slip surfaces considered for static global slope stability are in excess of 1.5, the generally acceptable value for static loading conditions. For seismic stability, a factor of safety less than 1.0, computed for rare loading such as resulting from the 1:2475-yr ground motions, does not imply catastrophic failure of the structures. Instead, in these situations, these structures would undergo permanent lateral deformations and rotations.

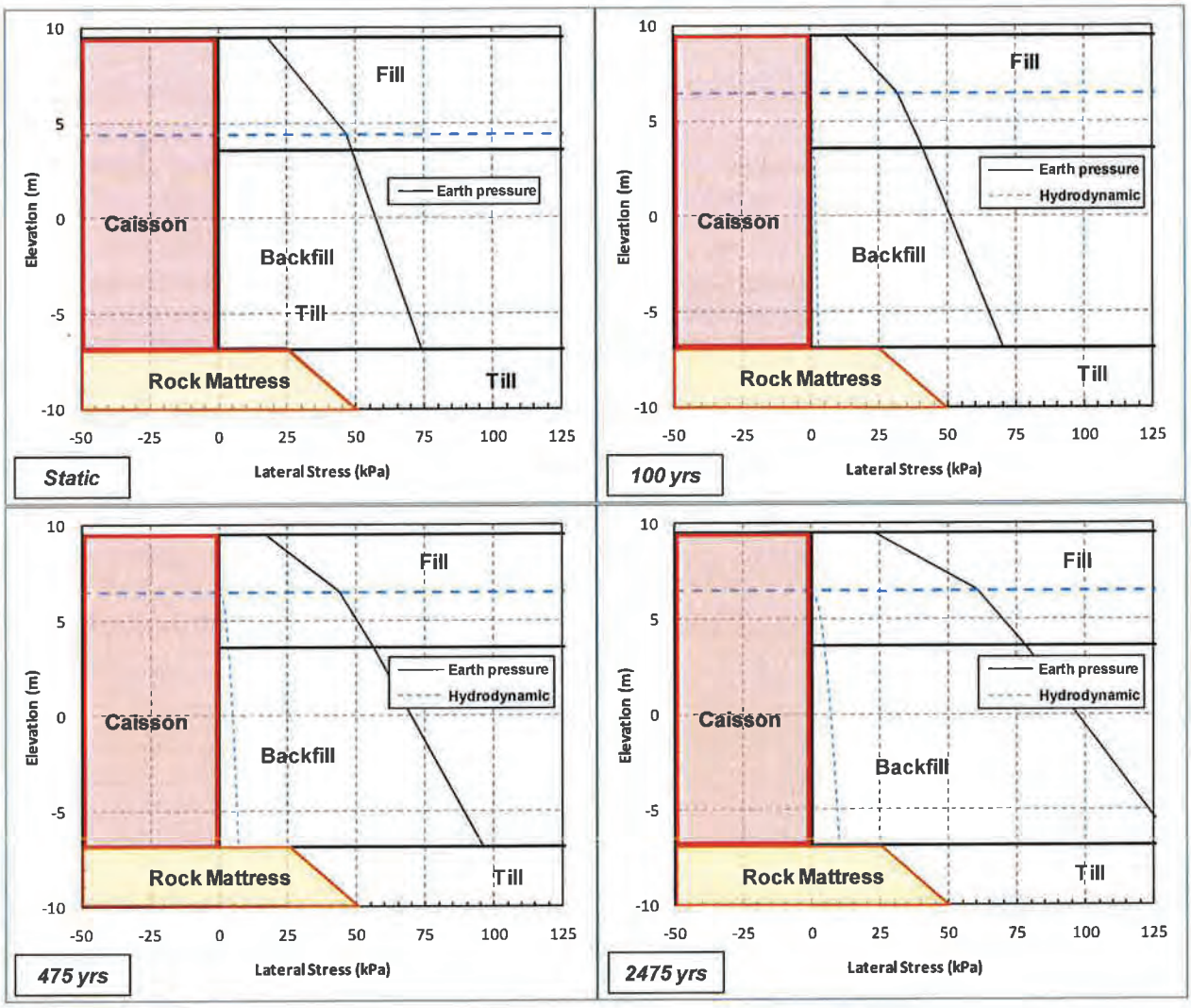


Figure 3-5: Static and Seismic Lateral Earth Pressures on Caisson Walls (Sections A-A', B-B', and C-C')

3.4 Pile and Deck Wharf Option

The pile and deck wharf option consist of rows of piles that are driven into competent bearing strata to support the deck loads. Typical wharf loads can be supported on 610 mm to 914 mm diameter steel pipe piles.

Steel pipe piles that are either 610 mm or 914 mm in diameter and driven to top of bedrock through till may be considered to support the deck and superstructure loads. Open-ended steel pipe piles driven through till to bedrock may be designed using an ultimate geotechnical axial compression capacities of 6 MN/pile for 610 mm diameter piles and 11 MN/pile or 914 mm diameter piles.

A FOS of 3 is recommended to be applied to the above noted ultimate compression capacities to obtain the allowable values. Provided that a Pile Driving Analyzer (PDA) is used to assess the bearing capacity of the pile foundations during production pile installation, the FOS can be reduced to 2.

For the piles driven to the top of the bedrock, the point of fixity can be taken at the top of the till encountered at an elevation of -11.8 to -14.5 m.

Available data on undrained shear strength and stress-strain response of sensitive marine clays and literature indicate that permanent dredged slopes of the order of 4H:1V may be developed in the sensitive marine clays. This slope angle corresponds to a conservatively estimated undrained shear strength of 25 kPa or an equivalent $(N_1)_{60}$ = 2 – 4 blows/0.3 m (*ref. "Construction of Marine and Offshore Structures", Gerwick (2007)).*

Considering the width of the wharf and the slope geometry *etc.*, a gravity cope wall or a sheet pile bulkhead/pile wall needs to be built on top of the slope at the back of the deck to retain fill in order to achieve the design site grade. Tie-rods and deadman anchors may need to be constructed at some locations behind these walls to provide lateral support for the bulkhead wall.

Results of global slope stability analyses completed for the piled wharf and deck option are summarized in Table 3-4. Details of the slip surfaces analyzed are presented in Appendix D.

Table 3-4: Summary of Global Slope Stability Results - Pile Wharf and Deck Option [1]

Section Reference	Static Stability	Seismic Stability			
		100-yr Earthquake	475-yr Earthquake	2475-yr Earthquake	ky (g)
Section A-A'	1.2	0.9	0.5	0.4	0.11
Section B-B'	1.1	0.8	0.5	0.4	0.11
Section C-C'	1.1	0.8	0.5	0.3	0.09

[1] The results shown here correspond to a dredged seabed elevation of -7.6 m

The factors of safety computed for the slip surfaces considered for static global slope stability are lower than 1.5, the generally acceptable value for static loading conditions. This is a result of the slope angle chosen, strength of clay, and the high surcharge loads (of 60 kPa) applied at ground surface from the crest of the soil landwards.

The factors of safety computed for seismic loading conditions are considerably less than unity with corresponding yield acceleration values greater than zero. While factors of safety less than unity under seismic loading conditions do not imply catastrophic failure of the slope, the considerably low factors of safety for the 475-yr and 2475-yr ground motions indicate potential for significant slope movements to occur within the slope when subjected to strong shaking.

3.5 Pros and Cons of Wharf Options

Pros and cons of the three different wharf options considered for the Development Master Plan Study are summarized in Table 3-5 below. From geotechnical and seismic considerations alone, the caisson wharf option is preferred with the pile-deck option being the least favourable, because of the uncertain seismic behaviour of Leda clay and its implications on the behaviour of the wall structure. From dredging/disposal/backfilling costs, the sheet pile wharf option is preferred, trading off the performance for cost. The pile and deck wharf option is the least preferred wharf alternative.

Table 3-5: Comparison of Wharf Options From Geotechnical Considerations

Structure Type	Pros	Cons
Anchored Sheet-Pile Wall	1. Lowest dredged soil volume. 2. Used at Contrecoeur Cargo Bulk Storage Terminal. 3. Good performance under static & moderate performance under seismic (475-yr, 2475-yr) loads.	1. Clays are left in place, whose seismic performance is uncertain. 2. Site settlements (long-term). 3. Sheet piles need to be robust and may not penetrate or have difficulties with installation all the way to top of bedrock.
Caisson	1. Good performance under static & seismic (475-yr, 2475-yr) loads. 2. Commonly used at the MPA sites.	1. High dredged soil volume. 2. Dredged soil disposal area required. 3. Densification of new granular fills required to achieve the desired seismic performance.
Piled Wharf & Deck	1. Improved settlement performance.	1. Stable dredged slopes need to be relatively flat (4H:1V). 2. High dredged soil volumes. 3. Dredged soil disposal area required. 4. Slope movements anticipated during pile installation and under seismic loading that may cause deflections and bending moments in the piles. 5. Piles installation in clay may cause reduced soil-pile interface strength.

4.0 DREDGING OF SITE SOILS

The development of wharfs would involve dredging and removal of site soils near shoreline areas to permit the design draft required for ship berthing and geotechnical stability. The steel sheet pile wharf option would involve the least amount dredging whereas the concrete caisson crib wharf option would involve considerable dredging of site soils.

The clayey soils underlying the site, if dredged using a clamshell, may stick to the bucket and not discharge readily. The clay will likely come off in chunks initially, but upon reworking or if left exposed to water or wet weather conditions for several months, will degrade into a soft and weak material that will be difficult to handle using conventional excavation equipment for disposal. Once the clay is in suspension, it becomes colloidal in behaviour, and the discharge will be highly turbid. A considerable length of time may be required in relatively still water for the clay particles to drop out of suspension.

Cutter dredging techniques, if used to remove the clay soils, will in considerable disturbance to the soils which will require pumping in a slurry state.

Regardless of the dredging technique used, the disposed soils are not considered suitable as site grading fills and support of foundations unless extensive ground remediation measures such as staged preloading over long periods of time, soil mixing with cement to develop stronger cellular structures, *etc.* are implemented.

Based on historical correlations of submerged permanent dredge slopes in clay with shear strength reported by Gerwick, B. "Construction of Marine and Offshore Structures", the precedent state of practice followed by the geotechnical engineering community in the Ottawa region where a significant number of slopes have been constructed in Leda clays, and case histories documented by Eden, W. J. and Mitchell, R. J. (1970) on "The mechanics of landslides in Leda clay" (ref. Canadian Geotechnical Journal, Vol.7, 285 - 296), we recommend that permanent (long-term) dredged slopes developed in the sensitive marine clay soils should not be steeper than 4H:1V. Temporary dredged slopes, however, may be developed with slopes no steeper than 3H:1V. With time, steeper slopes are likely to experience degradation and possible failure.

Dredging of the marine clays should be carried out with care taken not to over steepen the banks (even locally) to minimize the risk of slope failure. Historical evidence indicates that slope failures occurring within these soils are retrogressive in nature and, once triggered, can extend several hundred meters inland.

5.0 STEEL SHEET PILE WHARF OPTION

Following completion of the sizing of foundation elements and comparative cost benefit analyses, we understand that the steel sheet pile option has been selected as the preferred wharf option to be pursued further. The proposed design considers a berth face constructed using a heavy duty HZ steel sheet pile bulkhead consisting of H king pile with intermediate Z pile system anchored to 914 mm diameter anchor piles via a single row of tie rods located at an elevation of +5 m and some 45 m landwards of the berth face. The H piles are to be driven into bedrock whereas the sheet piles are to be installed to or close to bedrock in order to permit sufficient passive capacity at the toe. A sketch of the proposed design is presented in Figure 5-1.

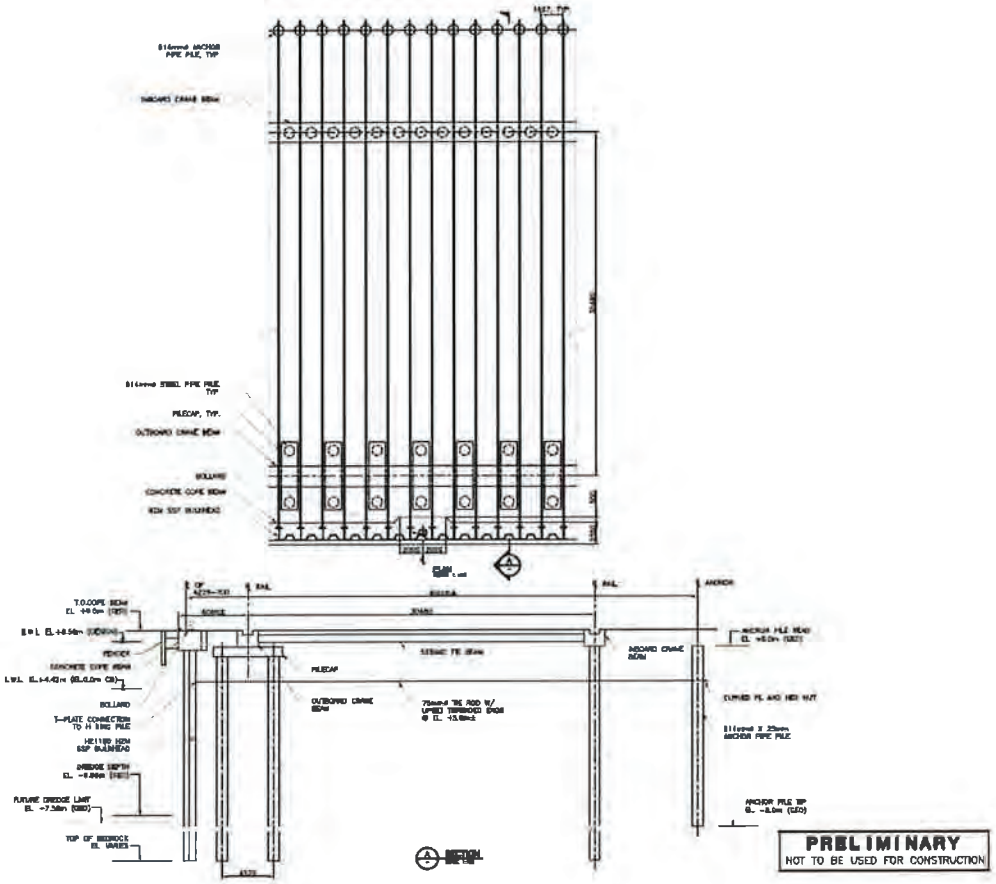


Figure 5-1: Sketch of Proposed Anchored Sheet Pile Wharf (Ref. Moffatt & Nichol Email dated July 30, 2010)

A simplified two-dimensional soil-structure interaction (SSI) model has been developed to evaluate the static and seismic loading-induced loads, bending movements, shear forces and deformations of the wharf and its components. The key purpose of this exercise is to explore the possible ruling out of the use of a "Double" HZ Pile System that is currently being pursued to withstand seismic loads. The model takes into consideration the pre- and post-cyclic stress-strain strength behaviour of the clayey site soils retained by the sheet pile wall and their interaction response with the foundations under static and seismic loading conditions and ignores the contribution from the piling installed to support the cranes. The results of the cyclic simple shear testing carried out on clay samples have been taken into consideration when deriving the input soil parameters for the model.

The SSI model has been developed using the public domain finite difference computer code FLAC. The main purpose of the SSI model was to undertake limited engineering analyses to confirm the magnitude and pattern of lateral earth pressures estimated using the simplified methods of analyses presented in Section 3.2 of this Technical Memorandum.

The SSI analyses are currently underway and the results will be presented in a separate Technical Memorandum upon completion.

6.0 DEVELOPMENT OF UPLAND AREAS

Geotechnical engineering recommendations and input for the development of various facilities in the upland areas of Contrecoeur Terminals are presented in this section. These include settlements anticipated in the container storage and handling areas, recommendations for building foundations, and preliminary recommendations on pavement structures applicable for the different areas developed primarily based on evaluations completed previously for the Hochelaga-Viau Terminal in Port of Montreal.

Settlements - Container Storage and Handling Areas

The container storage and handling areas will experience settlements occurring over time when subjected to aerial sustained loads. The sustained loads result from grade fills that will be placed for site development and surcharge loads from containers placed on site.

Our analyses indicate that the clay soils have an average overconsolidation stress difference of about 150 kPa. In some areas, however, the available overconsolidation stress difference is as low as 60 kPa whereas in other areas it is as high as 350 kPa. This implies that surcharge aerial loads inclusive of site grading fills will experience limited settlements as long as the combined applied stresses do not exceed about 150 kPa.

Sustained (*i.e.*, long-term) container storage loads of 50 to 60 kPa plus grade fill loads not exceeding 3 m in thickness are expected to induce total vertical settlements of the order of 120 mm to 140 mm over a period of 20 to 30 years. Approximately 50% of these settlements are likely to occur as differential settlements over time. With reduced sustained loads of 25 to 30 kPa, the settlements reduce to 65 to 75 mm over 20 to 30 years. These analyses consider a recompression index (C_r) of 0.05 estimated based on available data on consolidation characteristics of site soils. Sustained aerial loads that exceed the overconsolidation stress difference will induce significantly larger settlements over time than described above.

Settlement sensitive foundations such as automated Rail Mounted Grantrys (RMGs) located in the container storage area should be designed to accommodate the above-noted differential settlements. Alternatively, provision should be made to adjust the railings periodically to minimize the impact of differential settlements on the performance of the RMGs.

In case if the proposed equipment and other operational considerations cannot accommodate the noted total and differential settlements, pre-loading and surcharging the site may be considered to reduce the potential for total and differential settlements, but this may involve installation of closely spaced artificial drainage paths (*i.e.,* wick drains[1]) to enhance time required for consolidation. Even with this site treatment, the high plasticity in the clay soils would dictate a long preload/surcharge period, likely in the order of several years. Additional analyses are necessary to confirm the duration of preloading required.

Building Foundations

Lightly loaded and settlement insensitive buildings may be supported on shallow foundations supported on well-compacted structural fill placed for site development. These foundations may be designed using an allowable bearing pressure of 75 kPa.

Buildings that are sensitive to settlements may be supported on piles driven to bedrock. Applicable geotechnical capacities for 610 and 914 mm diameter steel pipe piles installed with open ends are provided in Section 3.4.

Pavements

Pavement structures for the different terminal, container storage, and trafficked areas are dependent on the loads imposed by the different equipment, load repetitions, and preferred pavement types. Based on pavement analyses recently completed for a similar Master Planning Study for the Hochelaga-Viau Terminal, the following pavement structures are proposed for consideration. Detailed analysis of the pavement structures is outside our current scope of work.

The depth of frost penetration in the Montreal area is of the order of 1.8 m. We recommend that the pavements have no frost-susceptible fills within 1.1 m of ground surface.

Details of the pavement structure proposed for the RTG wheel paths are given in Table 6-1. Given the high degree of channelization, we recommend the use of concrete strips for wheel paths of the RTG's. The pavement structure is controlled by the requirements for a 4 wheel RTG. The pavement structure, provided below for the RTG wheel paths, is similar to that used in the other parts of the Port of Montreal.

Table 6-1: Proposed Pavement Structure for RTG Wheel Paths

Layer	Thickness
Concrete	450 mm
Base Course (MG-20)	300 mm
Sub-base Course (MG-112)	350 mm
Total Thickness	1,100 mm

The pavement structure for the RTG operation area may be the same as for the container yard serviced by top-picks or reach stacker container handlers. The wheeled area of the container yard serviced by top-pick container handlers and/or reach stacker container handlers is to be used by both – top-picks and trucks/ bombcarts. The pavement structure design is governed by the damaging effect of the Reach Stacker and the proposed pavement structure is given in Table 6-2.

[1] Wick Drains, a type of prefabricated vertical drains, are a synthetic band shaped material approximately 100 m wide and 6 mm thick. The drains are installed vertically into ground containing soft soils to shorten the path water must travel to expel the water and consolidate. They are typically installed in a triangular or rectangular pattern at a c/c spacing of 1 to 1.5 m depending on preloading/surcharging requirements. The drains are installed using a mandrel to which the drain material is attached in the form of a roll.

Table 6-2: Proposed Pavement Structure for "Conventional" Container Yard

Layer	Thickness
Asphalt	285 mm
Cement Stabilized Base	200 mm
Base Course (MG-20)	300 mm
Sub-base Course (MG-112)	315 mm
Total Thickness	1,100 mm

A less robust pavement structure may be considered for the "Automated" container yard since the storage areas are not subjected to wheel loads from the top picks.

Parking areas that will be subjected to passenger vehicle traffic and occasionally to the wheel loads imposed by a large rubber tire crane may be provided with the pavement structure given in Table 6-3.

Table 6-3: Proposed Pavement Structure for Parking Areas

Layer	Thickness
Asphalt	100 mm
Base Course (MG-20)	300 mm
Sub-base Course (MG-112)	700 mm
Total Thickness	1,100 mm

7.0 CLOSURE

We trust that the information contained in this Technical Memorandum is sufficient for your immediate requirements. Should you have questions or need clarification of the contents, please do not hesitate to contact us.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

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Geotechnical Group

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Upul D. Atukorala, Ph.D., P.Eng.,
Principal

Attachments: Appendix A – Results of Simple Shear Testing of Clay
Appendix B – Results of Sheet Pile Slope Stability Analyses
Appendix C - Results of Caisson Pile Slope Stability Analyses
Appendix D - Results of Pile and Deck Slope Stability Analyses

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The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder cannot be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. **The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report.** The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

APPENDIX A
Results of Simple Shear Testing of Clay

Monotonic, Cyclic, and Post-Cyclic Simple Shear Tests on Samples from Contrecoeur Container Terminal, QC.

S. Sivathayalan, PhD, PEng

Carleton University

August 2010.

Introduction

Simple shear tests were carried out on samples obtained at the Contrecoeur container terminal site in Montreal, QC. The samples, provided by Golder Associates ('GA') on June 29, 2010 were wrapped in plastic and waxed. It is understood that these samples were obtained using Shelby tubes at four locations (in one bore hole, F-5-10) , and were extruded, cut into sections (approximately 4" long) and waxed in the laboratories of Groupe Qualitas Inc. prior to being transported to Carleton University. The samples were generally identified as TM-6 (6.1 - 6.6m), TM-7 (7.7 - 8.1m), TM-12 (15.3 - 15.8m) & TM-13 (16.8-17.3m) depending on the depth. Two monotonic tests, and six cyclic & post-cyclic tests were carried out as requested. Test parameters were prescribed, and adjusted following consultation with GA as the testing progressed.

Equipment

The tests were conducted using an NGI type simple shear device (Bjerrum & Landva, 1966) in the geotechnical research laboratory at Carleton University. This device uses a reinforced rubber membrane to enclose the soil sample, and as a result essentially Ko conditions prevail in the sample during consolidation, and constant volume conditions during shear loading. Typically 70mm nominal diameter specimens are tested in this device, however, a specimen diameter of 63.5 mm was used in this series of tests to accommodate the Shelby tubes used for sampling (outer diameter 2-7/8", and sample diameter 2¾"). The reduced sample diameter was required to enable trimming of some soil from the sides to reduce the effects of surface & sampling imperfections on the results.

Vertical, horizontal loads and displacements are monitored using an automated data acquisitions system, and these readings enable calculation of the required stresses and strains. The

drop in vertical load during constant volume loading (Finn et al. 1978) is considered equivalent to the excess pore pressure generated (Dyvik et al. 1989) in typical undrained tests, and the excess pore pressure data presented herein is derived from the changes in the vertical stress.

Data acquisition and control systems are fully automated, and measurement resolutions of about 0.01% (in strain measurements) and 0.2 kPa (in stress measurements) are achieved by using advanced signal conditioning, data acquisition and control hardware. A maximum vertical consolidation stress of about 1200 kPa, and a cyclic shear stress of about 230 kPa can be applied in the current configuration (using a nominal 2½ inch diameter specimen).

Ribbed end platens are used to ensure proper transfer of shear stresses in this device. Based on the observations from the first exploratory test, the ribs were sharpened, and channels were cut to reduce the surface area of the ribs, in order to enhance rib-penetration during setup. This was required as a result of the relatively low consolidation stress level and the high OCR in some of the tests.

Test Procedure

About 1¼" tall disk was cut from the provided samples, and pushed into a lubricated specimen ring with a sharp and tapered cutting edge. About half an inch of soil was trimmed away from the top and bottom to yield smooth samples surfaces. Any specimens that appeared disturbed, or had cavities/fissures, or not representative of the material being tested were discarded, and a newer specimen was obtained. This happened twice in this series: First specimen in TM-7C was discarded due to a silt seam, and in TM-13B was discarded due to fissures that impacted the sample quality. A photographic record showing the sample preparation and testing procedures is provided in Appendix 2. Test parameters, such as the vertical effective consolidation stress, and the cyclic stress ratio were provided by GA.

Consolidation stresses were applied in increments as prescribed by GA. Even though this permits an estimate of the compressibility characteristics, it should be noted the data is not always reliable, and cannot be a substitute for proper consolidation test because of the potential uncertainties in height change measurement due to the use of ribbed platens. In addition, the sample was allowed to drain only for shorter duration before the next increment was applied, except for the last increment. Upon the application of the last stress increment (final consolidation stress level), the sample was allowed to consolidate overnight (for a period of about 16 hours). The vertical deformation (and hence the volumetric strain) was recorded throughout the consolidation

process.

As requested by GA, specimens with relatively high OCRs, and consolidated to lower stress levels (TM-6, TM-7) were momentarily loaded to 150 kPa and unloaded (within about 20 seconds) prior to the application of the first consolidation stress increment. This was intended to remove any rib-penetration during consolidation, and increases the confidence in the volumetric strain data during consolidation. No such loading/unloading pulse was applied for specimens from TM-12 & TM-13. These specimens had relatively lower OCR values, and were consolidated to 100 - 125 kPa stress levels. Therefore, the measured consolidation height changes include rib-penetration in the tests on specimens from TM-12 & TM-13.

Constant volume conditions were imposed at the end of consolidation by arresting the vertical displacement, and a sinusoidal cyclic shear stress was applied at a frequency of 0.1 Hz. The target cyclic stress amplitude was based on the CSR values provided by GA, and the cyclic loading was applied under stress controlled loading. Care was taken to maintain the cyclic shear stress amplitude at essentially constant value throughout the loading. Specimens were loaded up to 10 cycles, or until they reached 5% shear strain. Strain controlled post-cyclic loading was carried out without reversal of the last cyclic loading pulse (i.e., in the direction opposite to the residual strain) at a loading rate of 12% per hour until the shear strains exceeded about 20%.

Test Results

A summary of the monotonic test results is provided in Table 1, and cyclic and post-cyclic in Table 2. Plots showing the recorded measurements during the consolidation, cyclic, and post-cyclic loading phases are presented in Appendix 2. There are three plots for each test:

1. Consolidation data

   The variation of vertical consolidation stress, and vertical strain (which equals the volumetric strain due to the use of a steel-wire reinforced membrane) with time are plotted.

2. Cyclic data as a function of loading cycles

   Applied cyclic shear stress, and measured excess pore pressure, and shear strain are presented with the number of load cycles. All stress/pressure quantities have been normalised by the initial consolidation stress level to facilitate comparison.

3. Post-cyclic Monotonic data

   Stress-strain, pore-pressure response as a function of shear strain, and the effective stress path are plotted for the post-cyclic data.

Comments

The samples provided appear to be fairly uniform across all Shelby tubes. Some organics were observed in specimen TM-12D, and we encountered some silt in TM-6A. As noted earlier, the specimen with the silt seam was not tested, and the specimen obtained just beneath was of good quality, and representative of the clay. A specimen from TM-6D was used for the initial exploratory test set up which led to the re-tweaking of the loading platens. The second specimen from TM-6D was loaded monotonically at 50 kPa, but due to issues observed with top cap seating, that test was discarded. Hence, the monotonic test at 50 kPa was conducted on a specimen from TM-6A (instead of TM-6D). Similarly the first cyclic test at CSR = 0.2 was run on TM-13B (instead of TM-13C, which was not available). All other tests were carried out on specimens prescribed by GA.

Initial water content measurements were about 51% at 6 to 7m, and around 56% at 12 to 15m depth. The initial bulk unit weight values are fairly consistent at about 16.7 kN/m^3 for the soil with high OCR at 6 to 7m depth, and about 16.2 kN/m^3 for the lightly over consolidated soil at 12-15m depth. Samples provided from Shelby tubes TM-6 and TM-7 had some surficial deposits (whitish/yellowish residue), but the specimens from 12 to 15 m were fairly clean.

Closure

Test results presented herein represent the response of the tested specimens at the given initial conditions under simple shear loading mode. Soil response is known to be dependent on the loading mode, and initial stress conditions among other parameters. In addition, the natural variability in-situ between boreholes and within a borehole, and possible effects of sampling disturbances should be taken into appropriate consideration prior to interpreting these test results for field application.

References

Bjerrum, L. and Landva, A. 1966. *Direct simple-shear tests on a Norwegian quick clay*, Geotechnique, 16(1): 1-20.

Dyvik, R., Berre, T., Lacasse, S., and Raadim, B. 1987. *Comparison of truly undrained and constant volume direct simple shear tests*, Geotechnique, 37(1): 3-10.

Finn, W.D.L., Vaid, Y.P., and Bhatia, S. K. 1978. *Constant Volume Cyclic Simple Shear Testing,* Proceedings of the Second International Conference on Microzonation for Safer Construction: Research & Applications, San Francisco, California, November 26 - December 1, 1978. Vol. 2, pp: 839-851.

List of symbols

CSR	Cyclic Stress Ratio
w_i	Initial water content of the specimen
σ'_{vc}	Vertical effective consolidation stress
$N_{\gamma \geq 3.75\%}$	Number of cycles required to exceed 3.75 % shear strain
γ_{max}	Maximum shear strain during cyclic loading
S_{peak}	Maximum shear strength in post cyclic loading
S_r	Residual Shear strength (at the end of monotonic loading)
$\gamma_{at}S_{peak}$	Shear strain at corresponding to the peak strength in post cyclic loading

Table 1: Monotonic Tests

Test ID	Specimen ID	W_i (%)	Consolidation		Monotonic Test				Test Results in pages
			σ'_{vc} (kPa)	ε_{vc} (%)	S_{peak}	γ at S_{peak} (%)	S_{peak}/σ'_{vc}	S_r	
SS02	TM-6A-2	51.8	50	0.26	50.6	3.7	1.02	34.8	A1.2 - A1.3
SS04	TM-12D-1	55.2	110	0.7*	51.8	3.8	0.47	37.4	A1.7 - A1.8

* Approximate Estimate.

Table 2: Cyclic Tests

Test ID	Specimen ID	W_i (%)	Consolidation		Cyclic Test			Post-cyclic			Test Results in pages
			σ'_{vc} (kPa)	ε_{vc} (%)	CSR	$N_{\gamma\geq5\%}$	γ_{max} (%)	S_{peak}	S_{peak}/σ'_{vc}	S_r	
SS03	TM-7C-1	51.1	60	0.33	0.20	10	0.3	67.9	1.12	44.9	A1.4-A1.6
SS08	TM-7D-1	50.8		0.35	0.40	10	0.6	57.0	0.97	39.0	A1.9-A1.11
SS09	TM-7D-2	50.5		0.35*	0.66	10	1.4	54.3	0.91	38.7	A1.12-A1.14
SS05	TM-13B-2	57.4	125	0.9*	0.20	10	0.6	58.0	0.46	39.9	A1.15-A1.17
SS06	TM-13D-1	54.5		1.4*	0.40	10	1.9	50.0	0.40	35.4	A1.18-A1.20
SS07	TM-13D-2	56.1		1.5*	0.47	9	8.4	40.7	0.33	36.0	A1.21-A1.23

* Approximate Estimate.

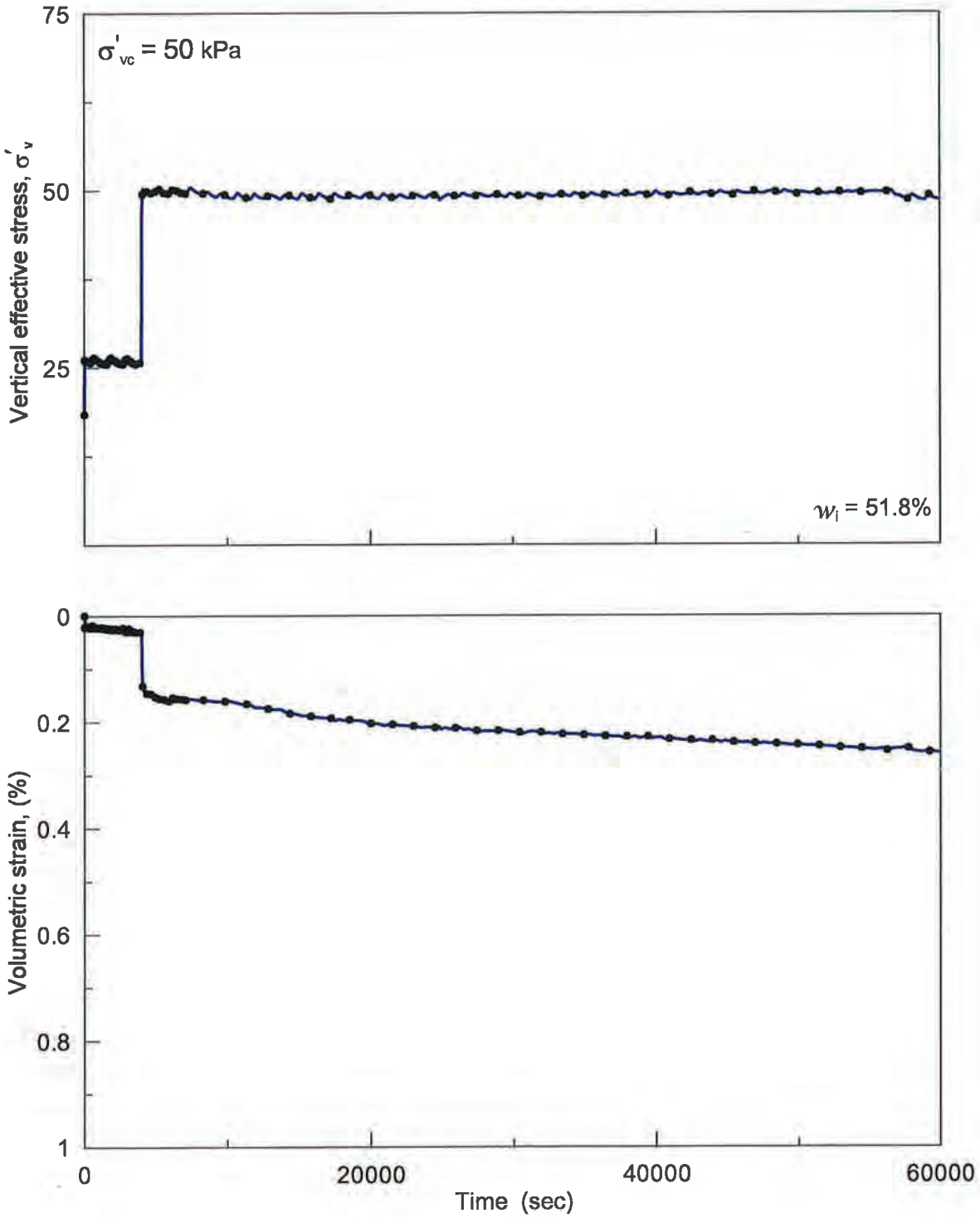
Appendix I

Test Results

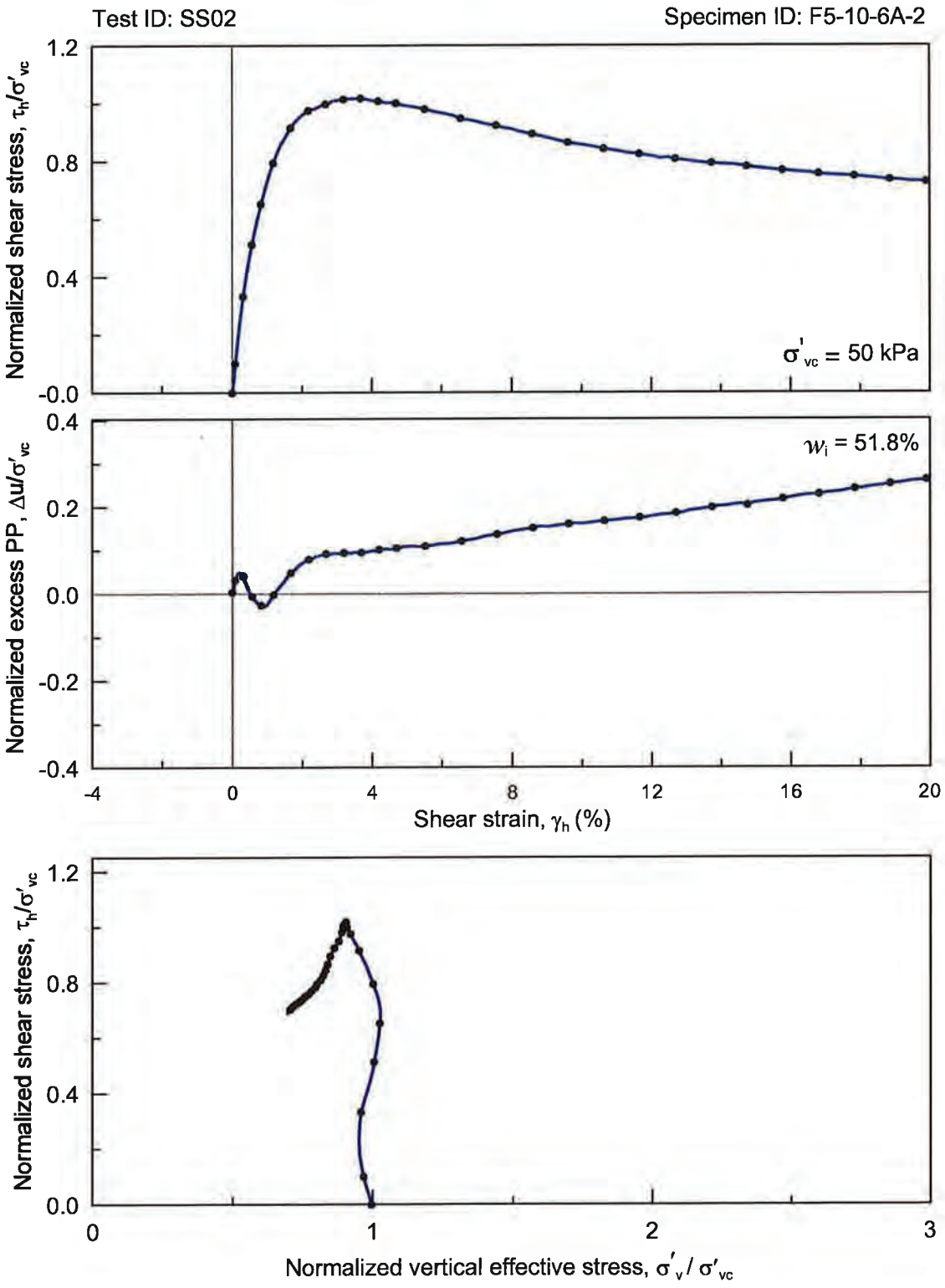
(K_o) Consolidation in Simple Shear

Test ID: SS02

Specimen ID: F5-10-6A-2



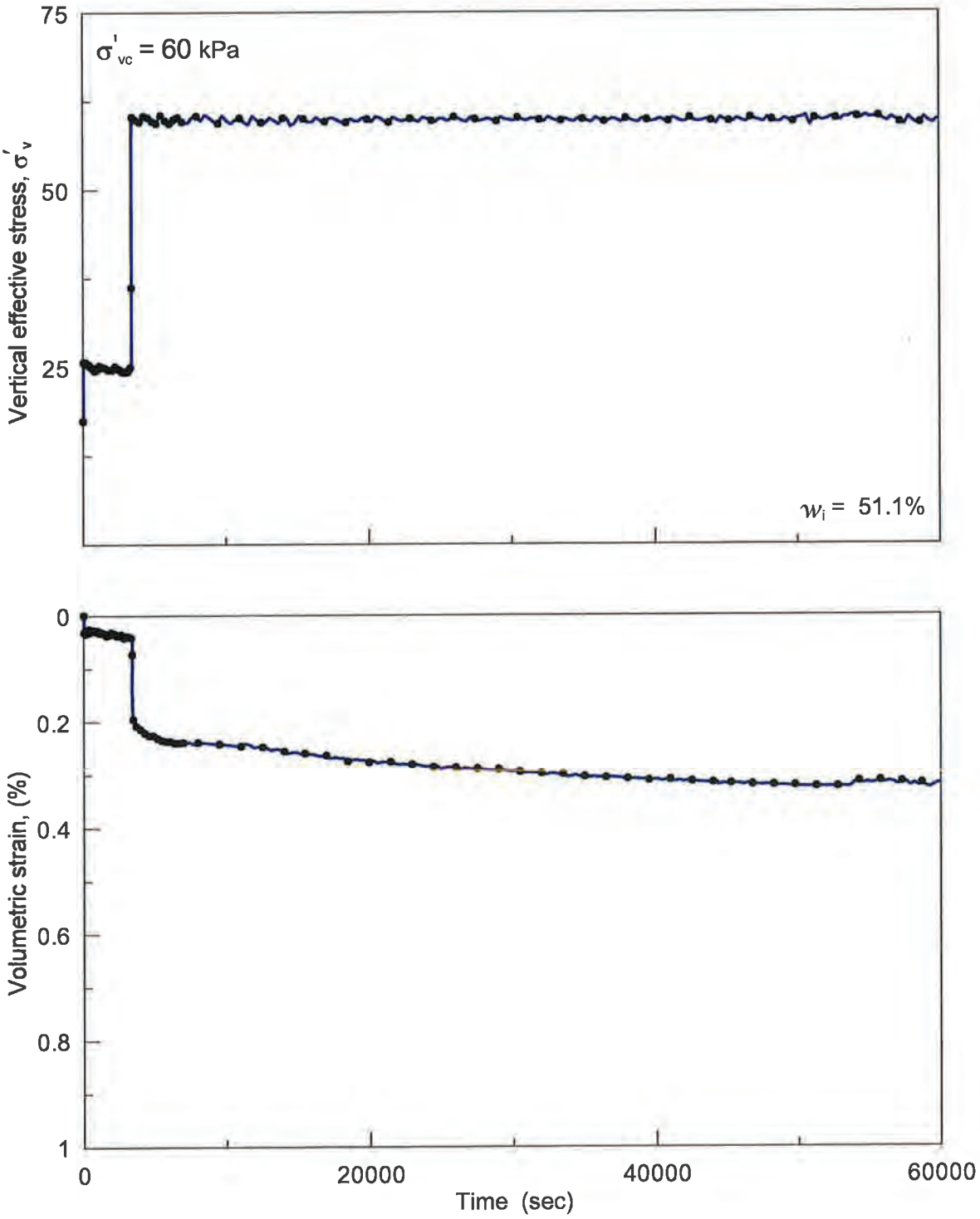
Monotonic Simple Shear



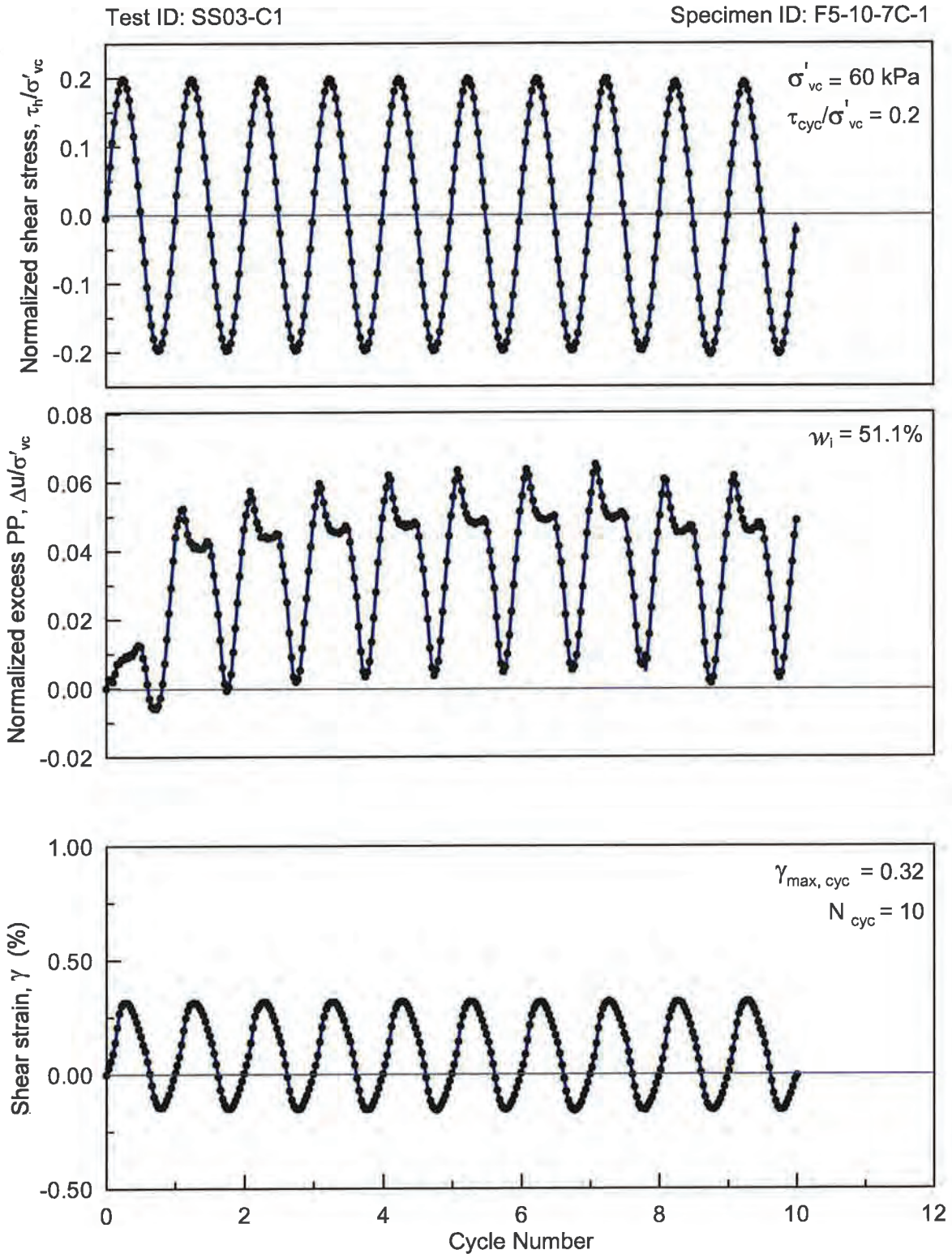
(K_o) Consolidation in Simple Shear

Test ID: SS03-C1

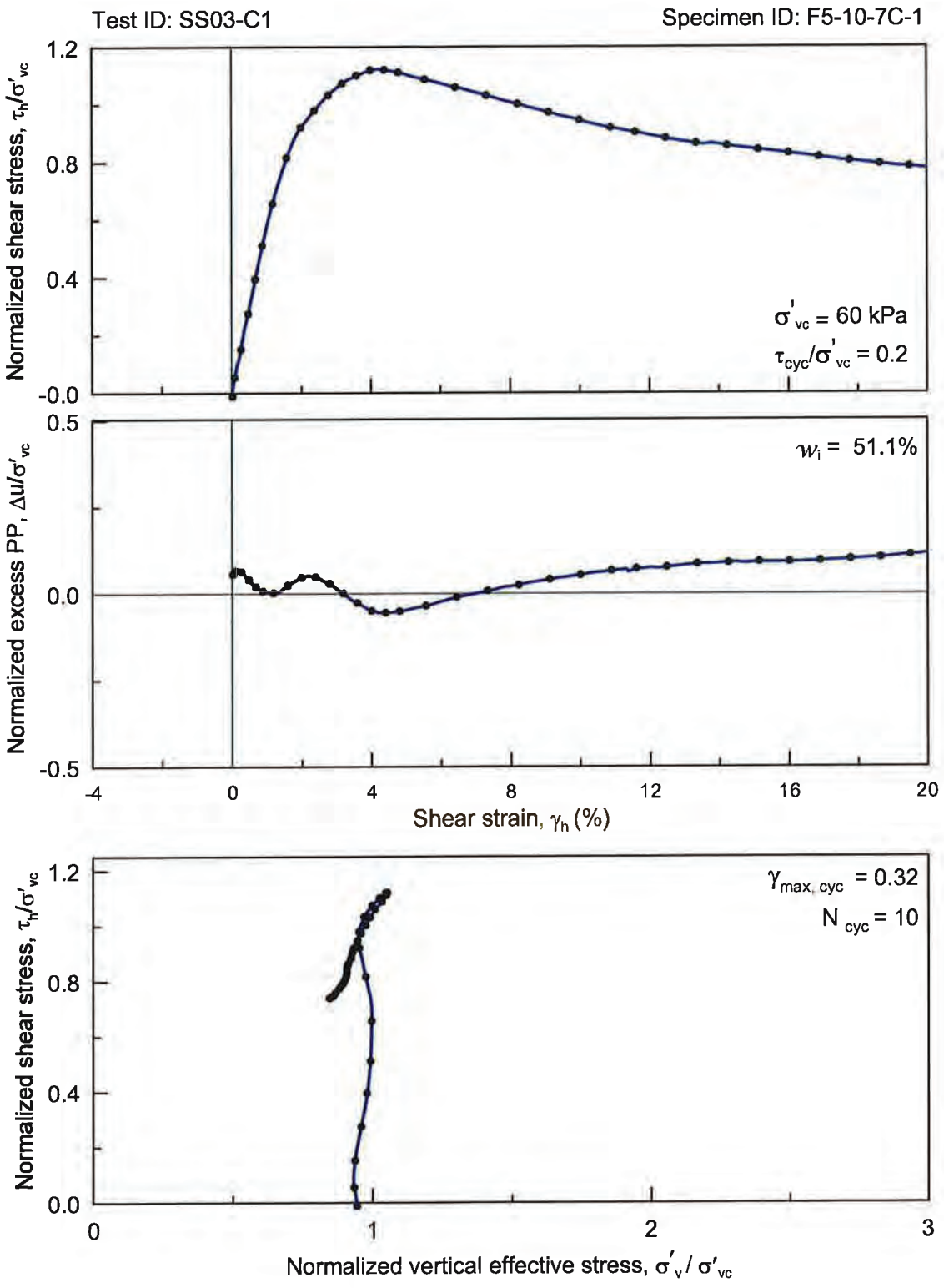
Specimen ID: F5-10-7C-1



Constant Volume Cyclic Simple Shear



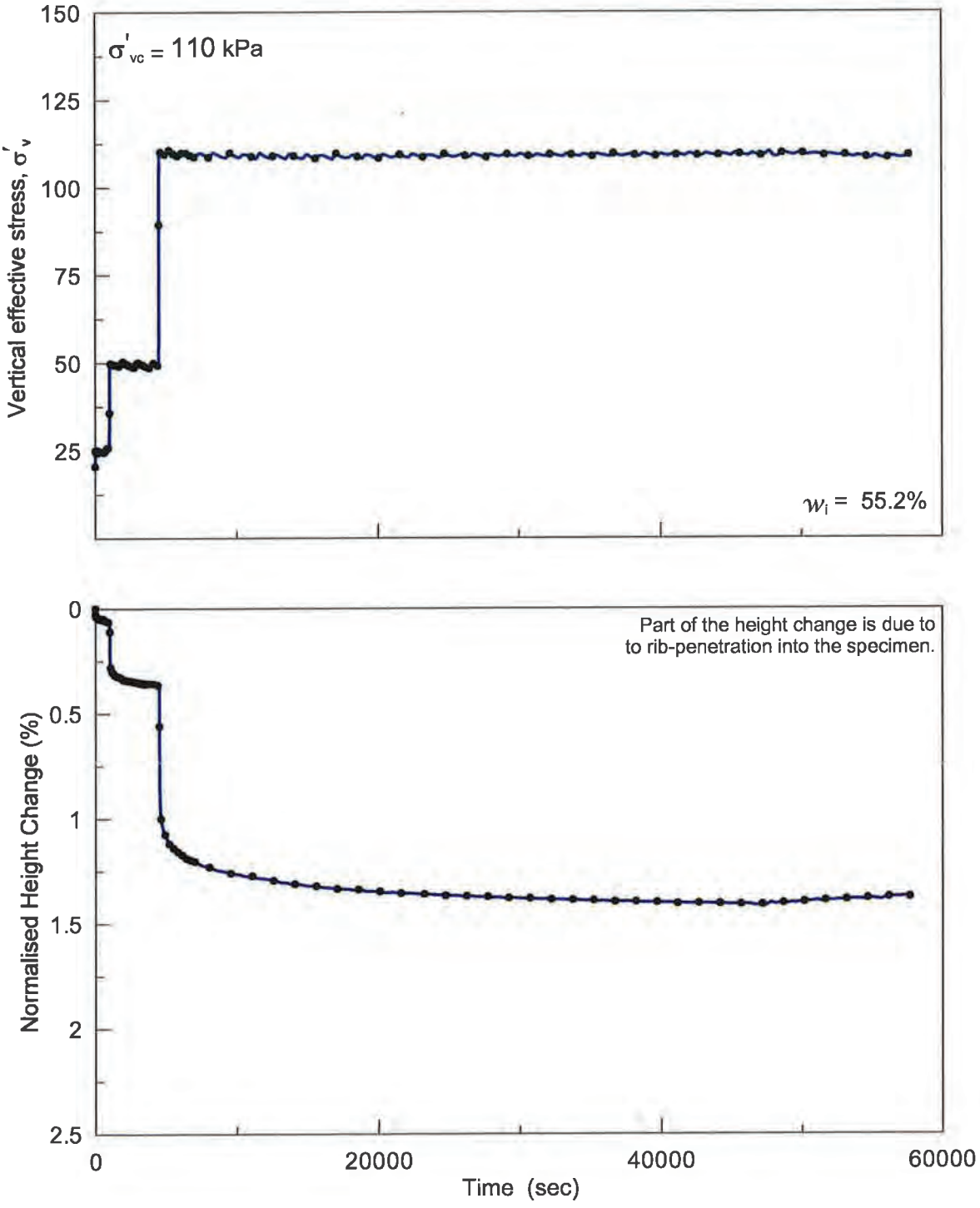
Post-cyclic Monotonic Simple Shear



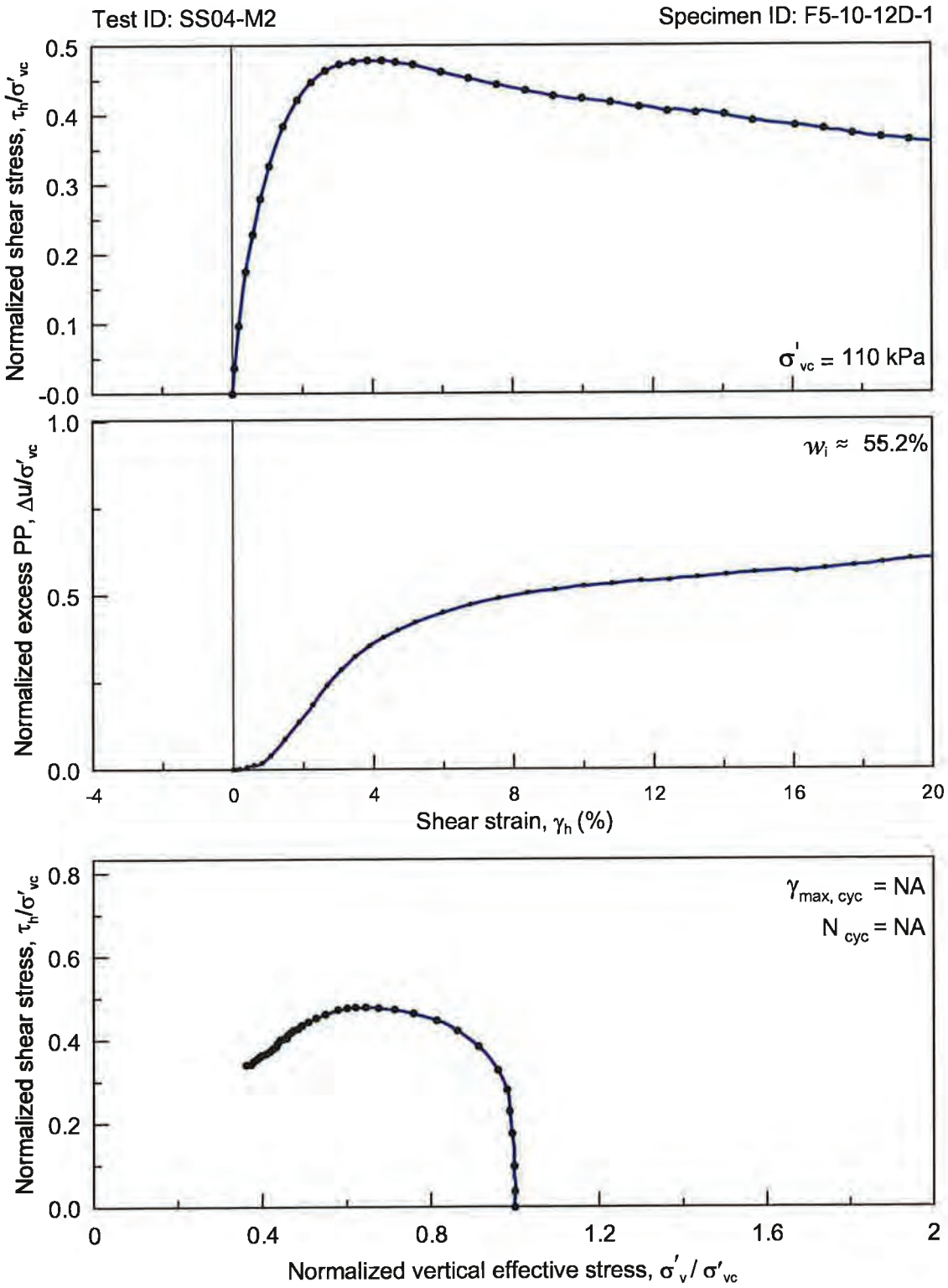
(K_o) Consolidation in Simple Shear

Test ID: SS04-M2

Specimen ID: F5-10-12D-1



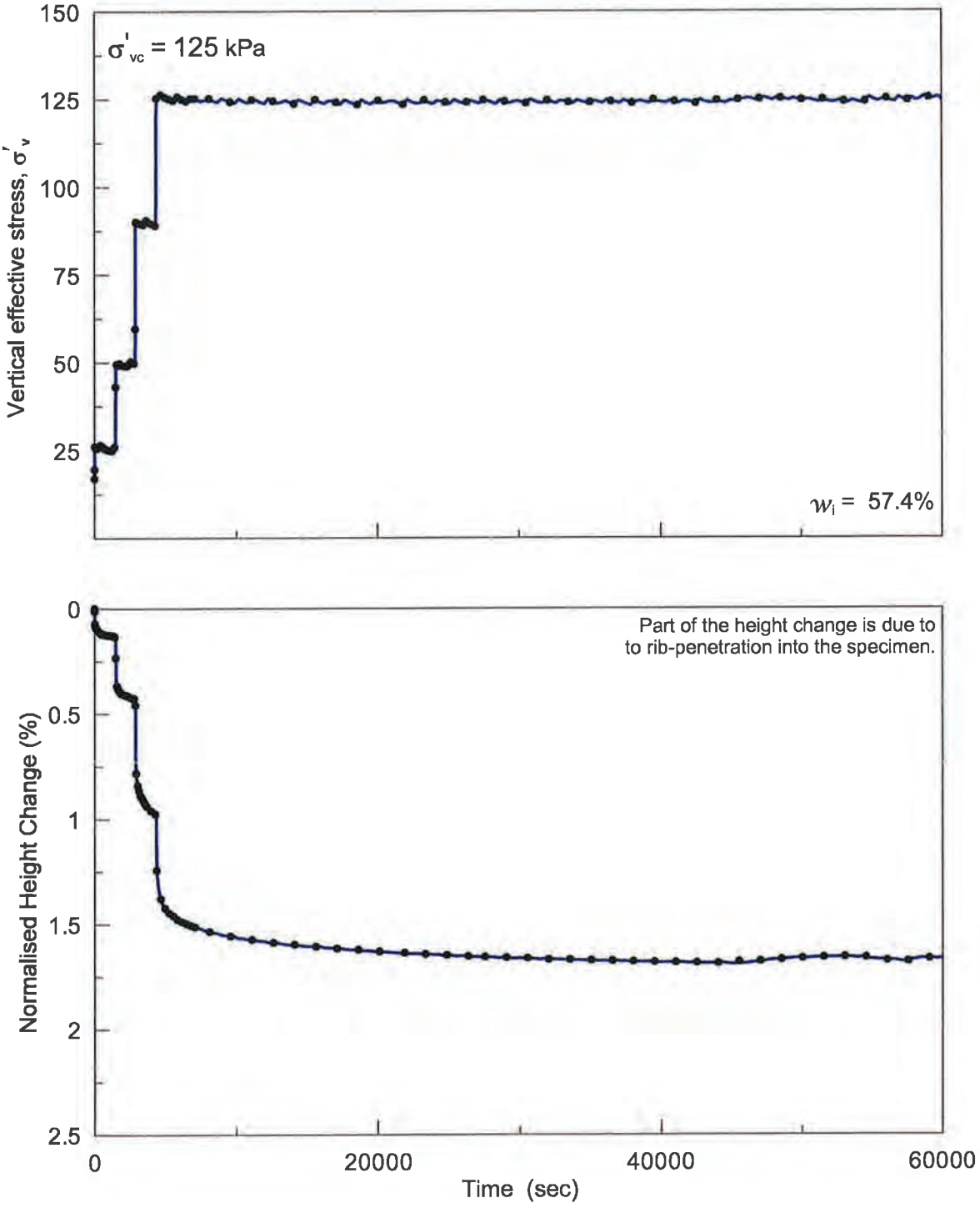
Monotonic Simple Shear



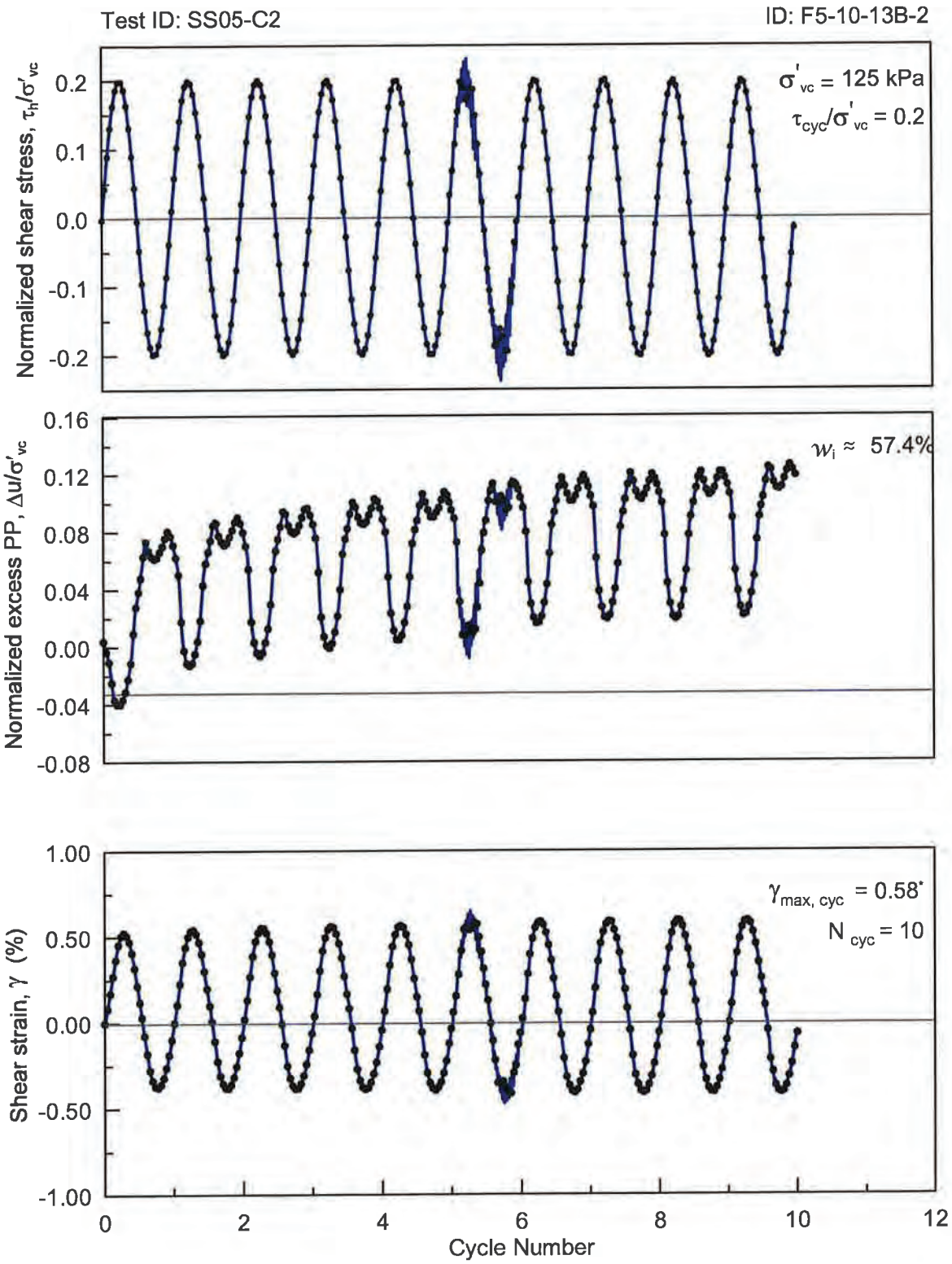
(K_o) Consolidation in Simple Shear

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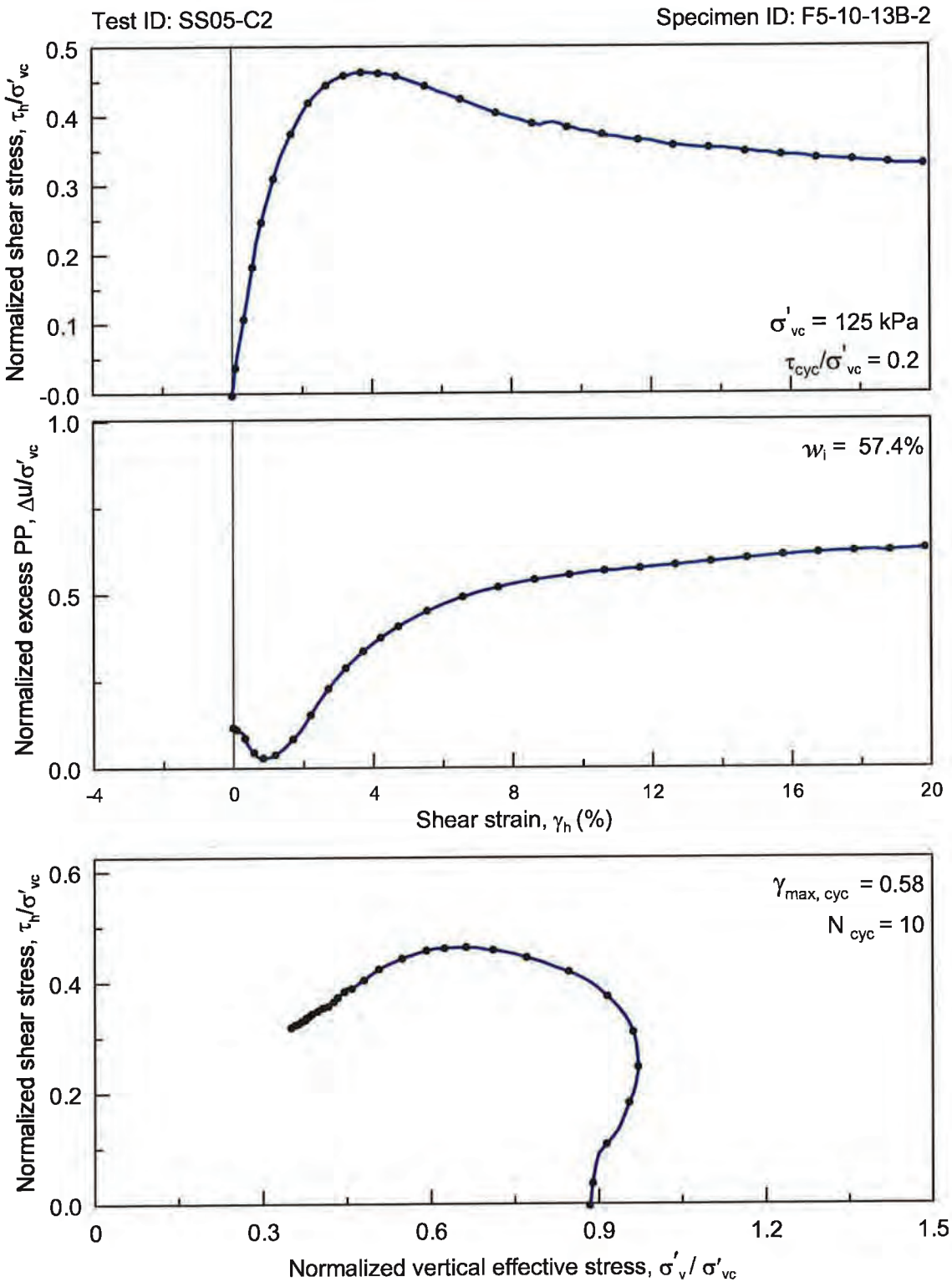
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Constant Volume Cyclic Simple Shear



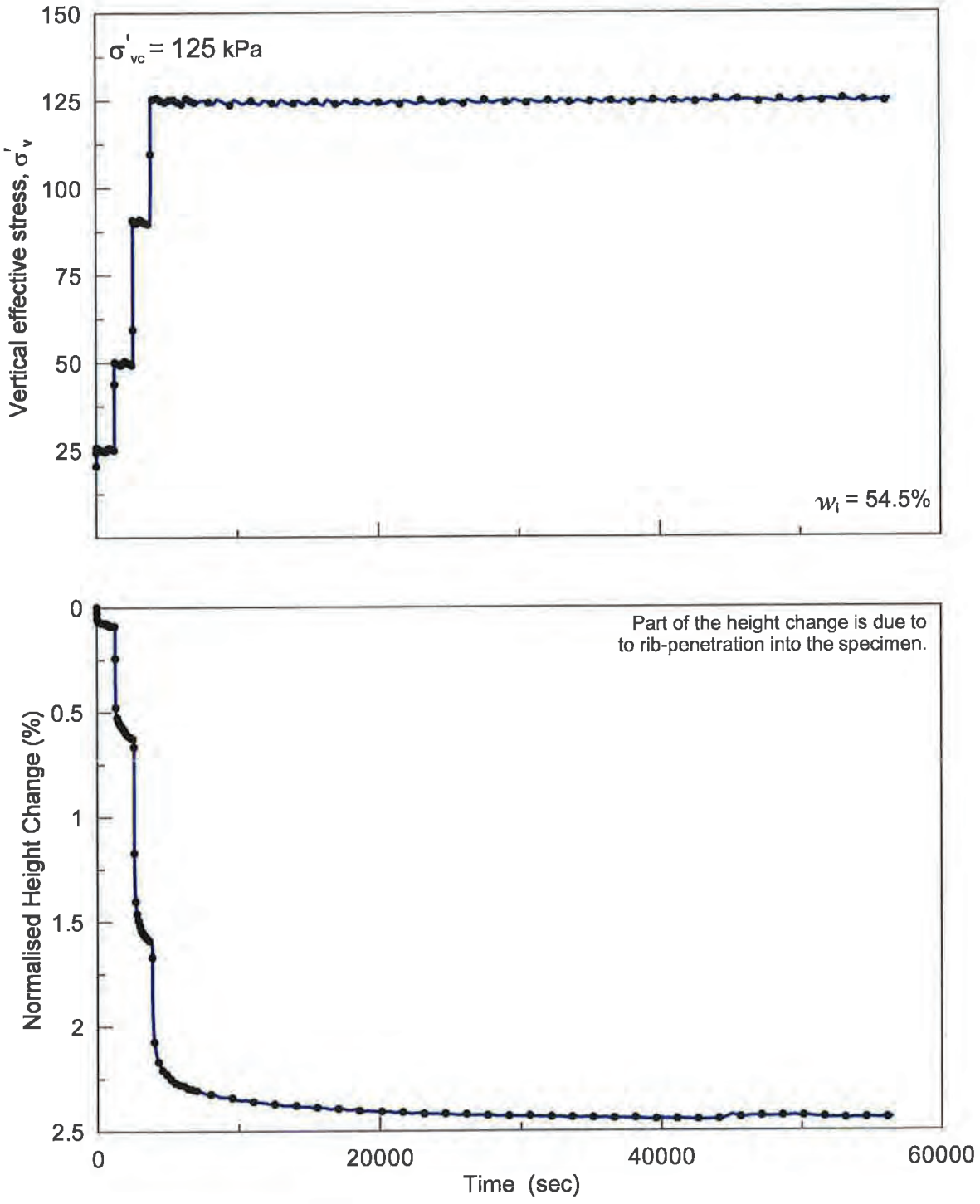
Post-cyclic Monotonic Simple Shear



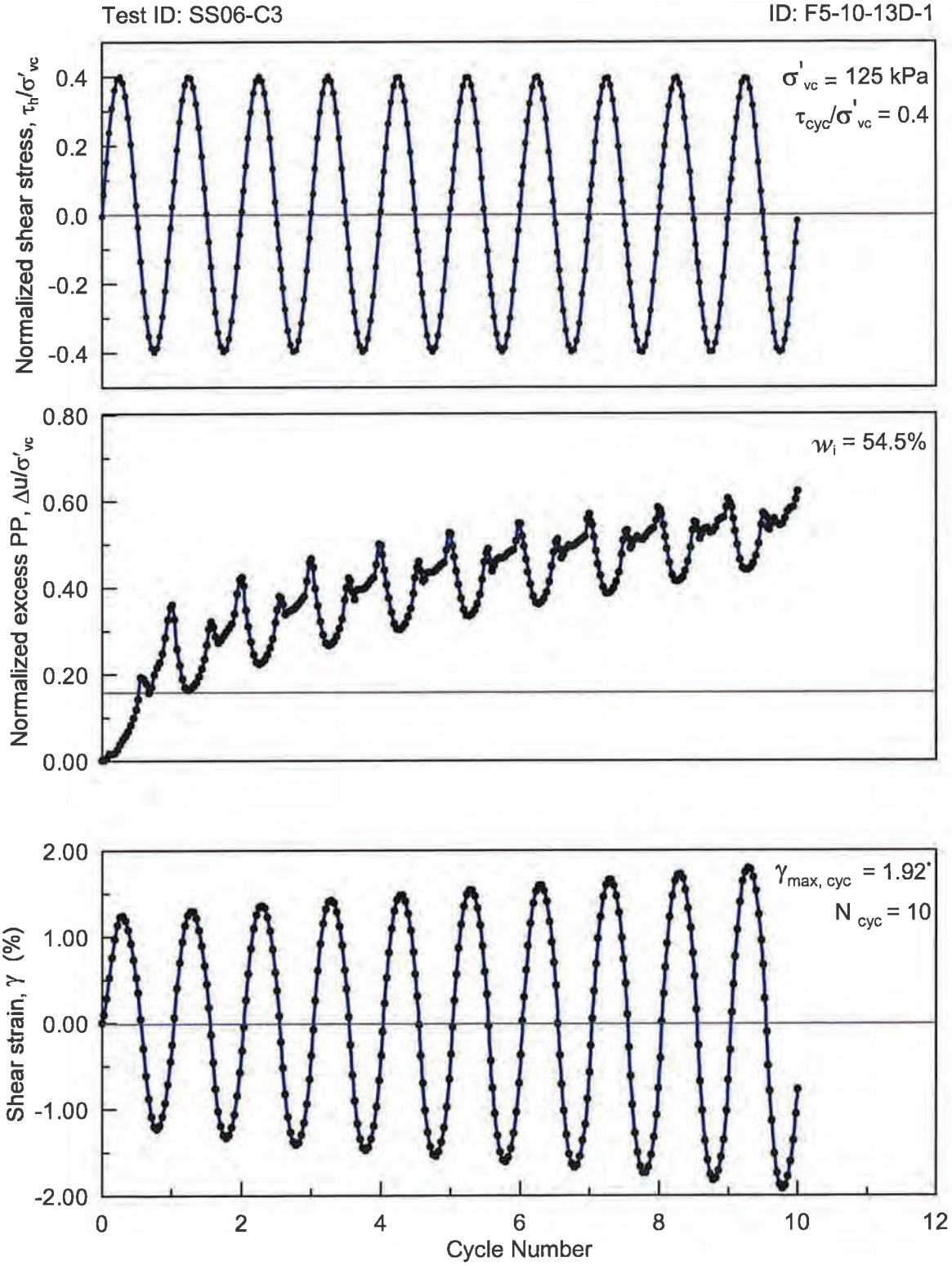
(K_o) Consolidation in Simple Shear

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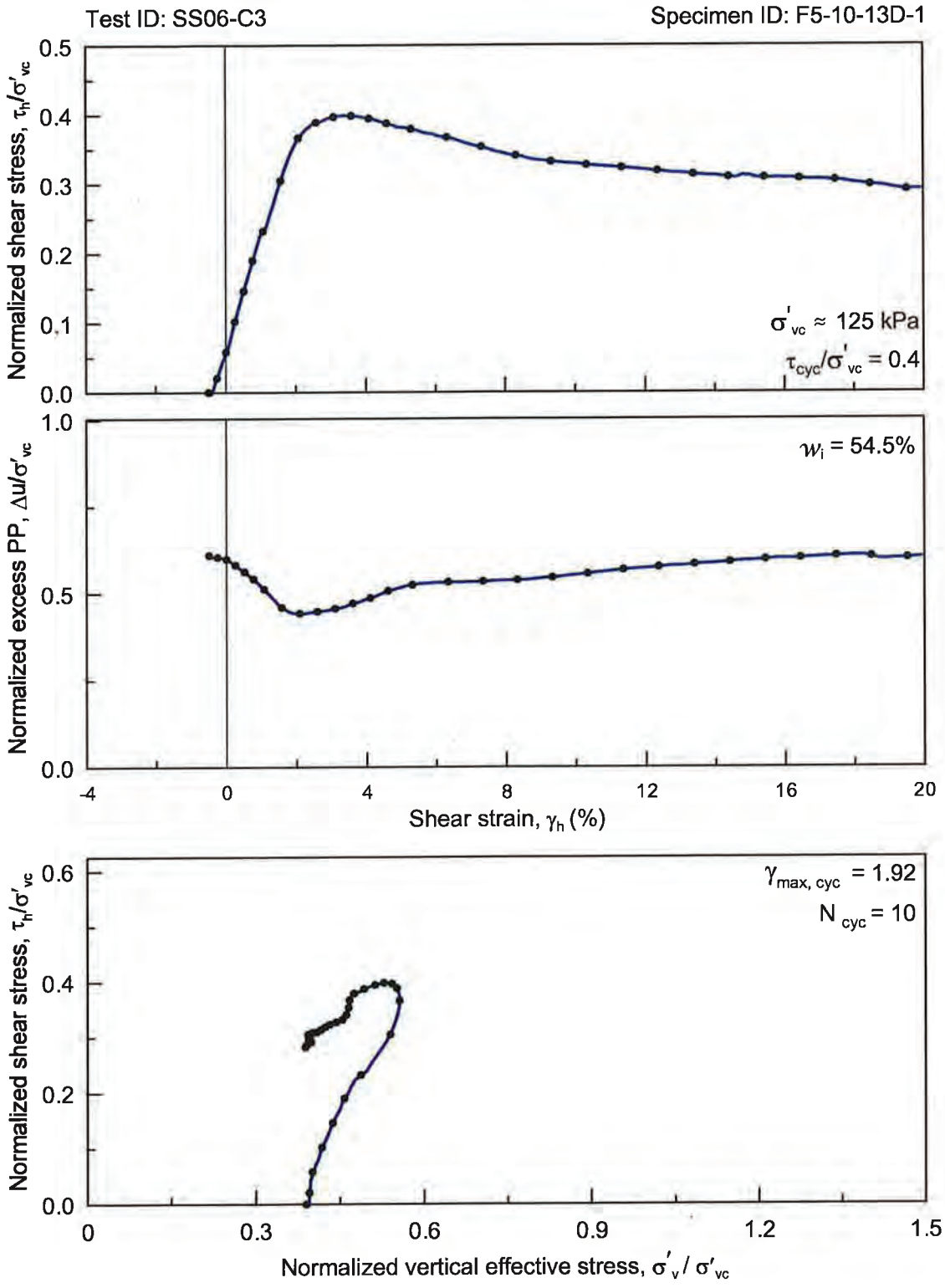
Specimen ID: F5-10-13D-1



Constant Volume Cyclic Simple Shear



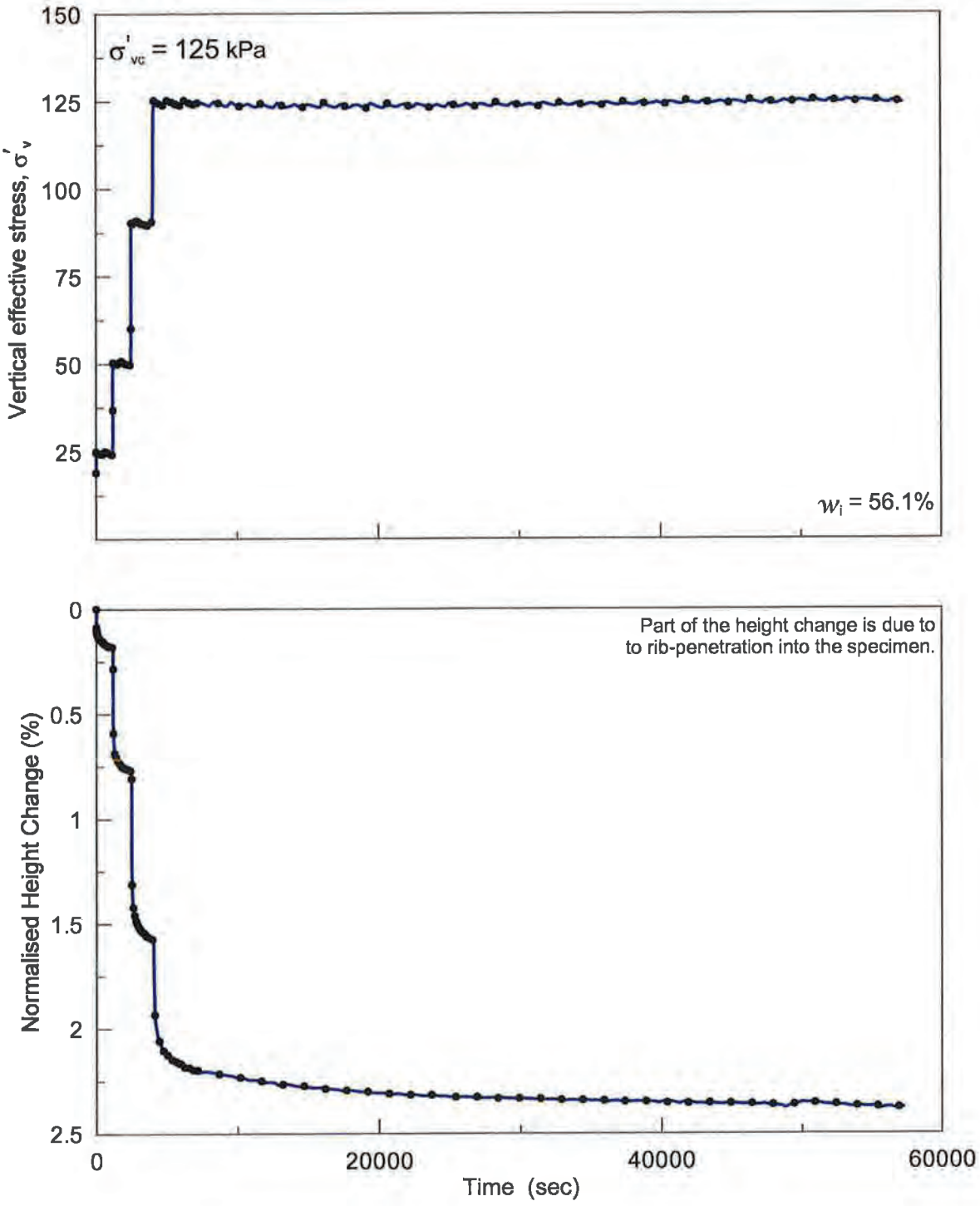
Post-cyclic Monotonic Simple Shear



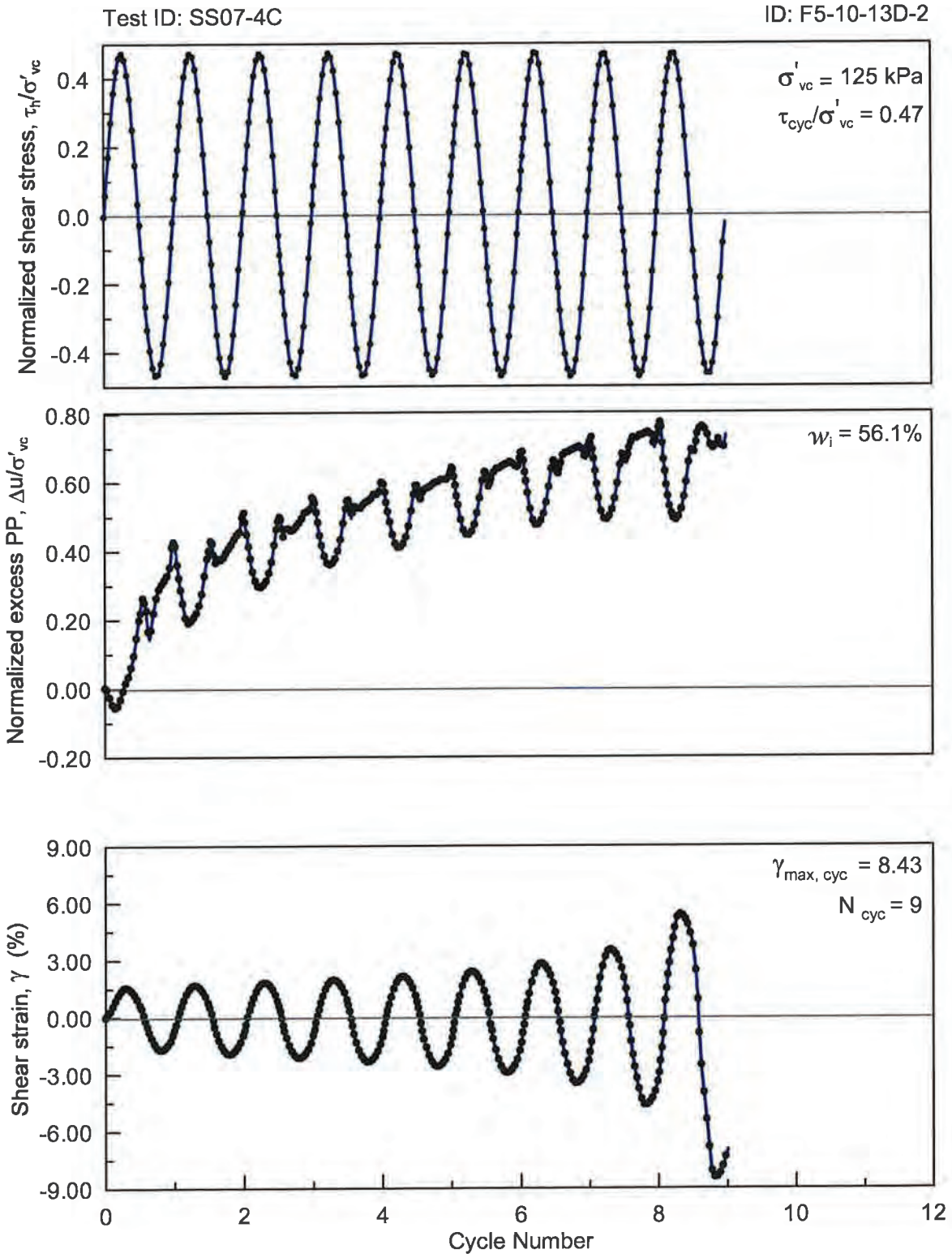
(K_o) Consolidation in Simple Shear

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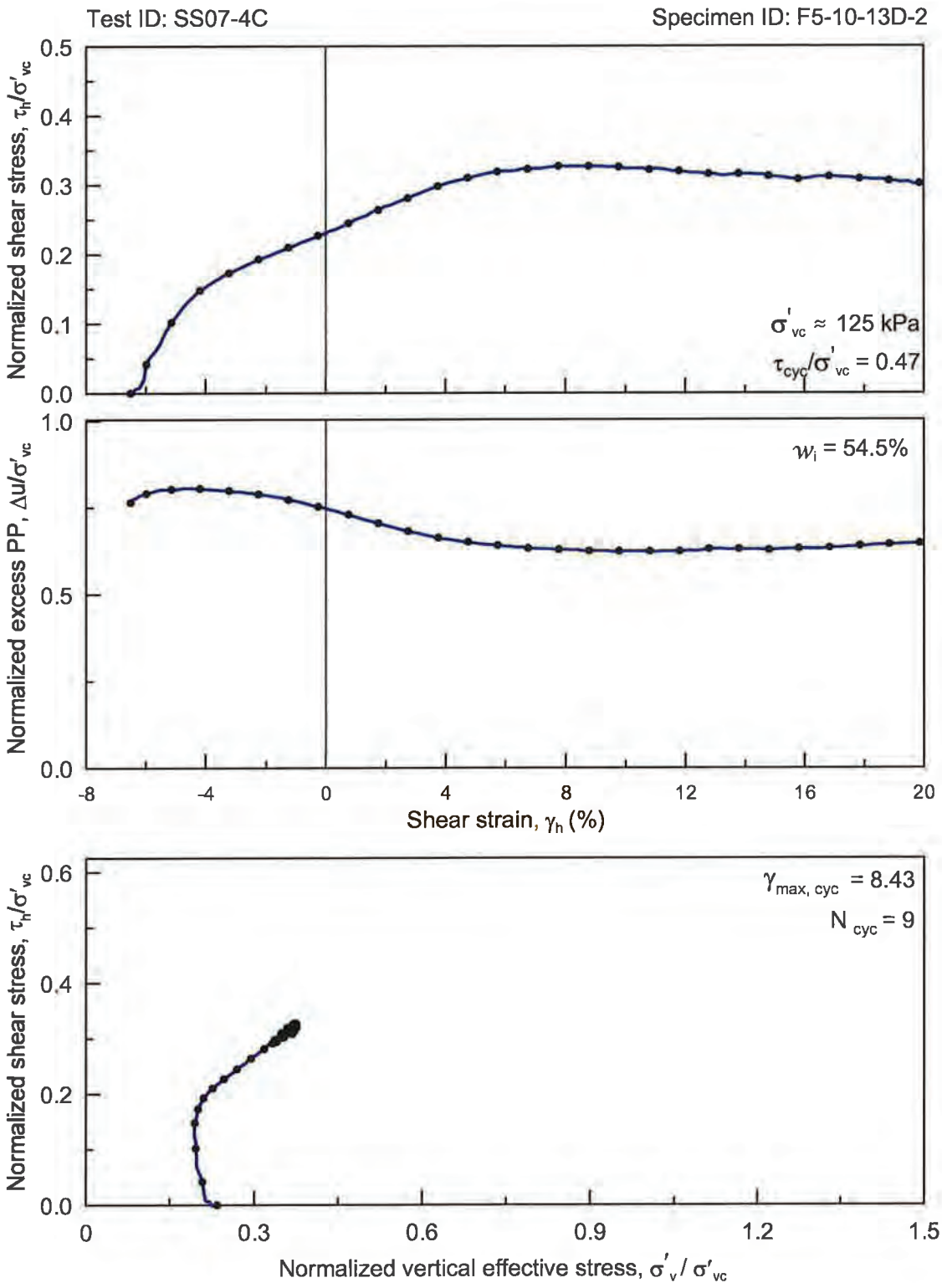
Specimen ID: F5-10-13D-2



Constant Volume Cyclic Simple Shear

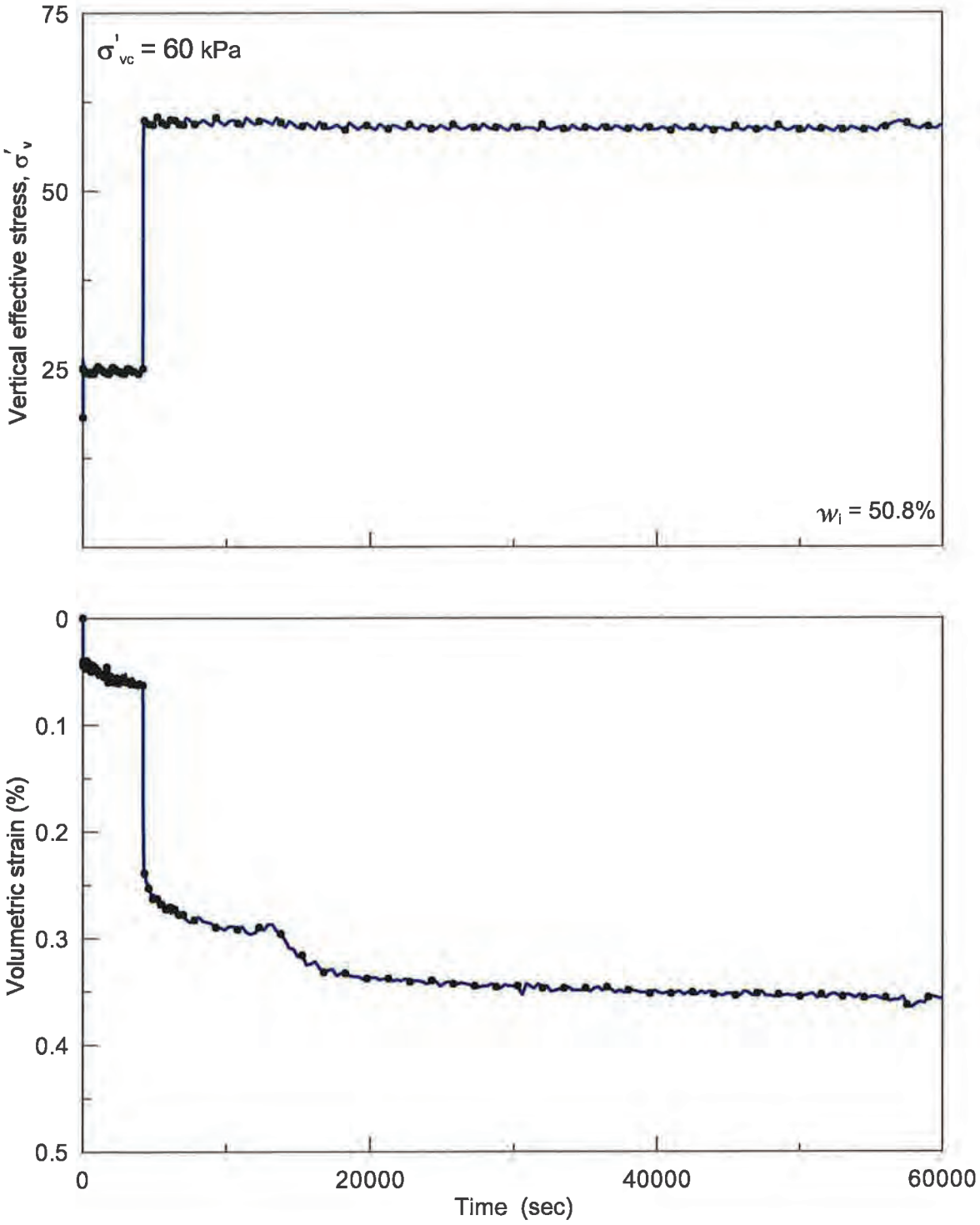


Post-cyclic Monotonic Simple Shear

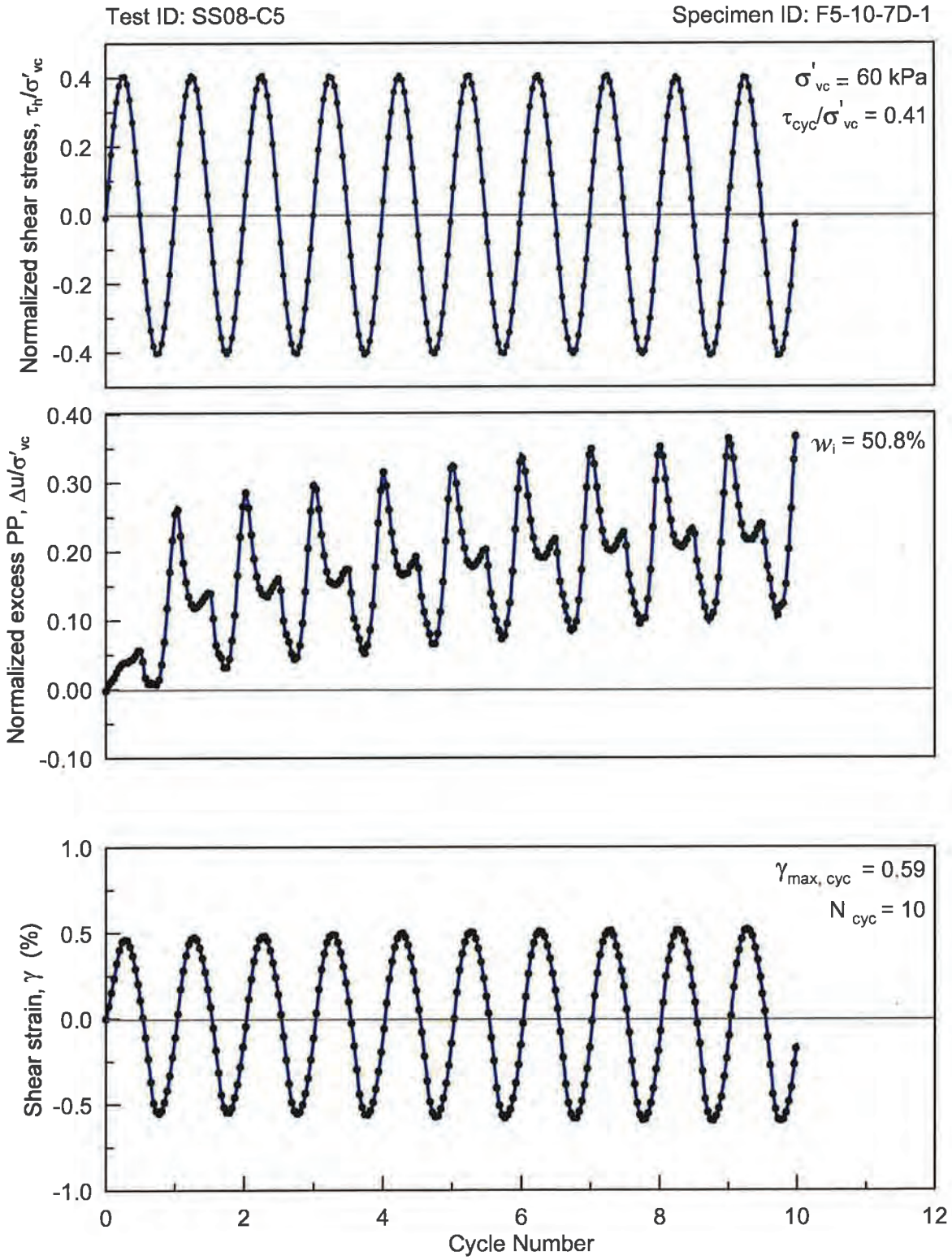


(K_o) Consolidation in Simple Shear

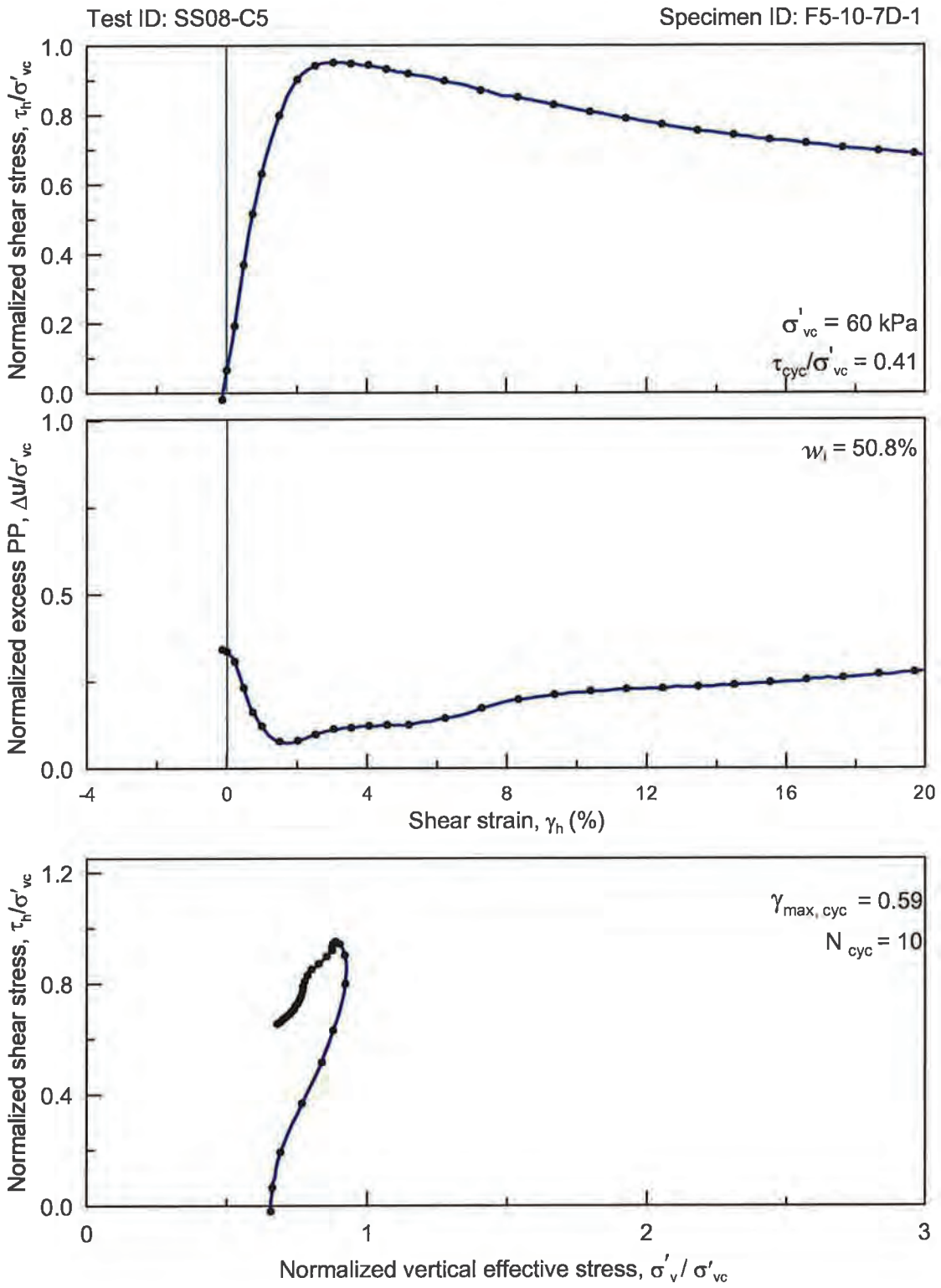
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Constant Volume Cyclic Simple Shear

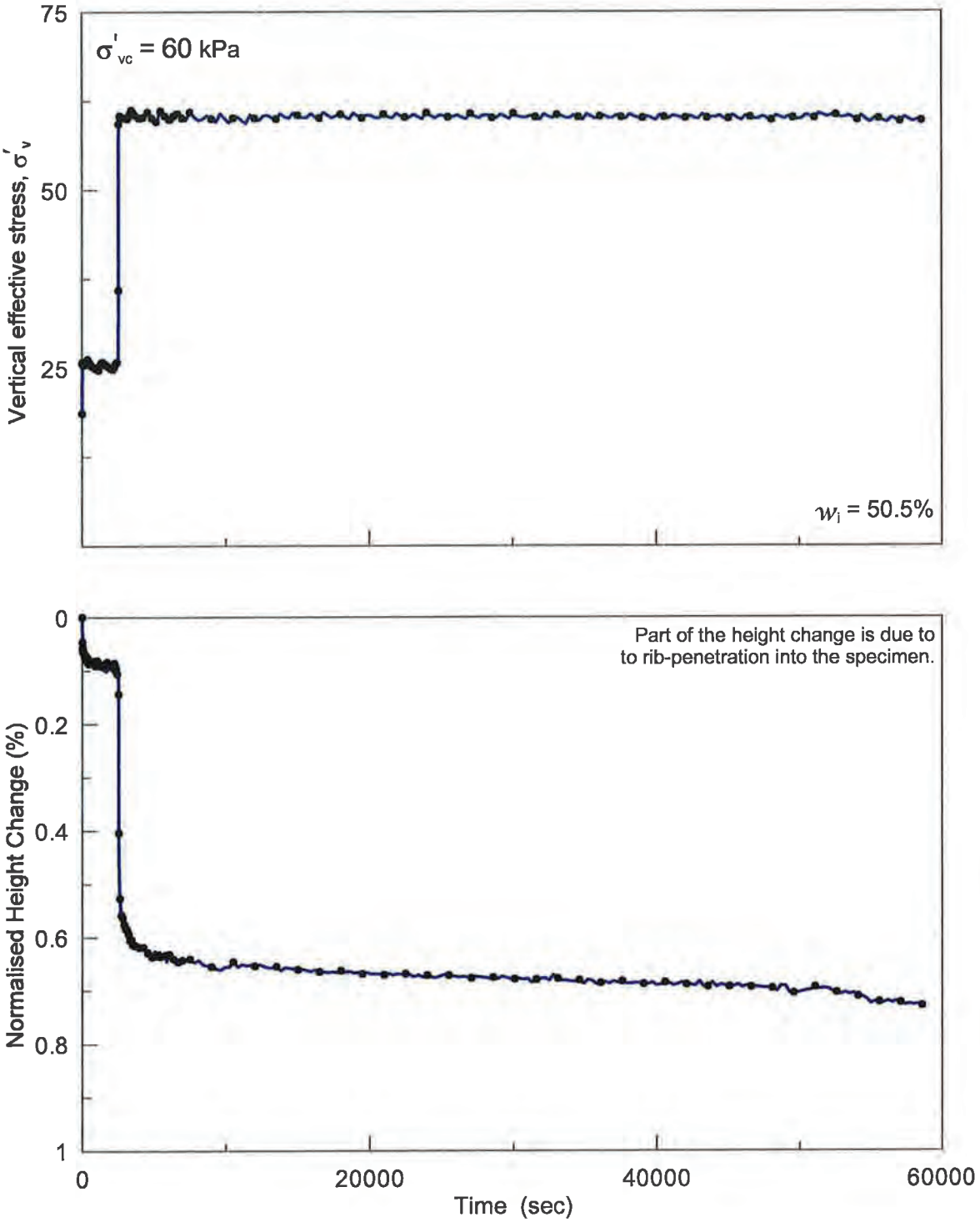


Post-cyclic Monotonic Simple Shear

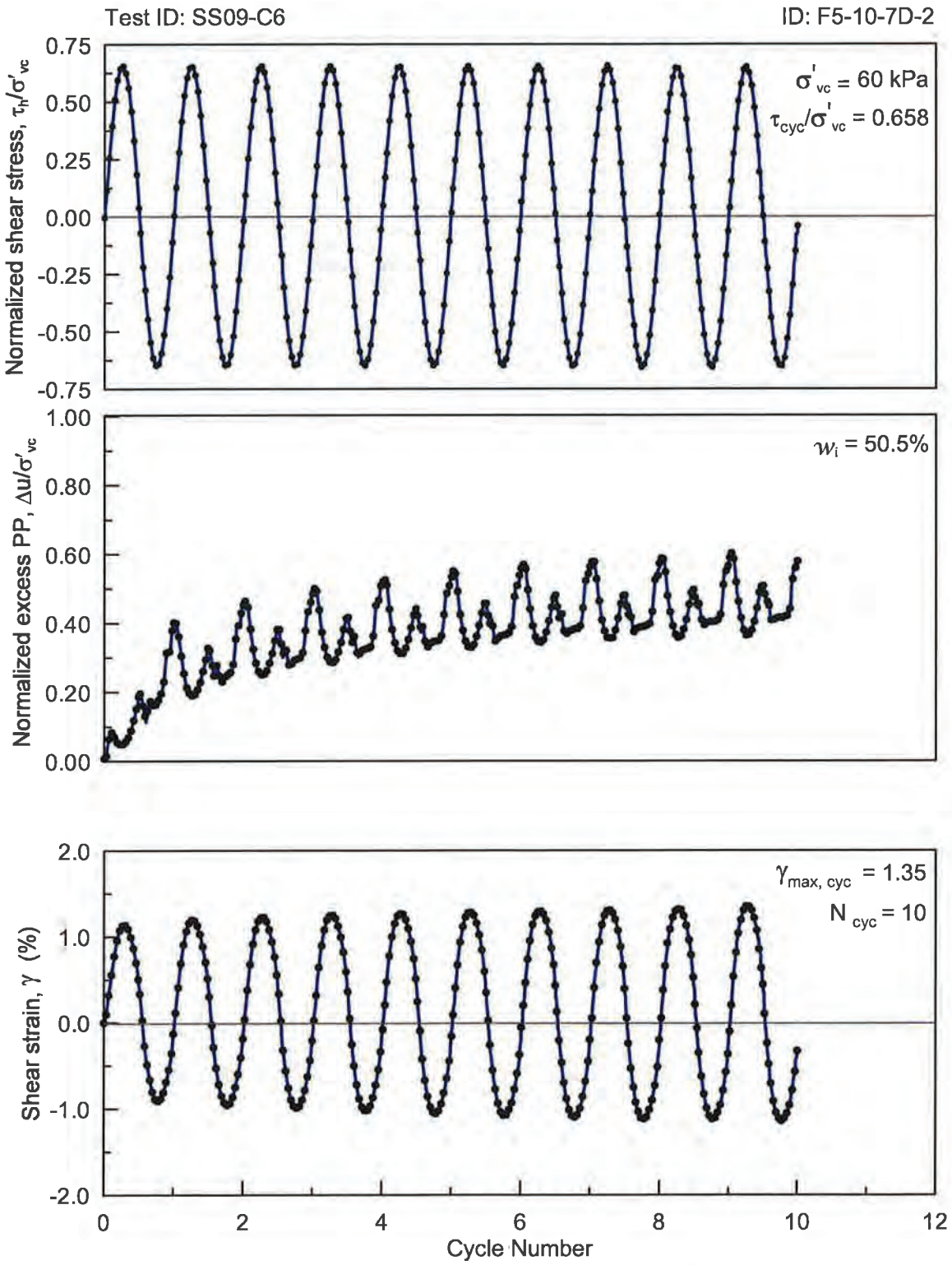


(K_o) Consolidation in Simple Shear

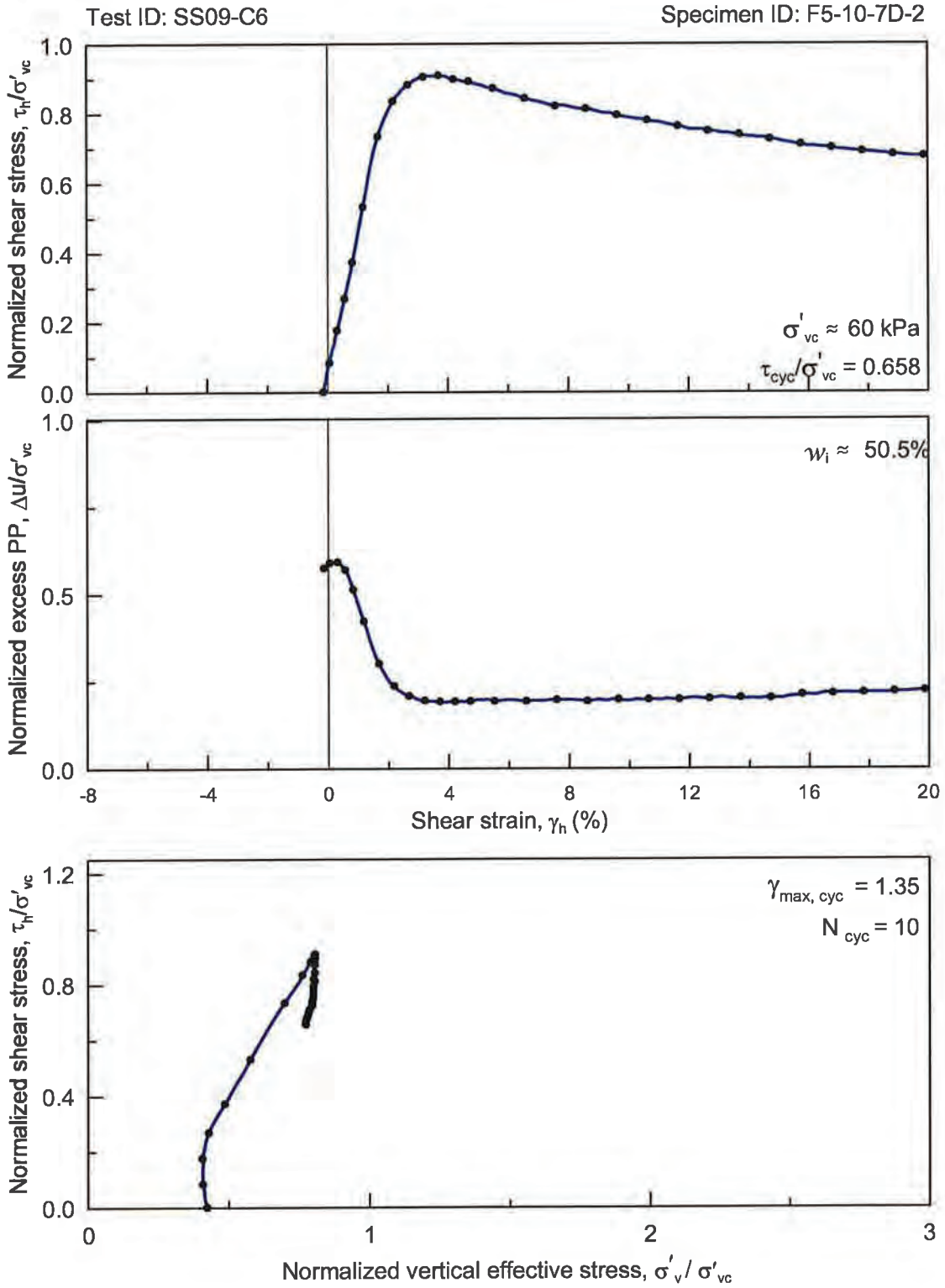
Test ID: SS09-C6 Specimen ID: F5-10-7D-2



Constant Volume Cyclic Simple Shear



Post-cyclic Monotonic Simple Shear



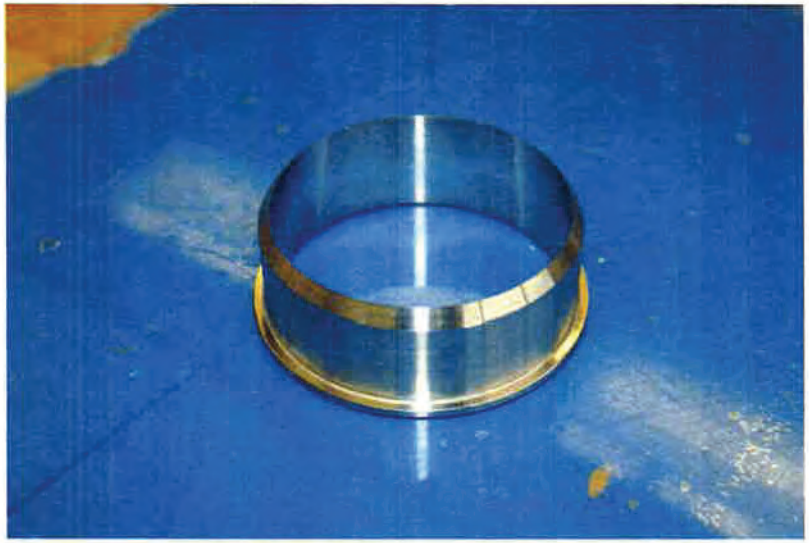
Appendix II: Photographic Record

Specimen Preparation, Testing Process & Samples

CU simple shear device



Specimen cutting ring



Specimen Cavity



A1.3

A2.3

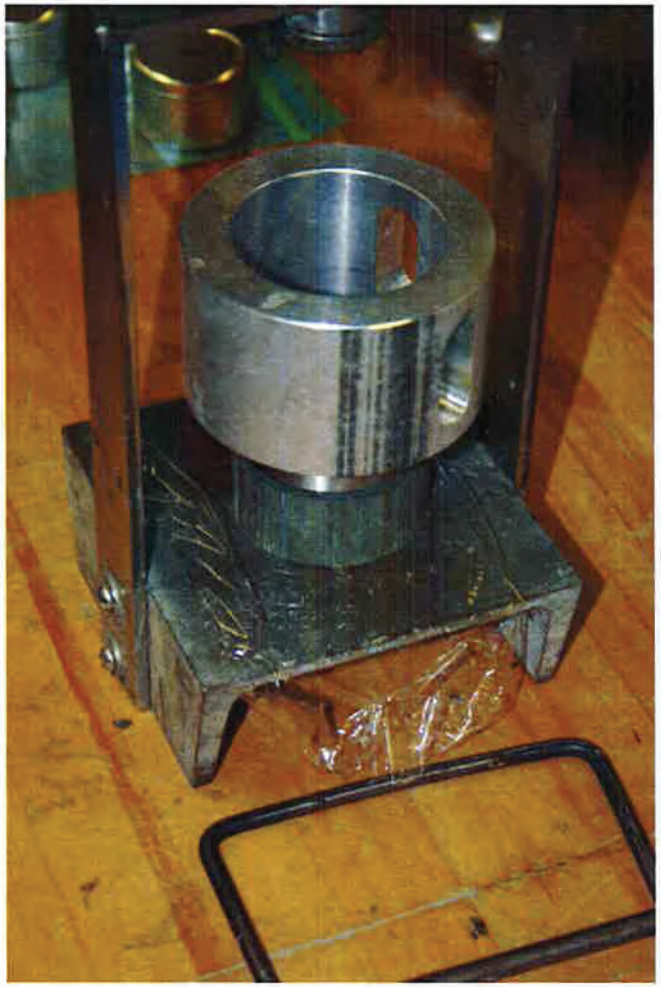
Specimen Trimming



Specimen Trimming



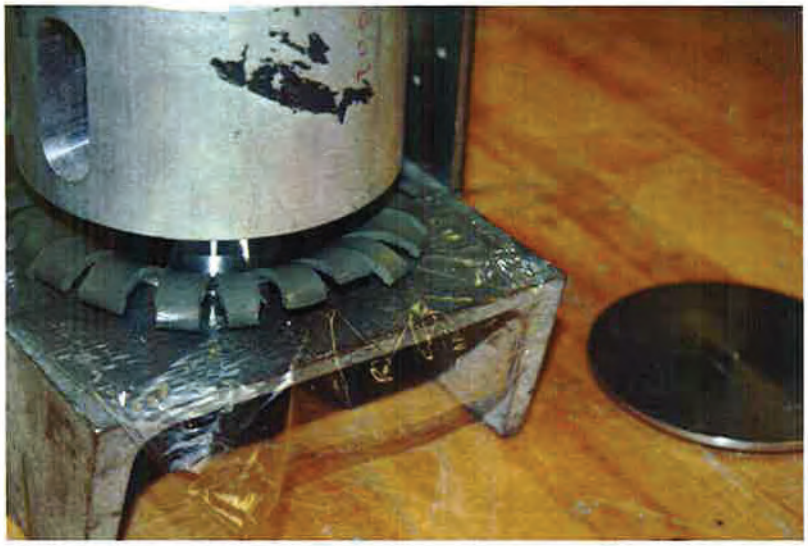
Specimen Trimming



Specimen Trimming



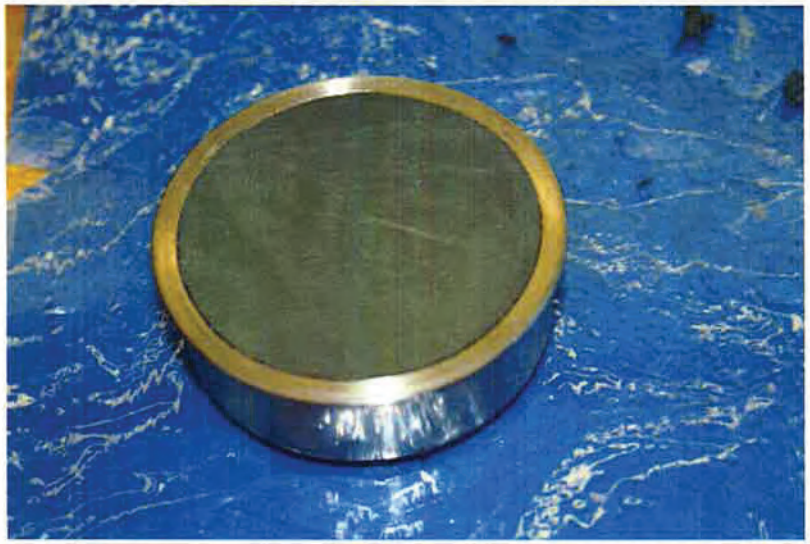
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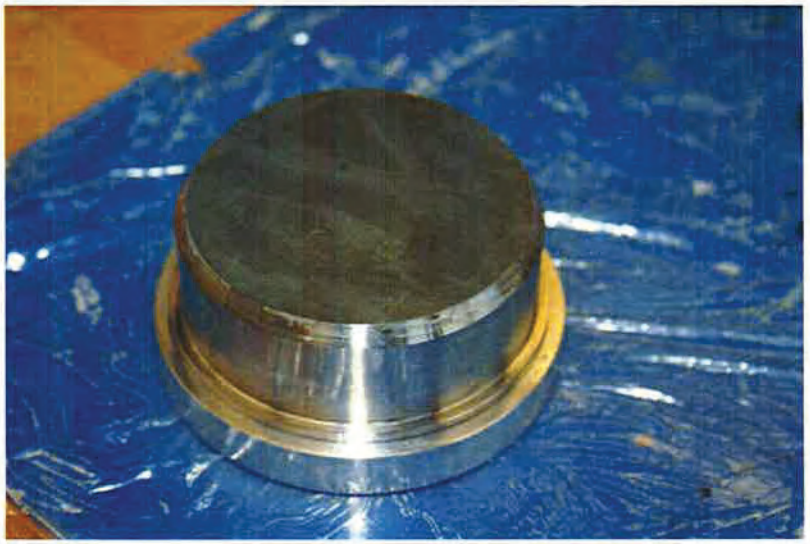
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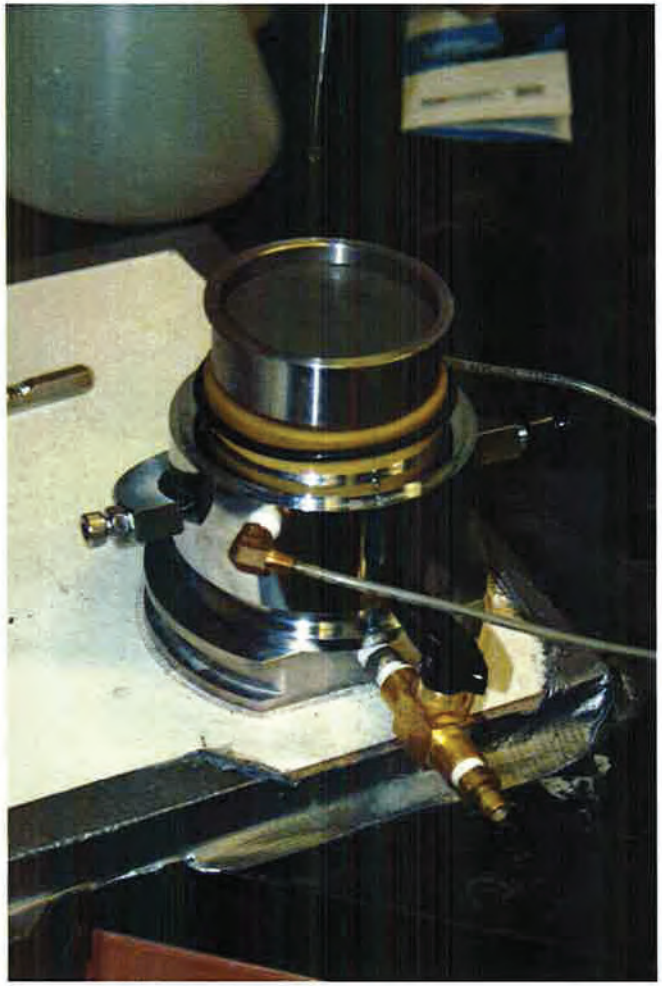
Specimen top trimmed



Both sides trimmed



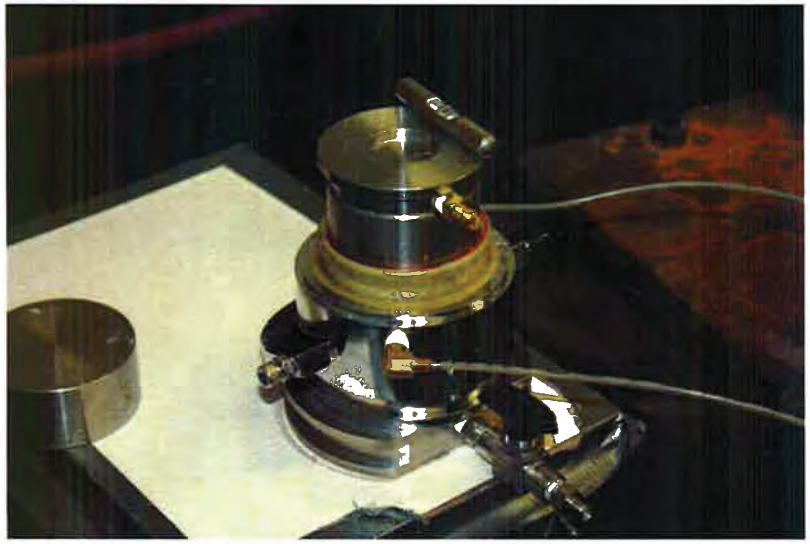
Specimen transfer to cavity



Specimen transfer to cavity



Top cap placed



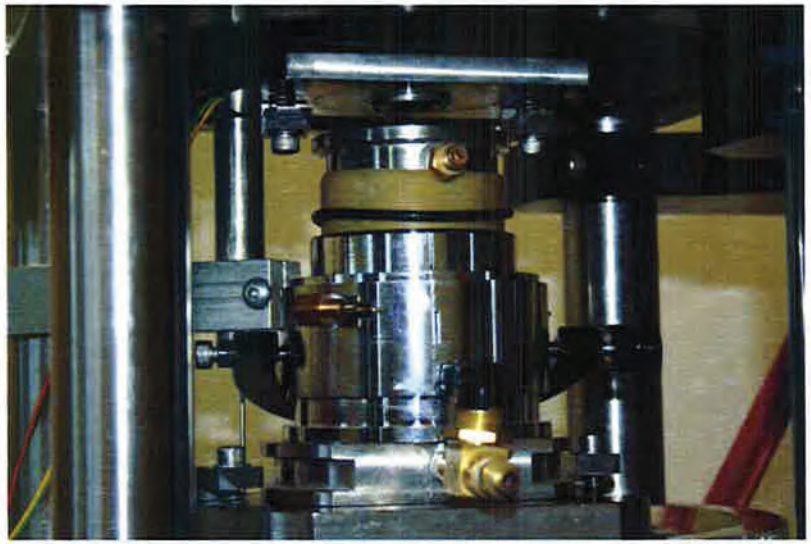
Initial Height Recorded



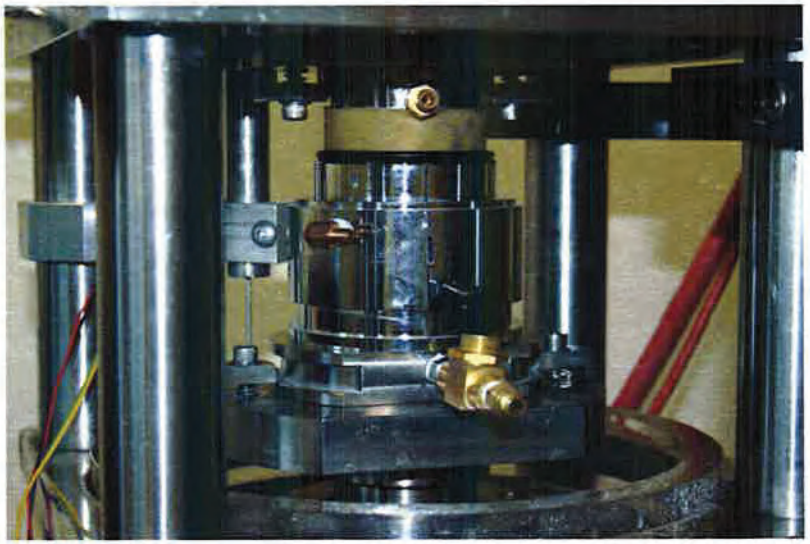
A1.9

A2.9

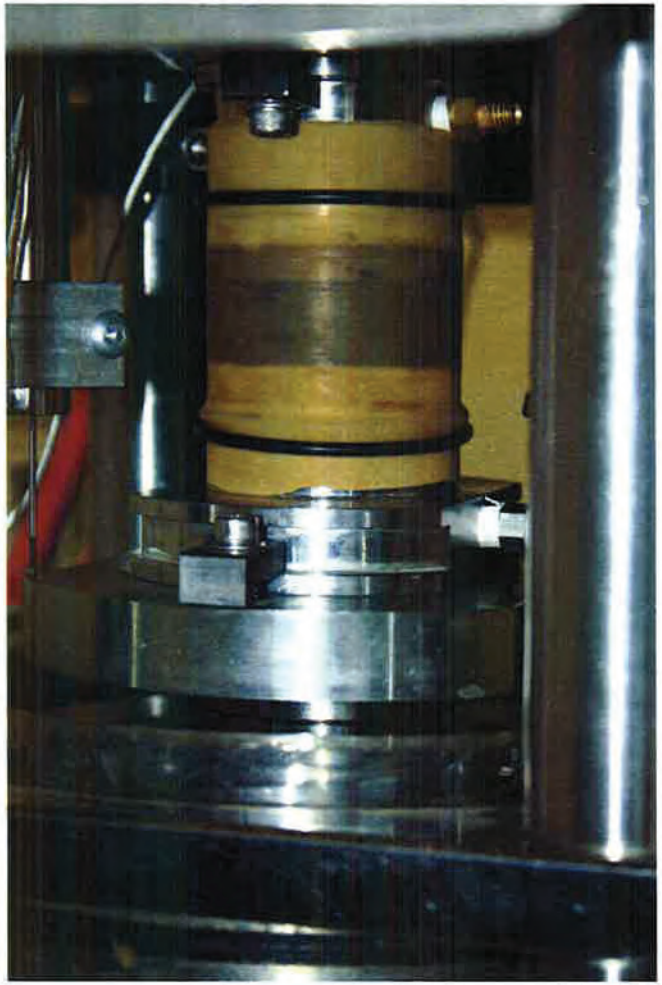
Specimen moved to device



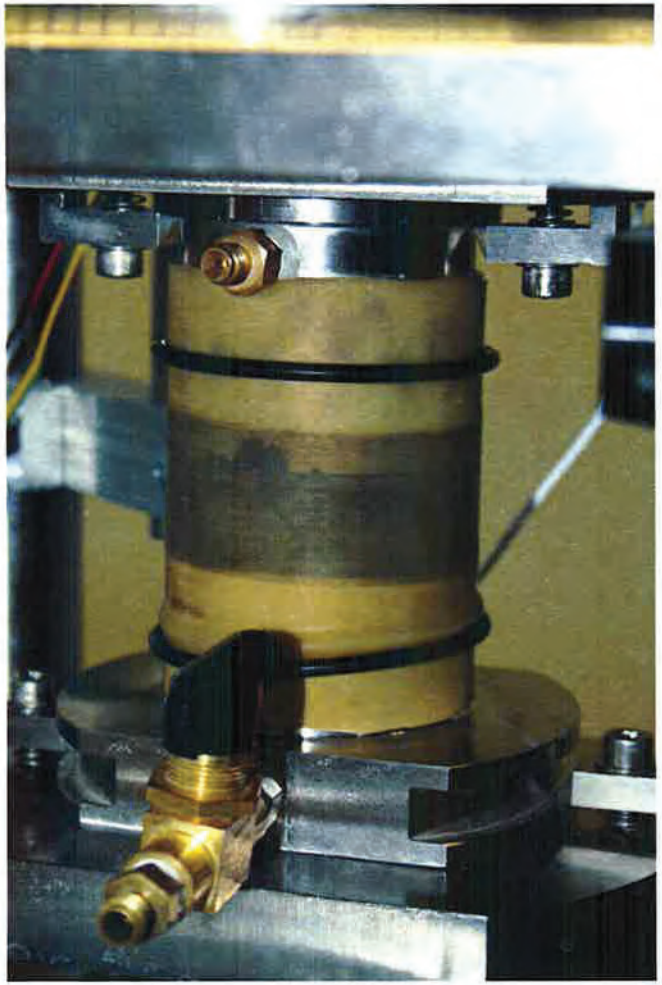
Specimen with a small seating load



Seating load applied, and split former removed, side view



Seating load applied, and split former removed, front view



Ready for loading



Sample TM-6A





Sample TM-7C





Sample TM-7D





Sample TM-12D



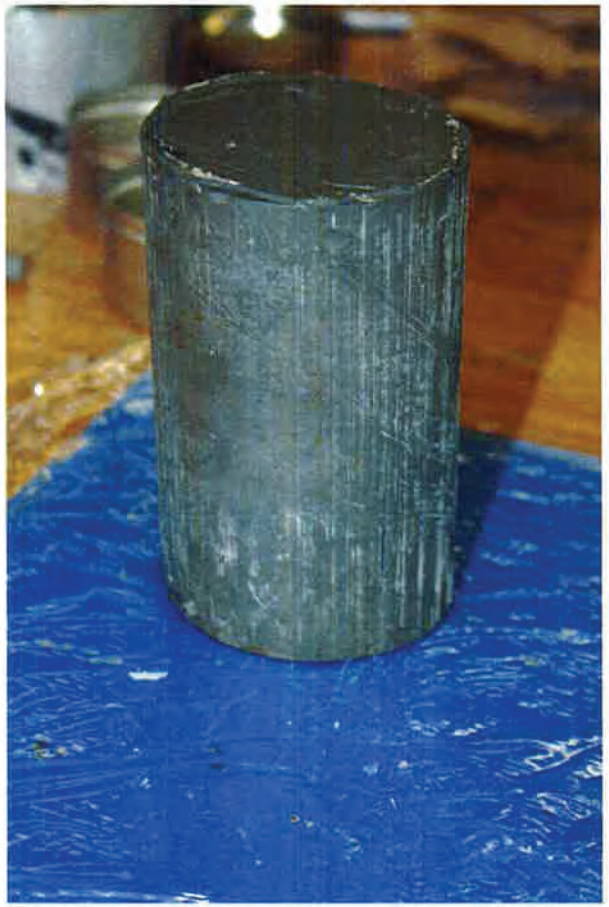


Sample TM-13B



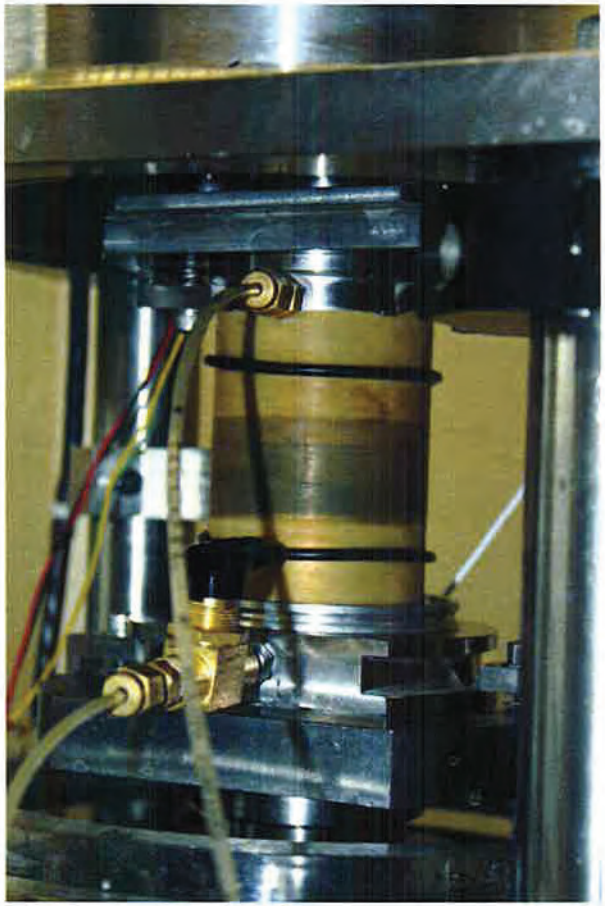


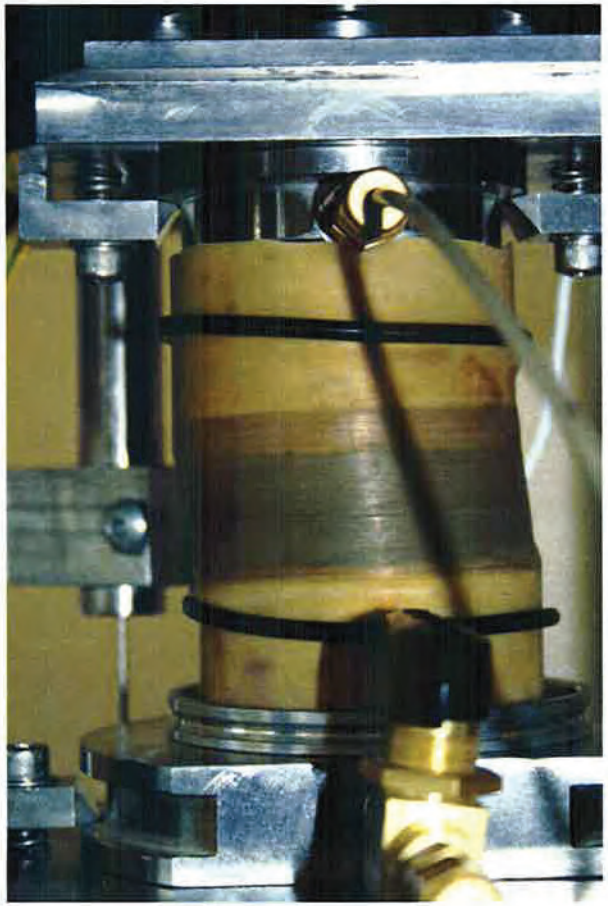
Sample TM-13D



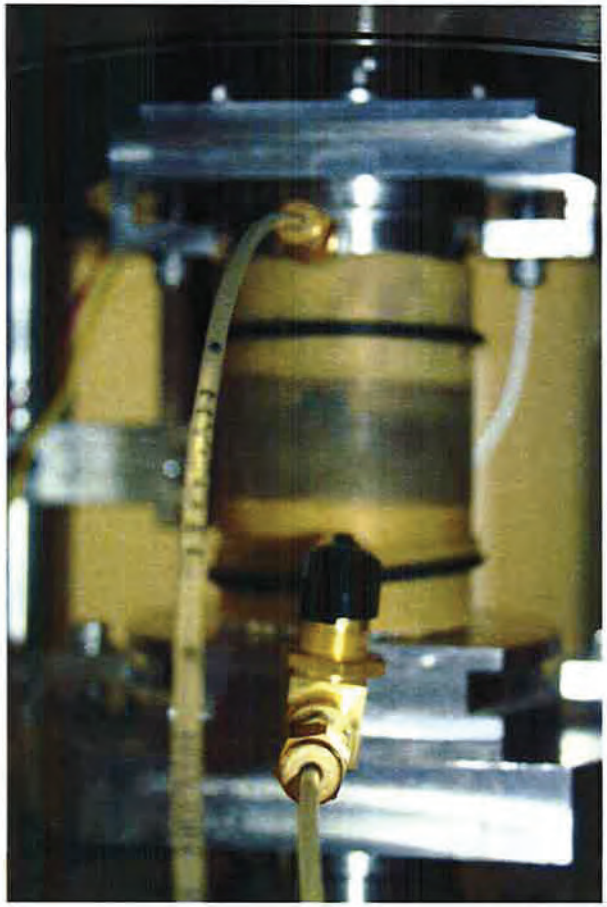


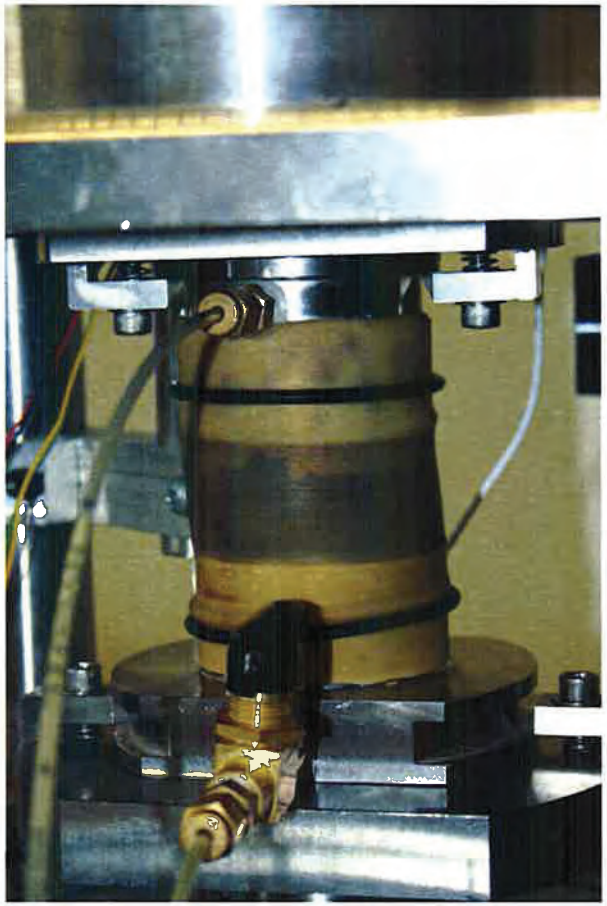
Initial & Final Photos: SS02



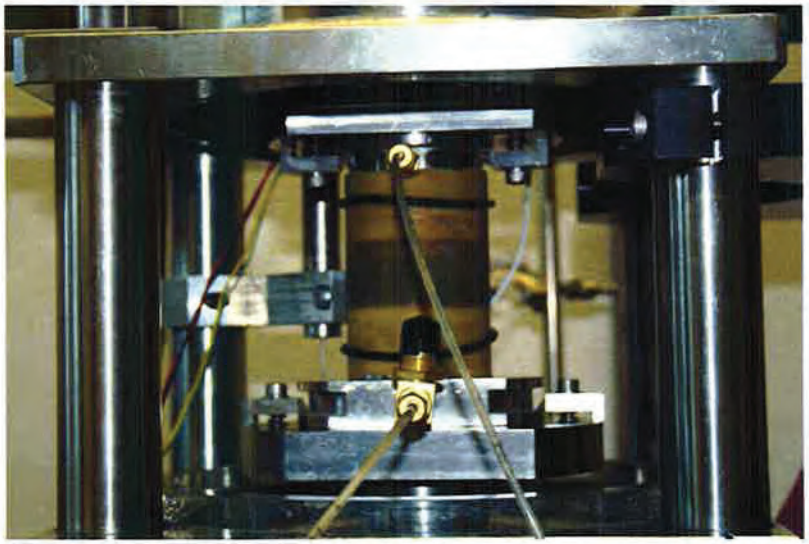


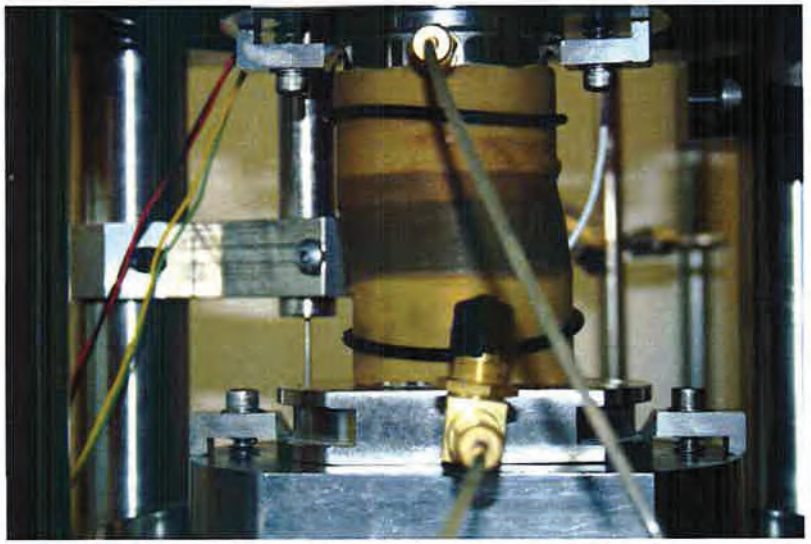
Initial & Final Photos: SS03



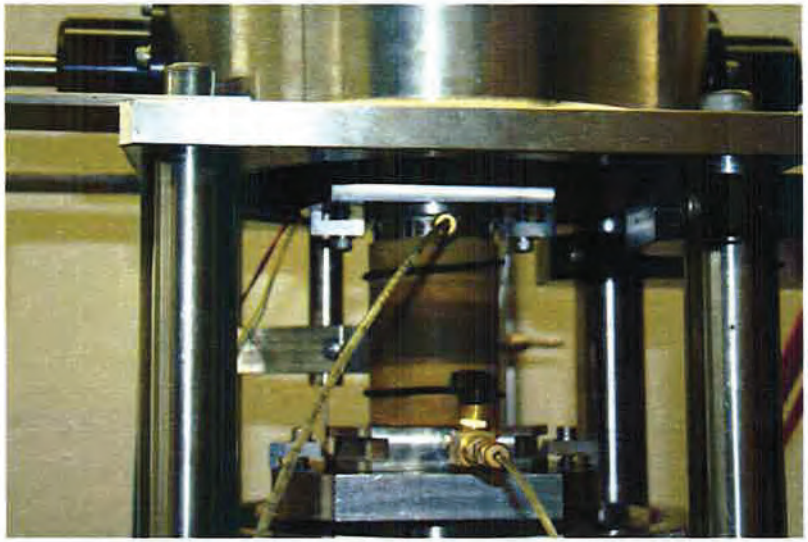


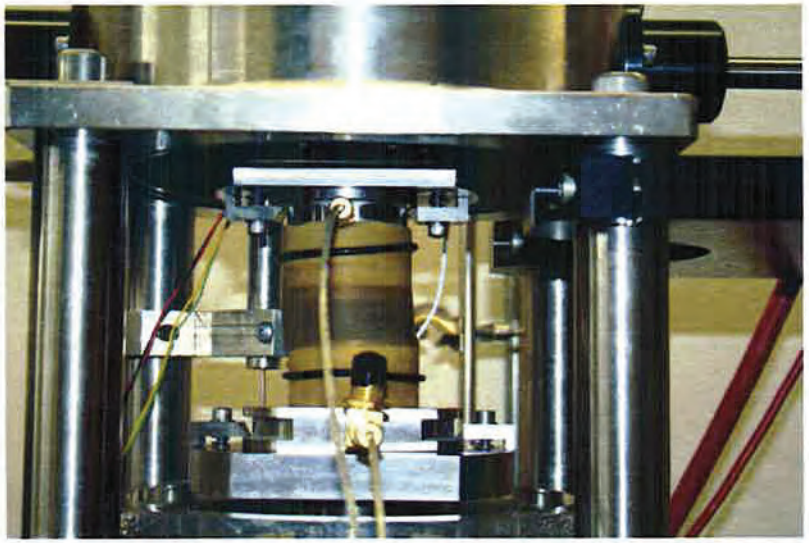
Initial & Final Photos: SS04



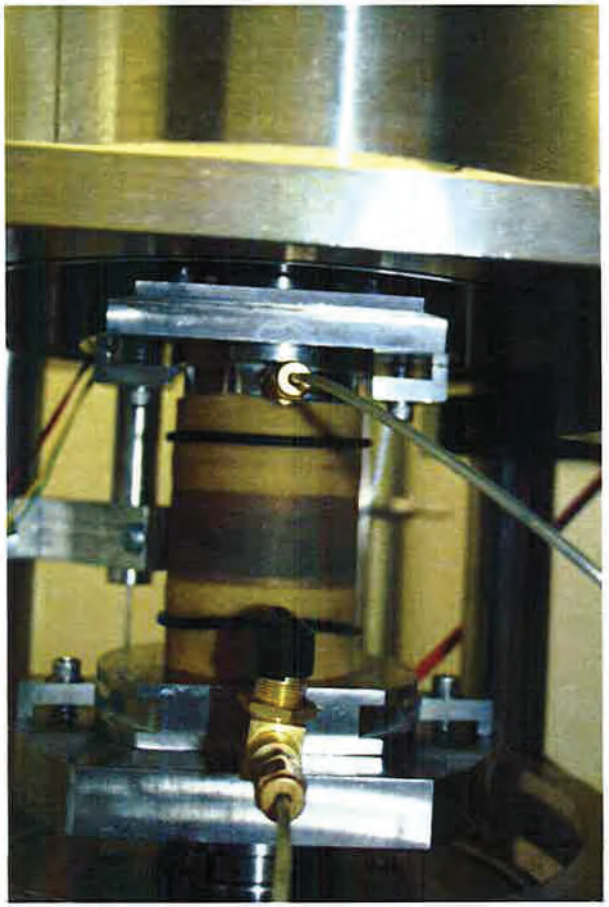


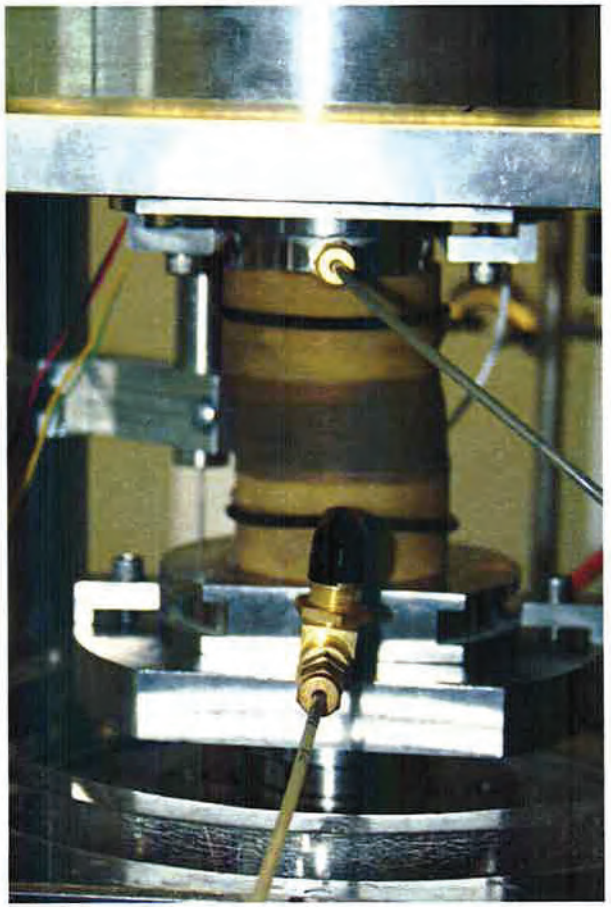
Initial & Final Photos: SS05



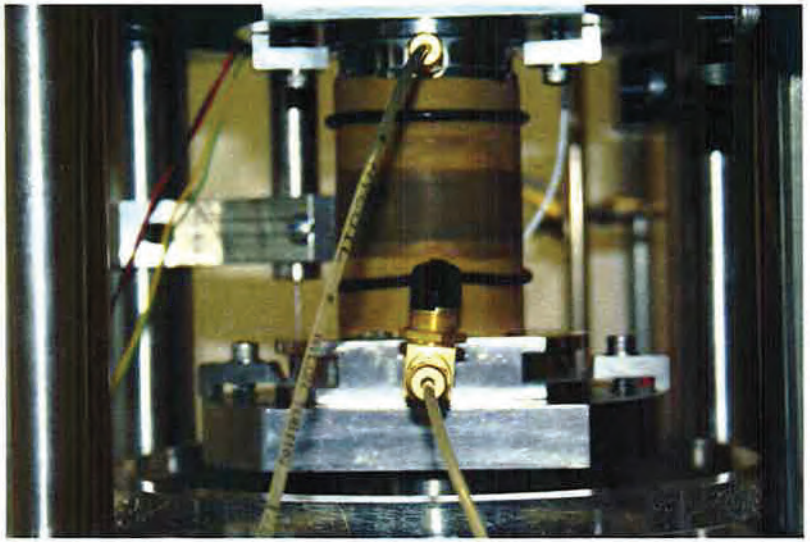


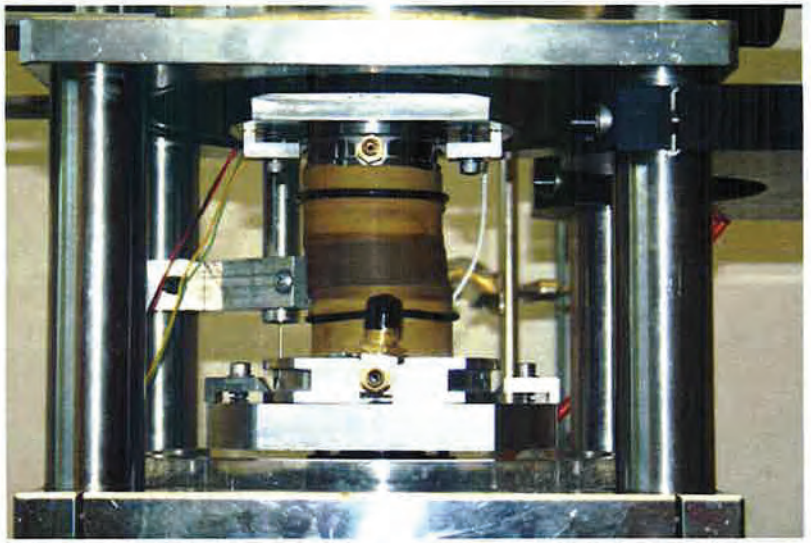
Initial & Final Photos: SS06



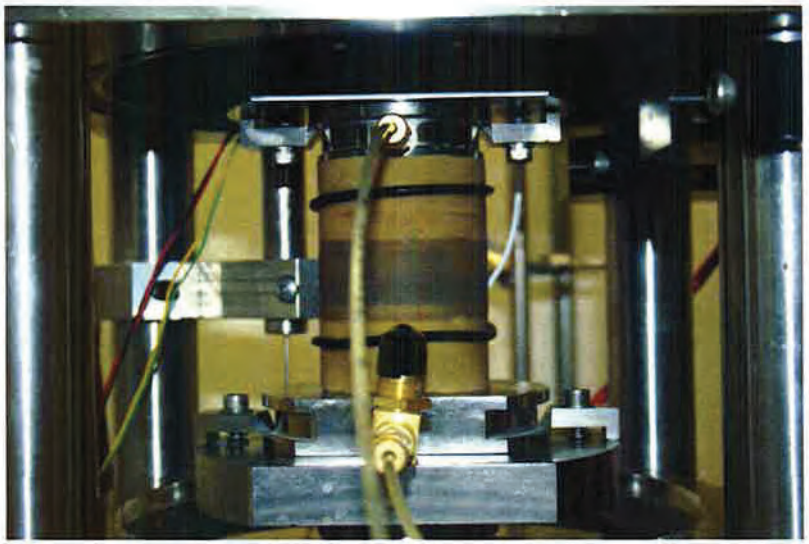


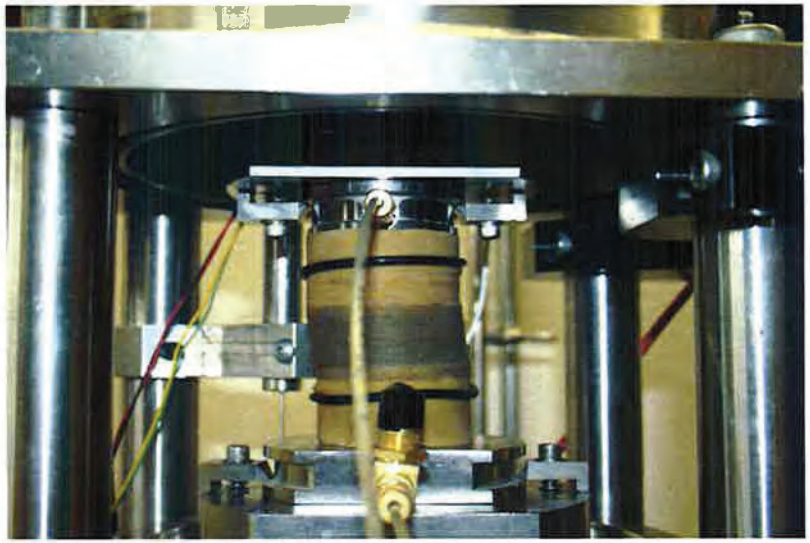
Initial & Final Photos: SS07



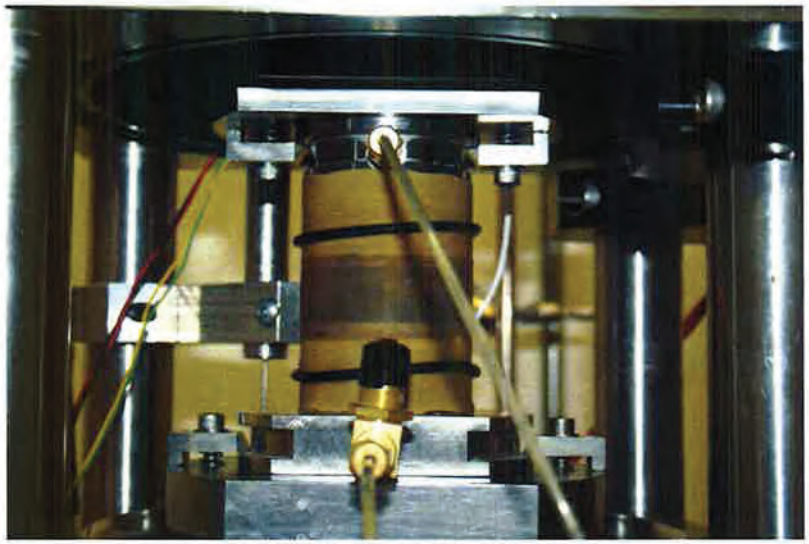


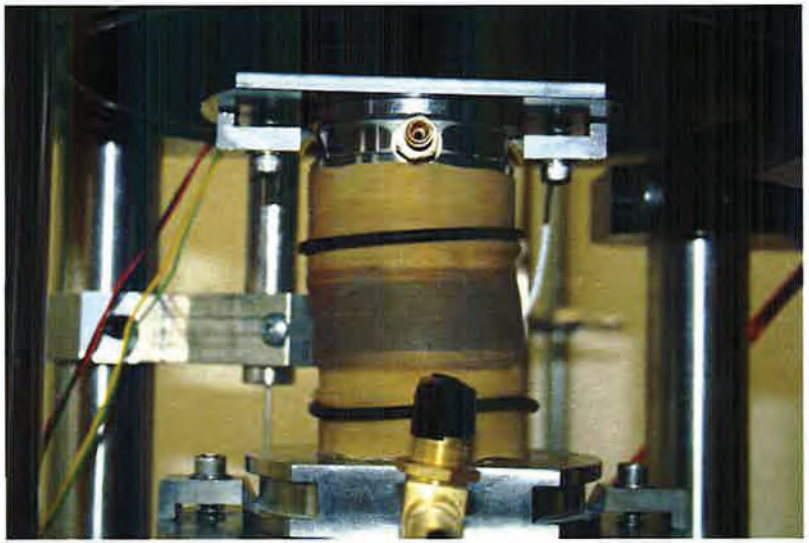
Initial & Final Photos: SS08



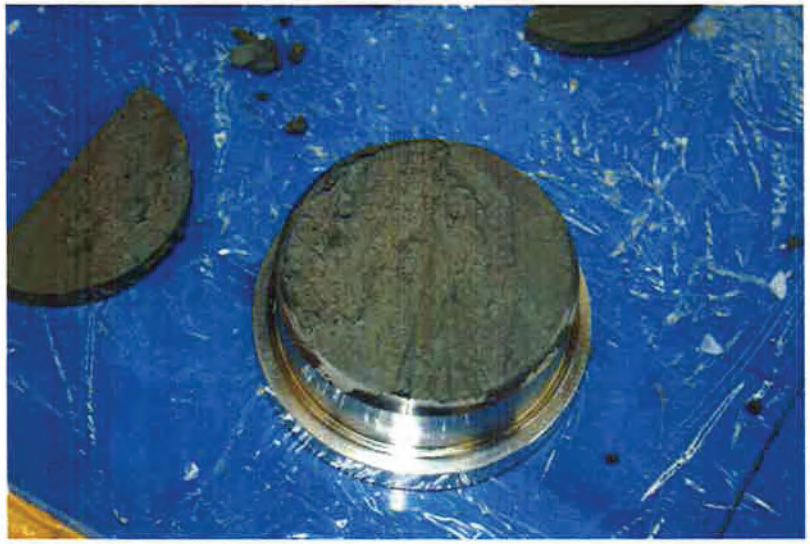


Initial & Final Photos: SS09





Discarded specimen in TM-7C
(sheared along silt seam during preparation)



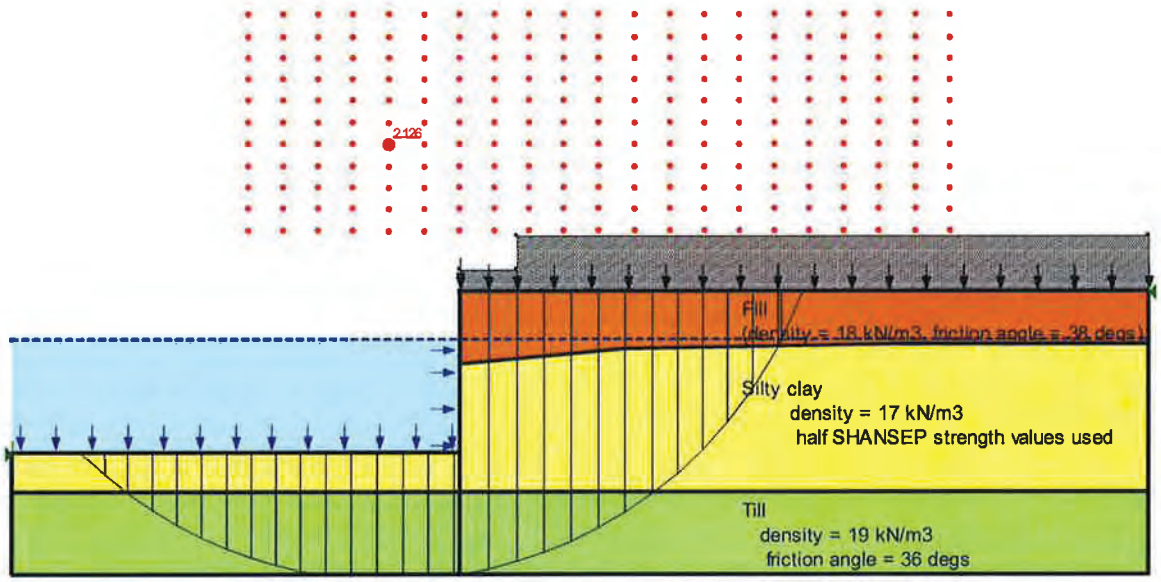
Possible Organics in TM-12D



APPENDIX B
Results of Sheet Pile Slope Stability Analyses

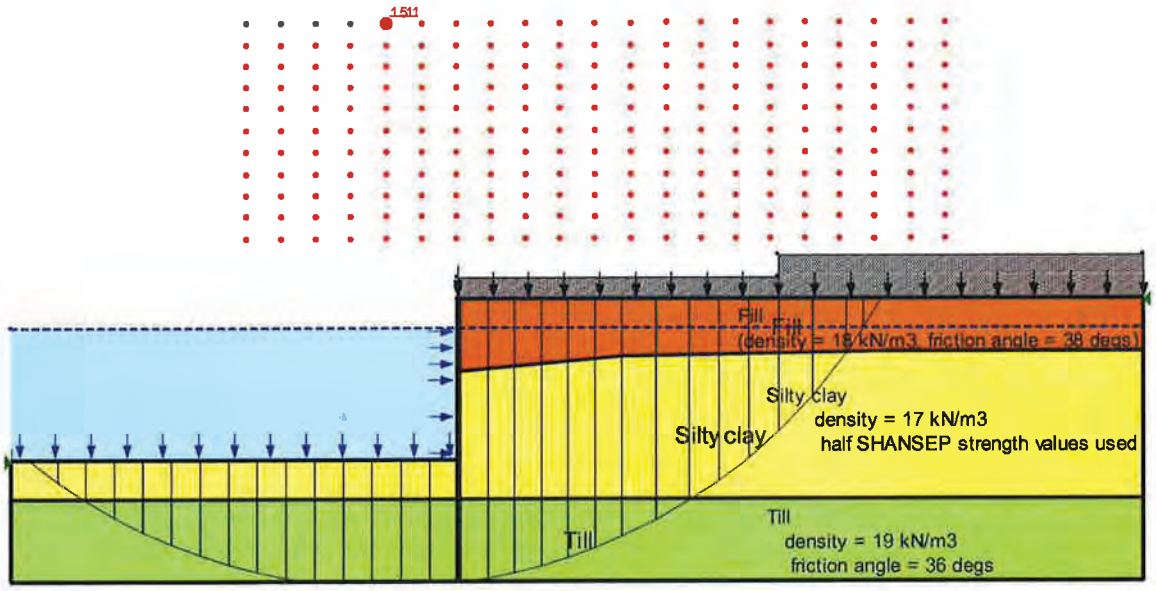
Sheetpiles: Section A-A'

Structure: Sheetpile driven to bedrock
Section: A-A'
Analysis: Static
Water table: LWL (elevation = 4.42 m)
Dredgeline: -7.58 m
Static loading: 24kPa within first 6 m from berth face and 60 kPa thereafter
Half-peak strengths used for silty clay



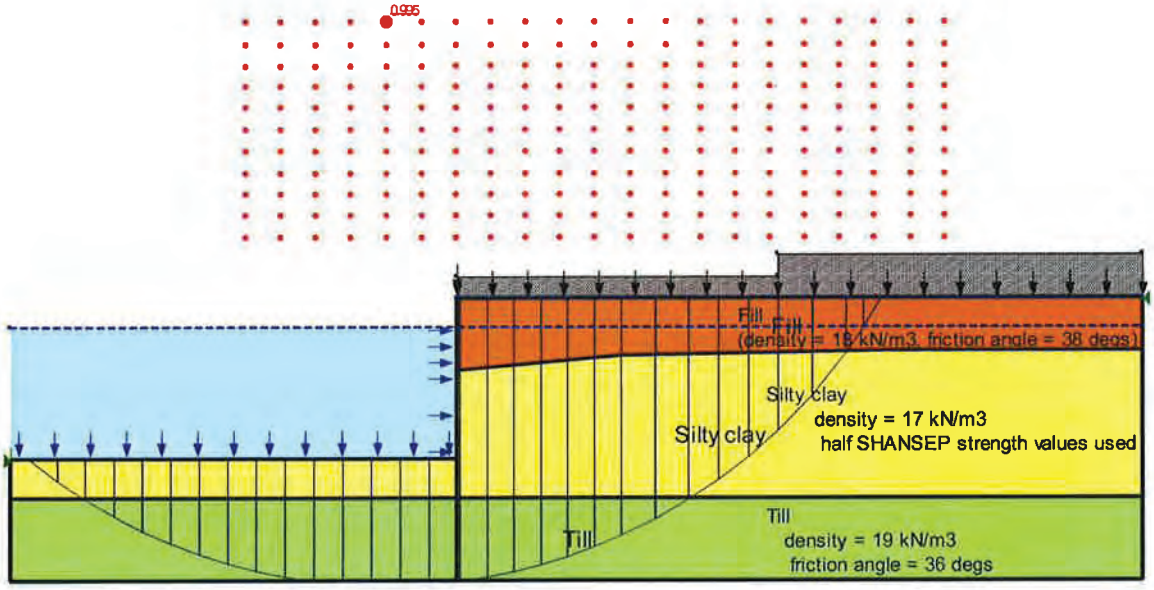
Static slope stability of sheetpile option, dredgeline at -7.58 m, and static loading

Structure: Sheetpile driven to bedrock
Section: A-A'
Analysis: Pseudo-static (kh = 0.149, 100 yrs return period)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa within first 34 m from berth face and 48 kPa thereafter
Half-peak strengths used for silty clay



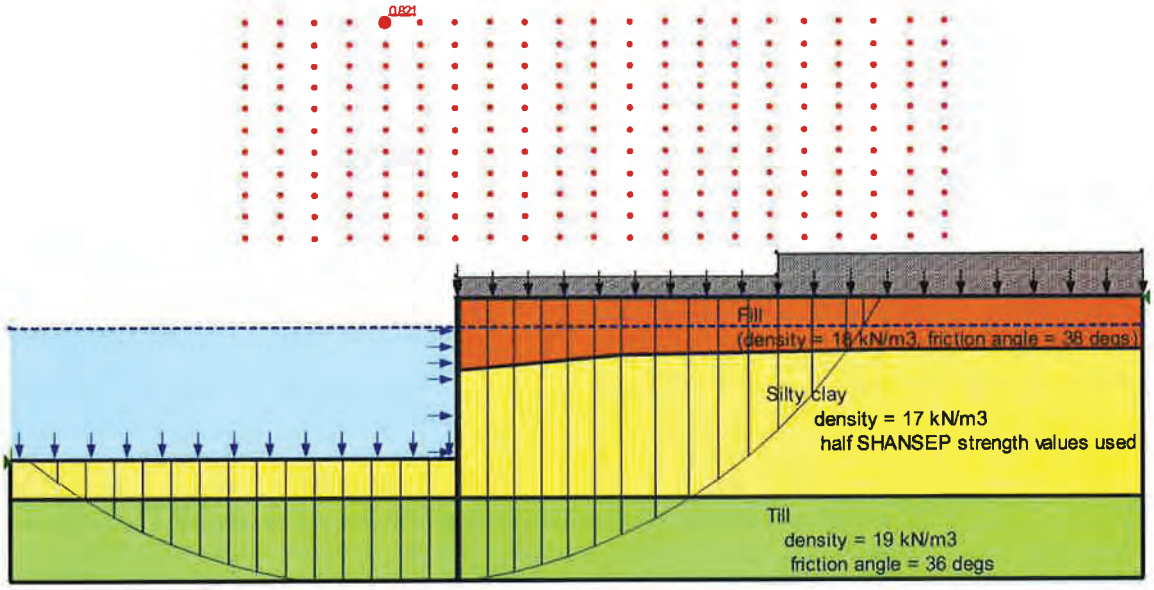
Pseudo-static (100yrs return period) slope stability of sheetpile option, dredgeline at -7.58 m, and seismic loading

Structure: Sheetpile driven to bedrock
Section: A-A'
Analysis: Pseudo-static (kh = 0.366, 475 yrs return period)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa within first 34 m from berth face and 48 kPa thereafter
Half-peak strengths used for silty clay



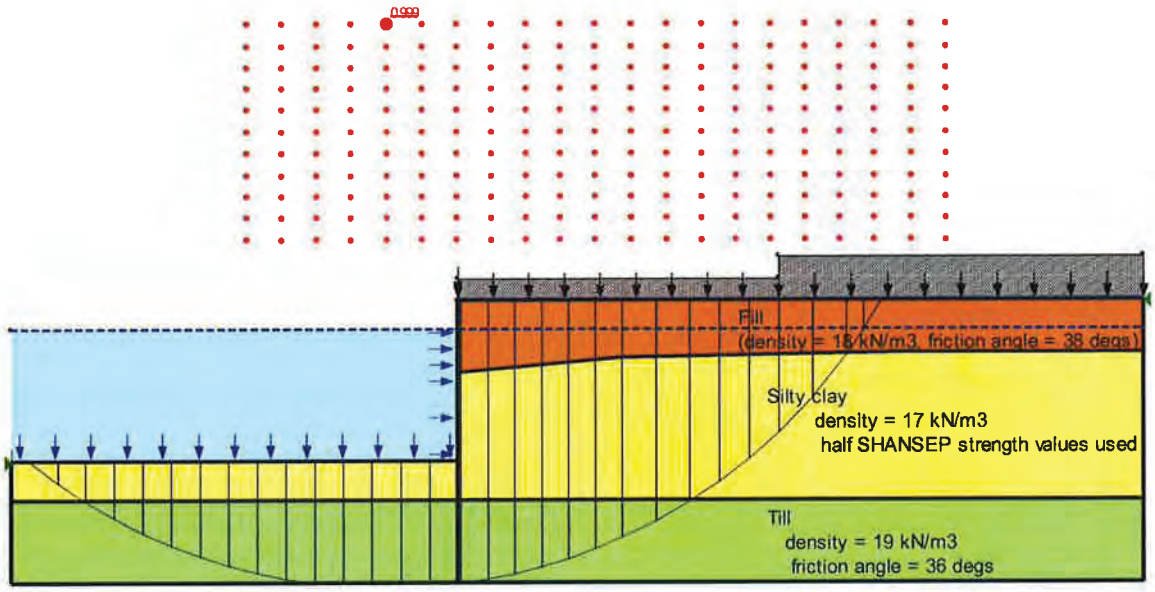
Pseudo-static (475yrs return period) slope stability of sheetpile option, dredgeline at -7.58 m, and seismic loading

Structure: Sheetpile driven to bedrock
Section: A-A'
Analysis: Pseudo-static (kh = 0.526, 2475 yrs return period)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa within first 34 m from berth face and 48 kPa thereafter
Half-peak strengths used for silty clay



Pseudo-static (2475yrs return period) slope stability of sheetpile option, dredgeline at -7.58 m, and seismic loading

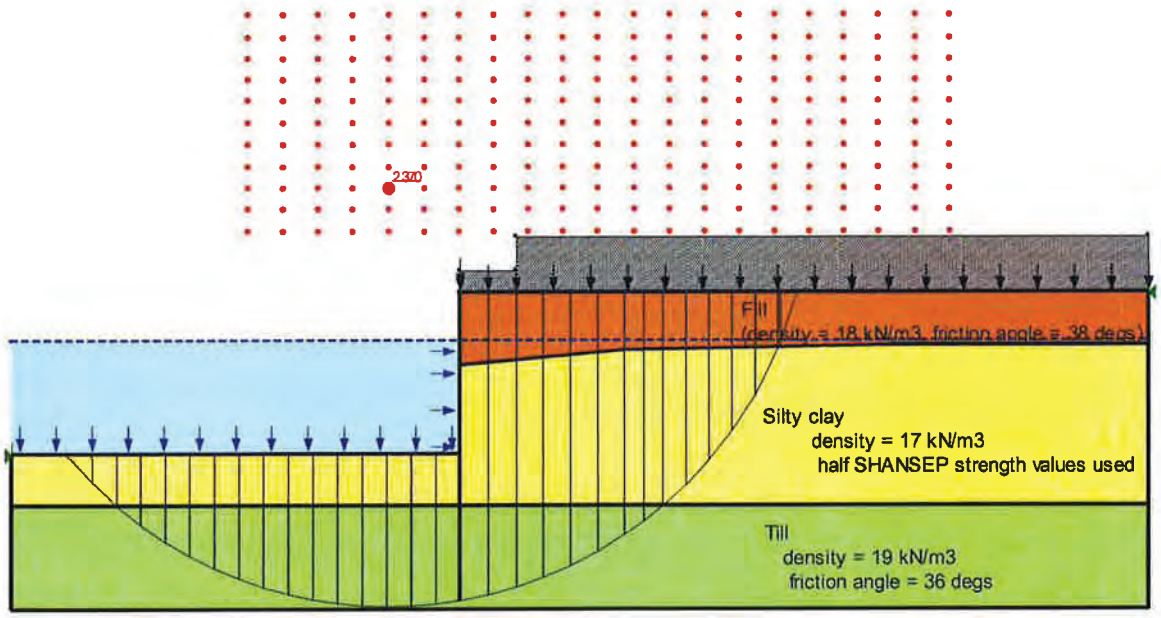
Structure: Sheetpile driven to bedrock
Section: A-A'
Analysis: Pseudo-static (kh = 0.363, yield acceleration)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa within first 34 m from berth face and 48 kPa thereafter
Half-peak strengths used for silty clay



Pseudo-static (yield) slope stability of sheetpile option, dredgeline at -7.58 m, and seismic loading

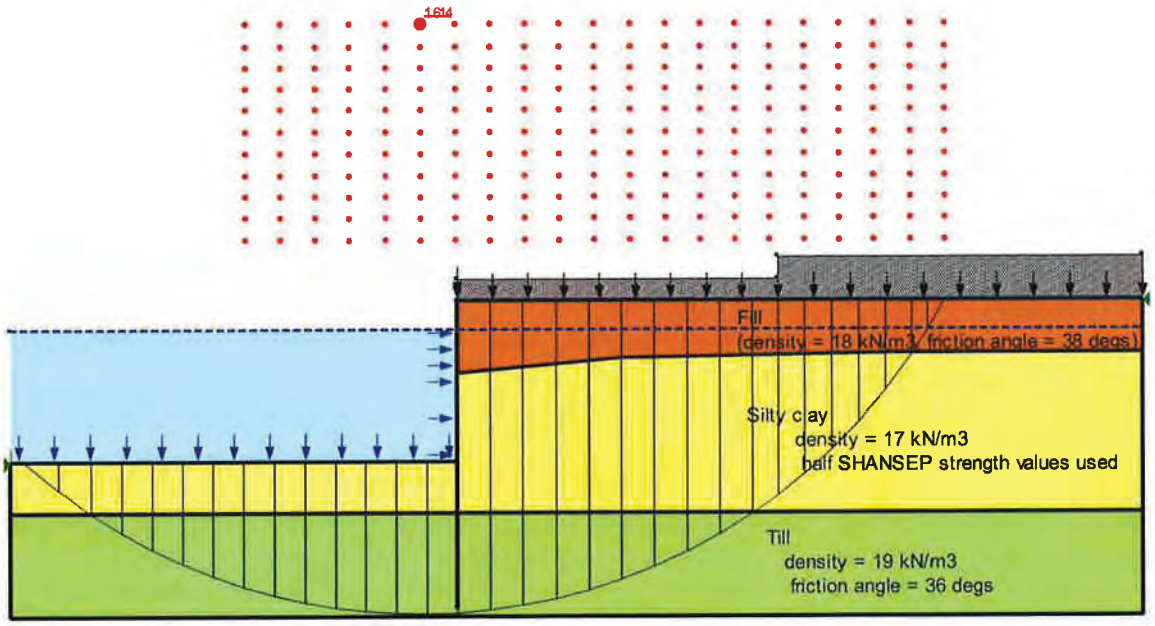
Sheetpiles: Section B-B'

Structure: 33m high sheetpile
Section: B-B'
Analysis: Static
Water table: LWL (elevation = 4.42 m)
Dredgeline: -7.58 m
Static loading: 24kPa within first 6 m from berth face and 60 kPa thereafter
Half-peak strengths used for silty clay



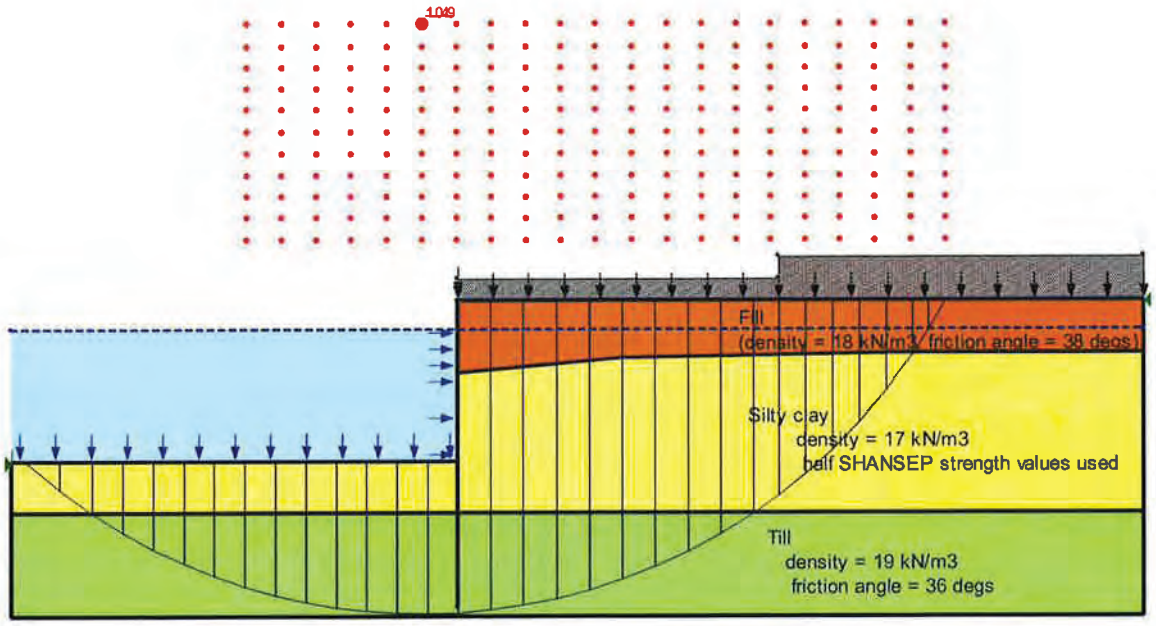
Static slope stability of sheetpile option, dredgeline at -7.58 m, and static loading

Structure: 33 m high sheetpile
Section: B-B'
Analysis: Pseudo-static (kh = 0.149, 100 yrs return period)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa within first 34 m from berth face and 48 kPa thereafter
Half-peak strengths used for silty clay



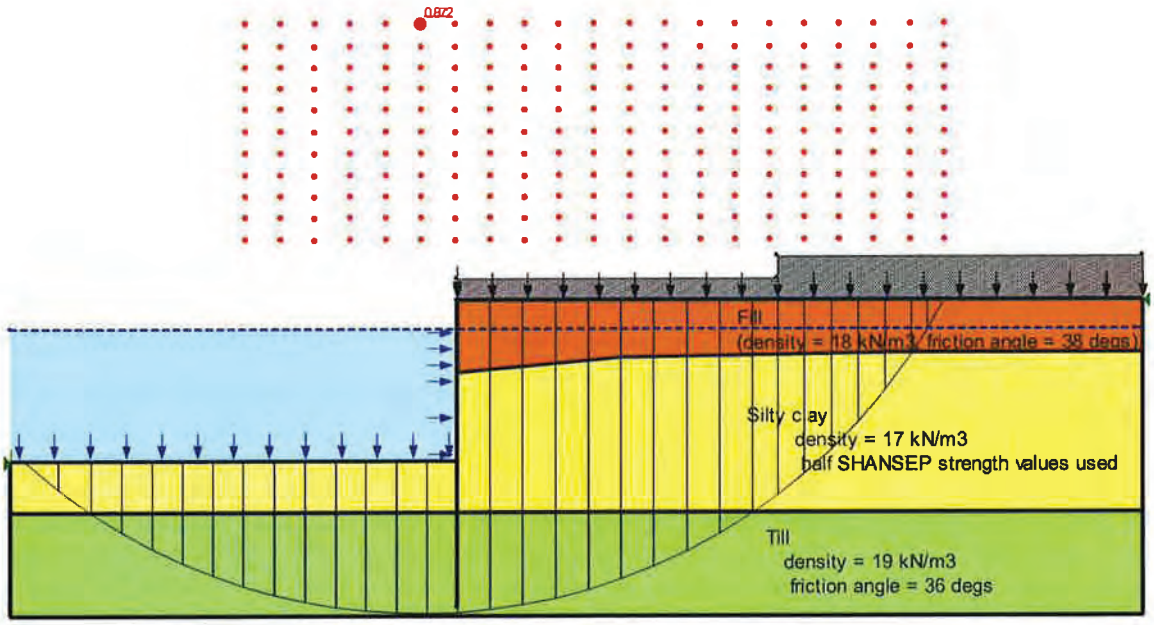
Pseudo-static (100yrs return period) slope stability of sheetpile option, dredgeline at -7.58 m, and seismic loading

Structure: 33 m high sheetpile
Section: B-B'
Analysis: Pseudo-static (kh = 0.366, 475 yrs return period)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa within first 34 m from berth face and 48 kPa thereafter
Half-peak strengths used for silty clay



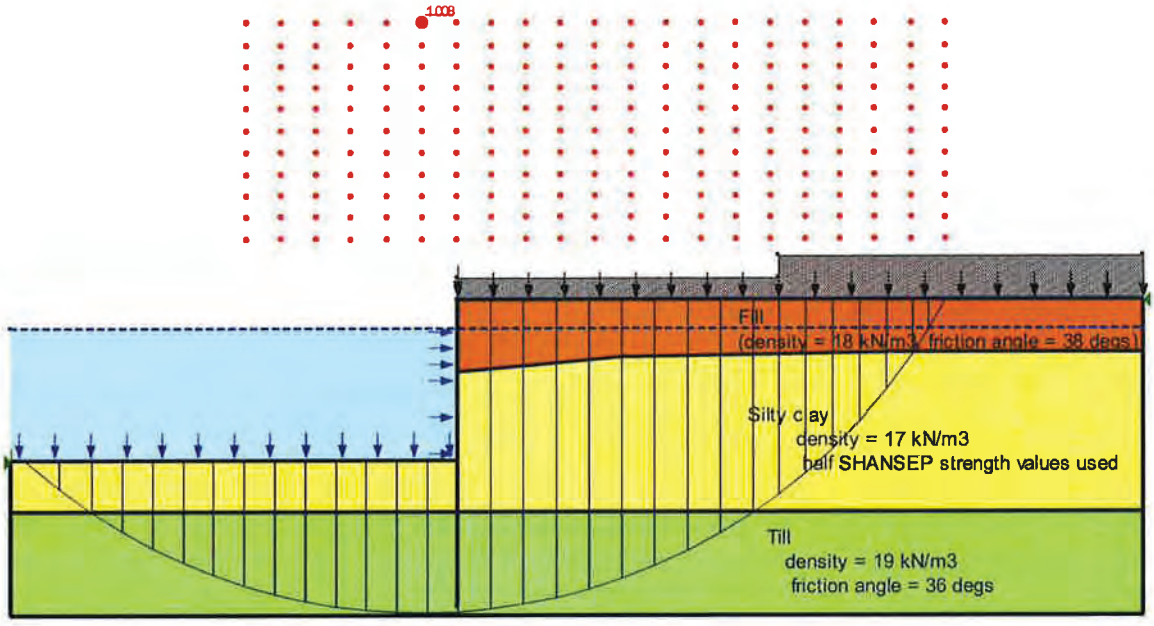
Pseudo-static (475yrs return period) slope stability of sheetpile option, dredgeline at -7.58 m, and seismic loading

Structure: 33 m high sheetpile
Section: B-B'
Analysis: Pseudo-static (kh = 0.526, 2475 yrs return period)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa within first 34 m from berth face and 48 kPa thereafter
Half-peak strengths used for silty clay



Pseudo-static (2475yrs return period) slope stability of sheetpile option, dredgeline at -7.58 m, and seismic loading

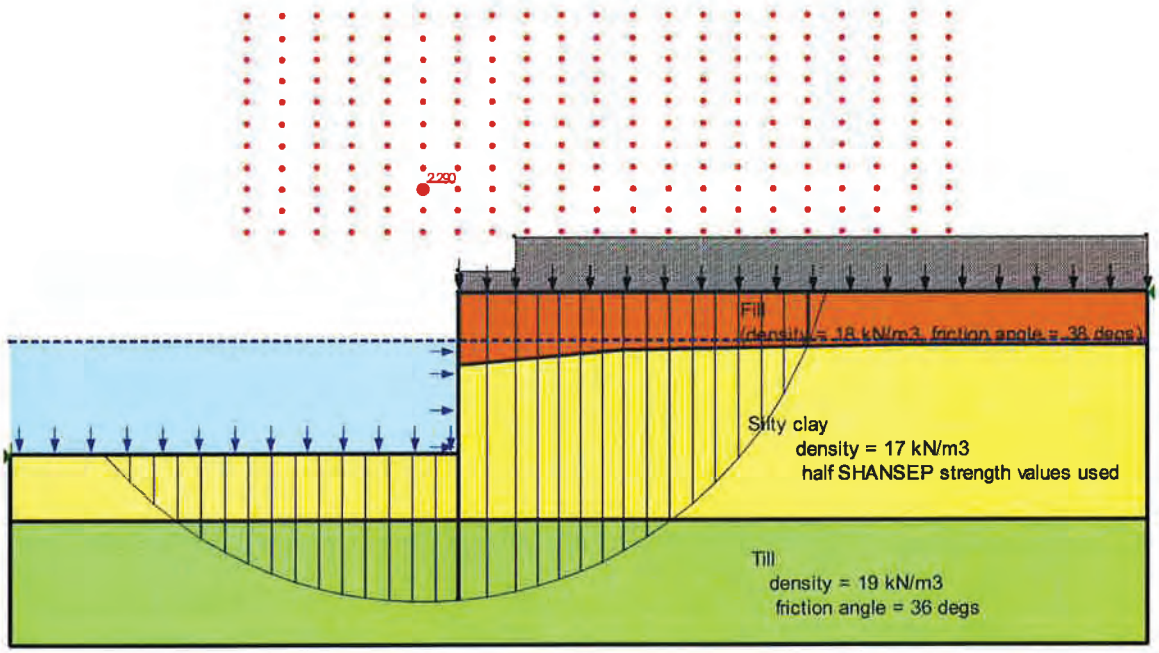
Structure: 33 m high sheetpile
Section: B-B'
Analysis: Pseudo-static (ky = 0.4, yield acceleration)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa within first 34 m from berth face and 48 kPa thereafter
Half-peak strengths used for silty clay



Pseudo-static (yield) slope stability of sheetpile option, dredgeline at -7.58 m, and seismic loading

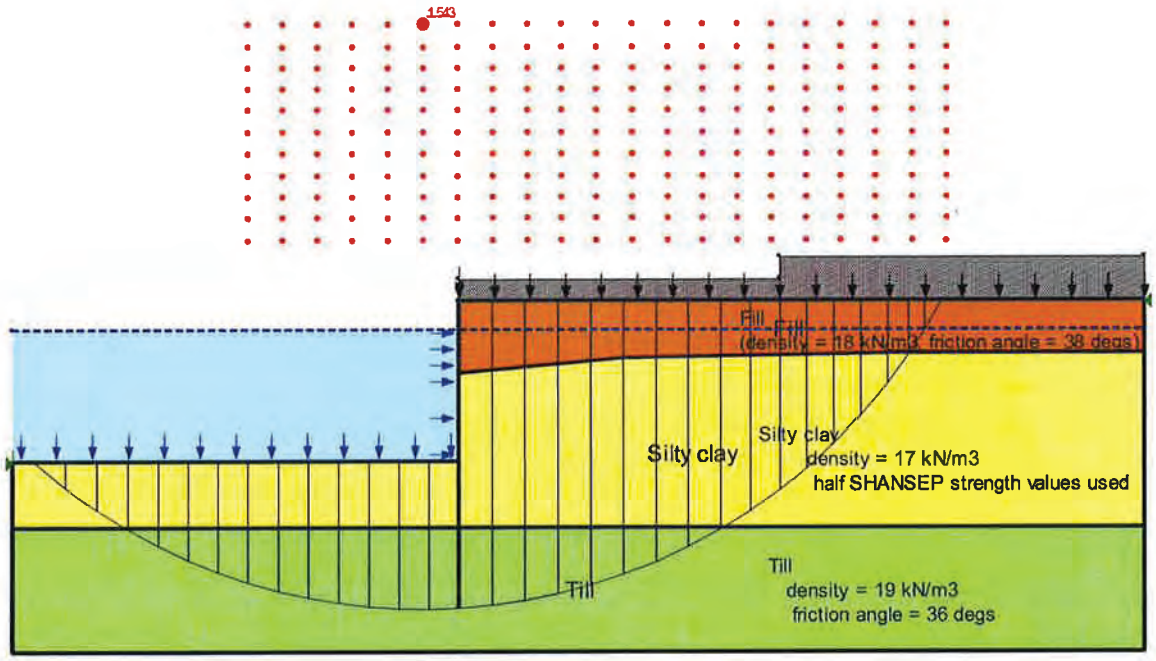
Sheetpiles: Section C-C'

Structure: 33m tall sheetpile
Section: C-C'
Analysis: Static
Water table: LWL (elevation = 4.42 m)
Dredgeline: -7.58 m
Static loading: 24kPa within first 6 m from berth face and 60 kPa thereafter
Half-peak strengths used for silty clay



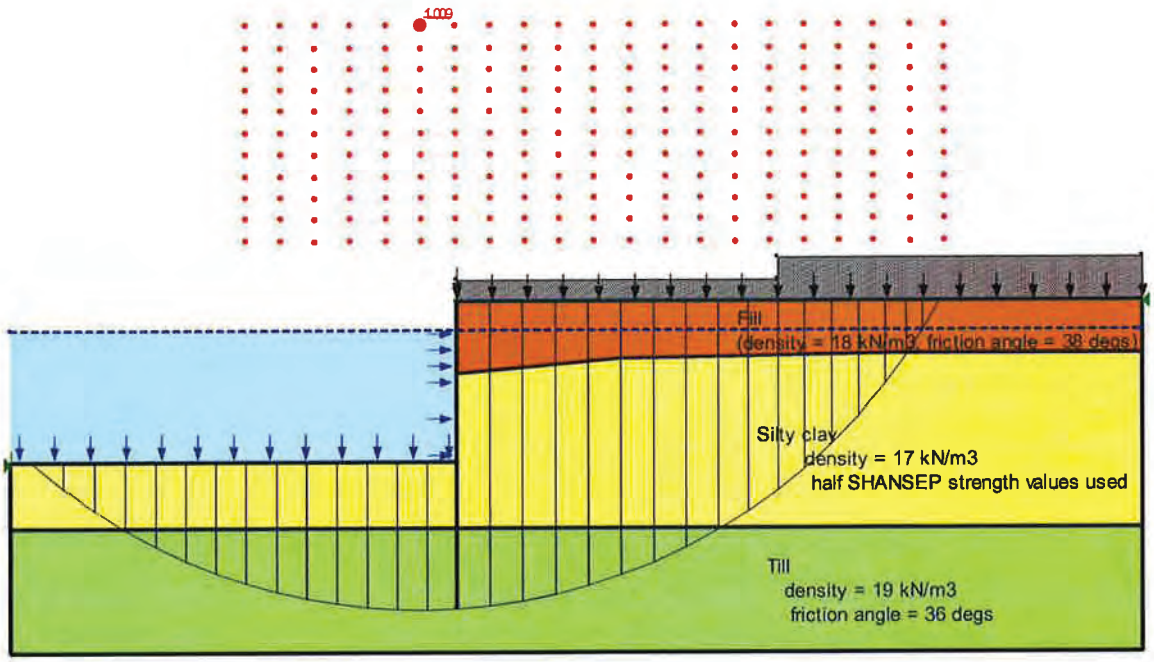
Static slope stability of sheetpile option, dredgeline at -7.58 m, and static loading

Structure: 33m tall sheetpile
Section: C-C'
Analysis: Pseudo-static (kh = 0.149, 100 yrs return period)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa within first 34 m from berth face and 48 kPa thereafter
Half-peak strengths used for silty clay



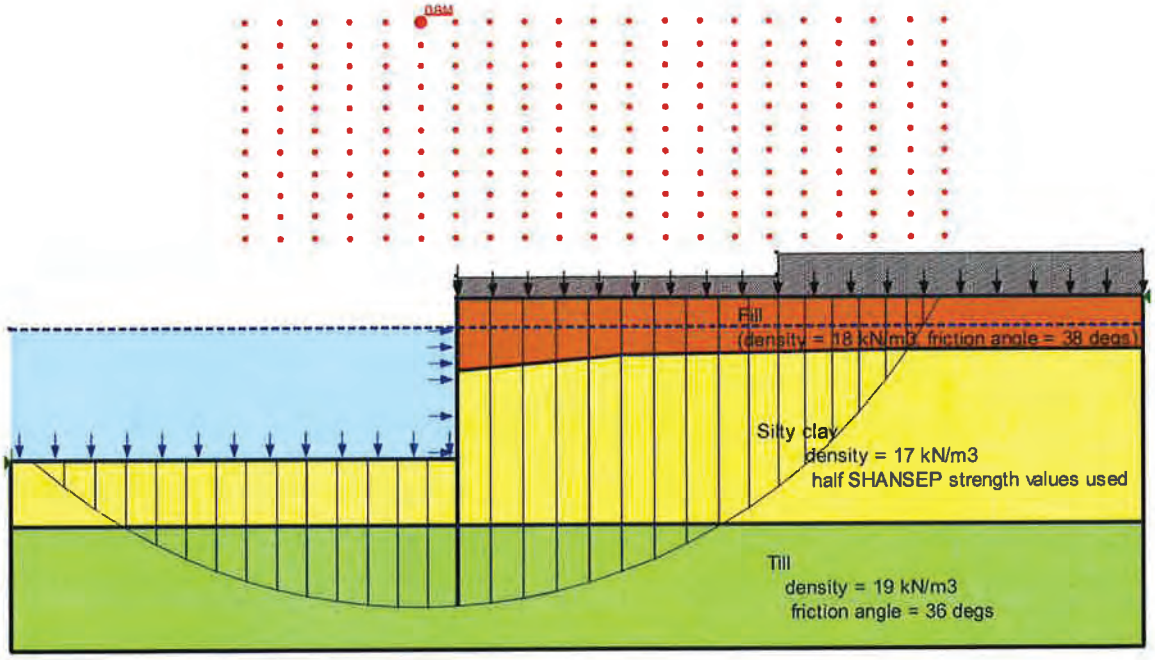
Pseudo-static (100yrs return period) slope stability of sheetpile option, dredgeline at -7.58 m, and seismic loading

Structure: 33m tall sheetpile
Section: C-C'
Analysis: Pseudo-static (kh = 0.366, 475 yrs return period)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa within first 34 m from berth face and 48 kPa thereafter
Half-peak strengths used for silty clay



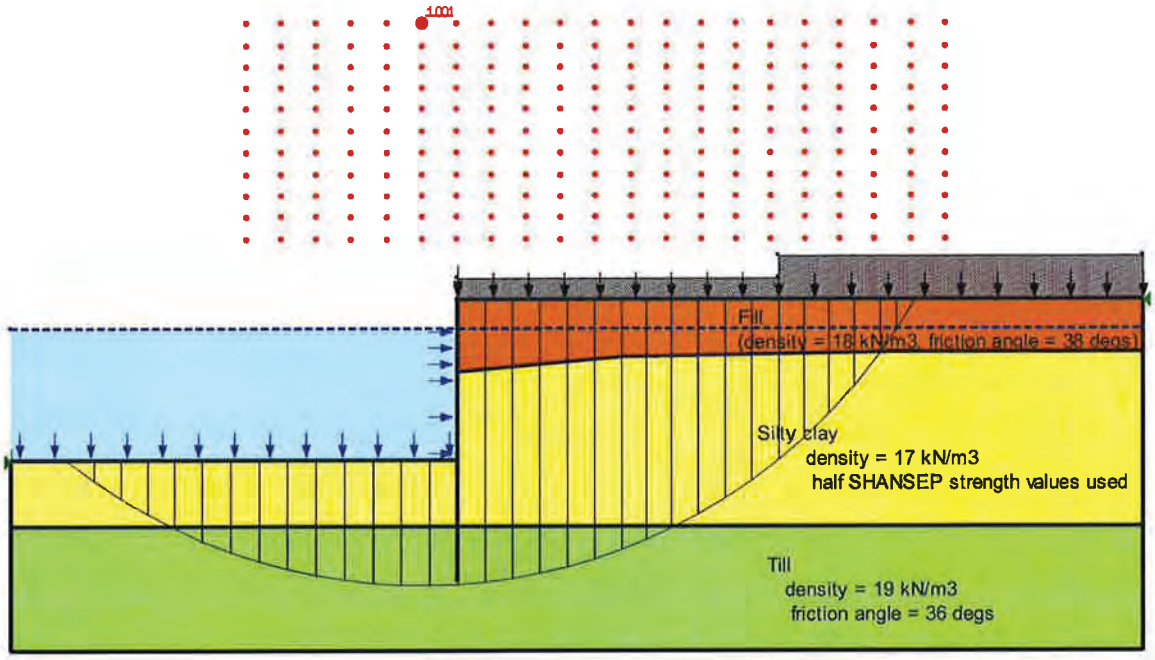
Pseudo-static (475yrs return period) slope stability of sheetpile option, dredgeline at -7.58 m, and seismic loading

Structure: 33m tall sheetpile
Section: C-C'
Analysis: Pseudo-static (kh = 0.526, 2475 yrs return period)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa within first 34 m from berth face and 48 kPa thereafter
Half-peak strengths used for silty clay



Pseudo-static (2475yrs return period) slope stability of sheetpile option, dredgeline at -7.58 m, and seismic loading

Structure: Sheetpile driven to bedrock
Section: C-C'
Analysis: Pseudo-static (ky = 0.33, yield acceleration)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa within first 34 m from berth face and 48 kPa thereafter
Half-peak strengths used for silty clay

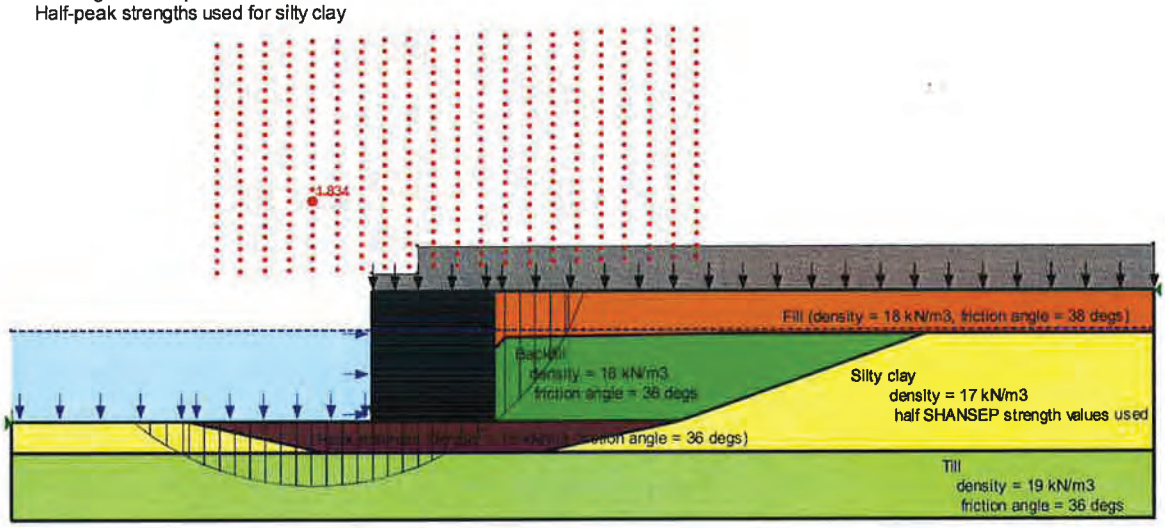


Pseudo-static (yield) slope stability of sheetpile option, dredgeline at -7.58 m, and seismic loading

APPENDIX C
Results of Caisson Slope Stability Analyses

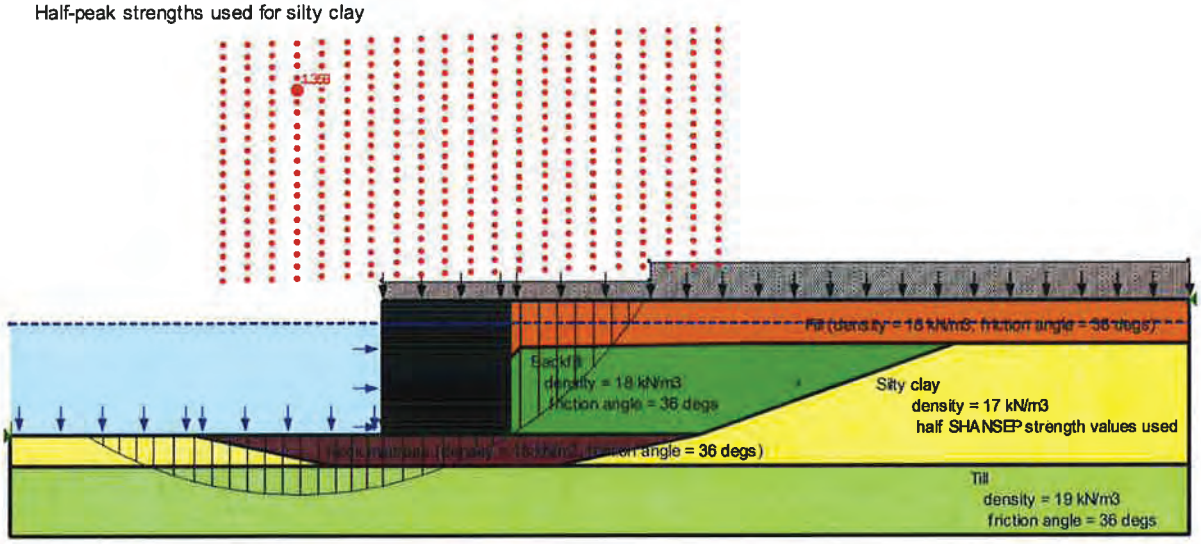
Caissons: Section A-A'

Structure: Caisson
Section: A-A'
Analysis: Static
Water table: LWL (elevation = 4.42 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 6m behind wall from berth face, 60 kPa thereafter
Half-peak strengths used for silty clay



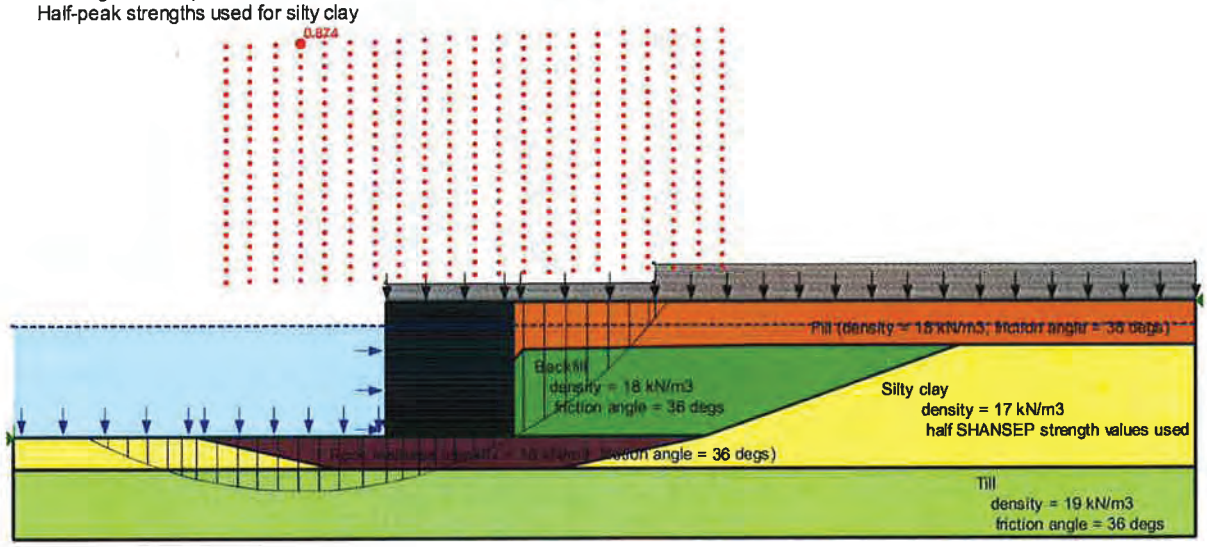
Static slope stability of caisson option, dredgeline at -7.58 m, and static loading

Structure: Caisson
Section: A-A'
Analysis: Pseudo-static (kh = 0.149 - 100yrs return period earthquake)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face to crane rail, 48 kPa thereafter
Half-peak strengths used for silty clay



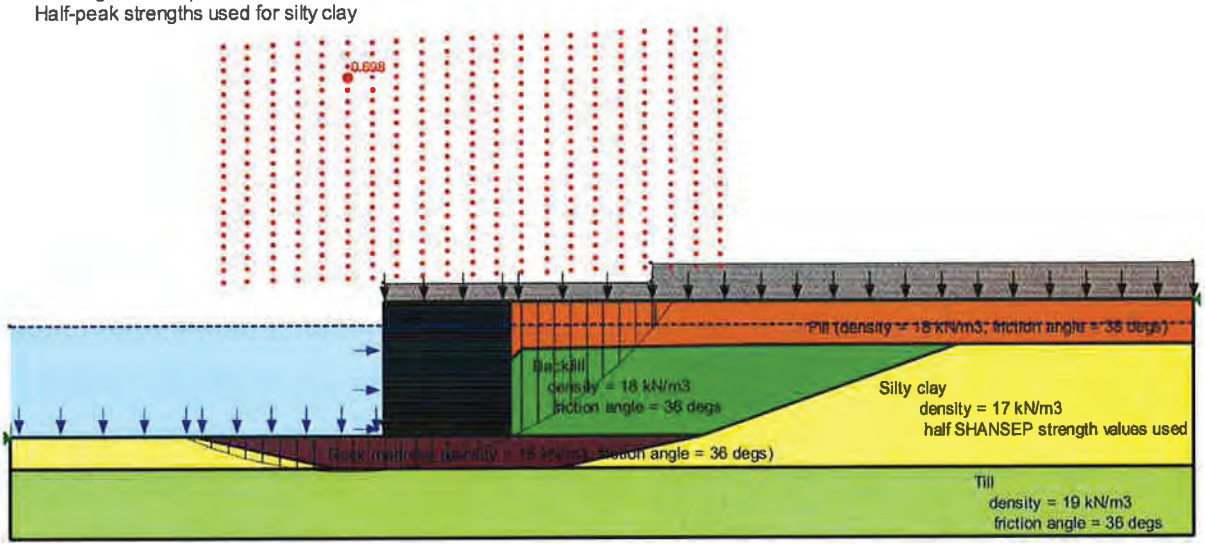
Pseudo-static (100yrs return period) slope stability of caisson option, dredgeline at -7.58 m, and seismic loading

Structure: Caisson
Section: A-A'
Analysis: Pseudo-static (kh = 0.366 - 475yrs return period earthquake)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face to crane rail, 48 kPa thereafter
Half-peak strengths used for silty clay



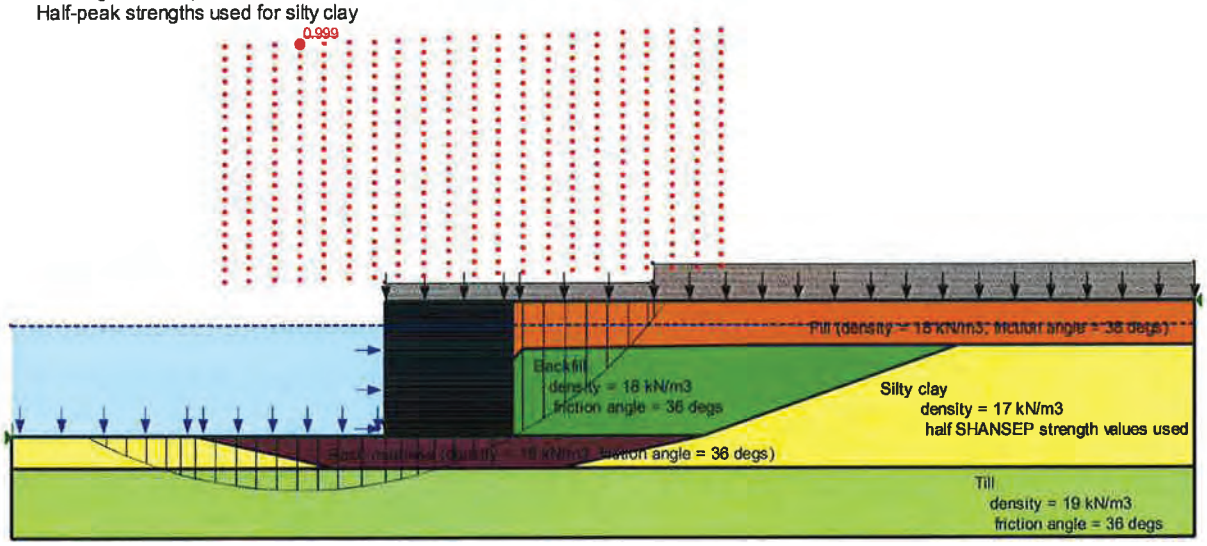
Pseudo-static (475yrs return period) slope stability of caisson option, dredgeline at -7.58 m, and seismic loading

Structure: Caisson
Section: A-A'
Analysis: Pseudo-static (kh = 0.526 - 2475yrs return period earthquake)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face to crane rail, 48 kPa thereafter
Half-peak strengths used for silty clay



Pseudo-static (2475yrs return period) slope stability of caisson option, dredgeline at -7.58 m, and seismic loading

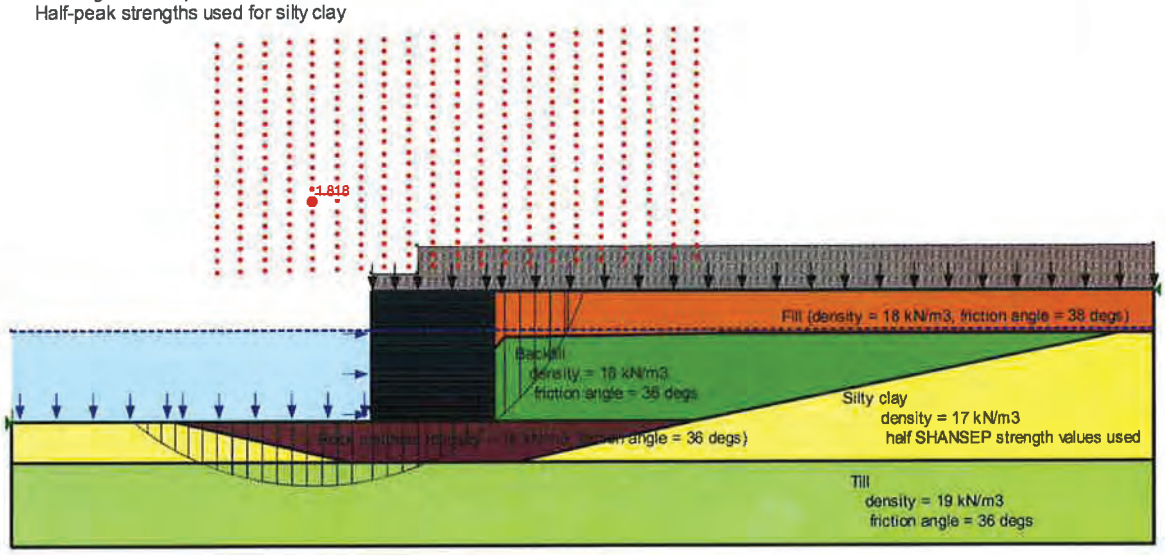
Structure: Caisson
Section: A-A'
Analysis: Pseudo-static (ky = 0.29 - yield acceleration)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face to crane rail, 48 kPa thereafter
Half-peak strengths used for silty clay



Pseudo-static (yield) slope stability of caisson option, dredgeline at -7.58 m, and seismic loading

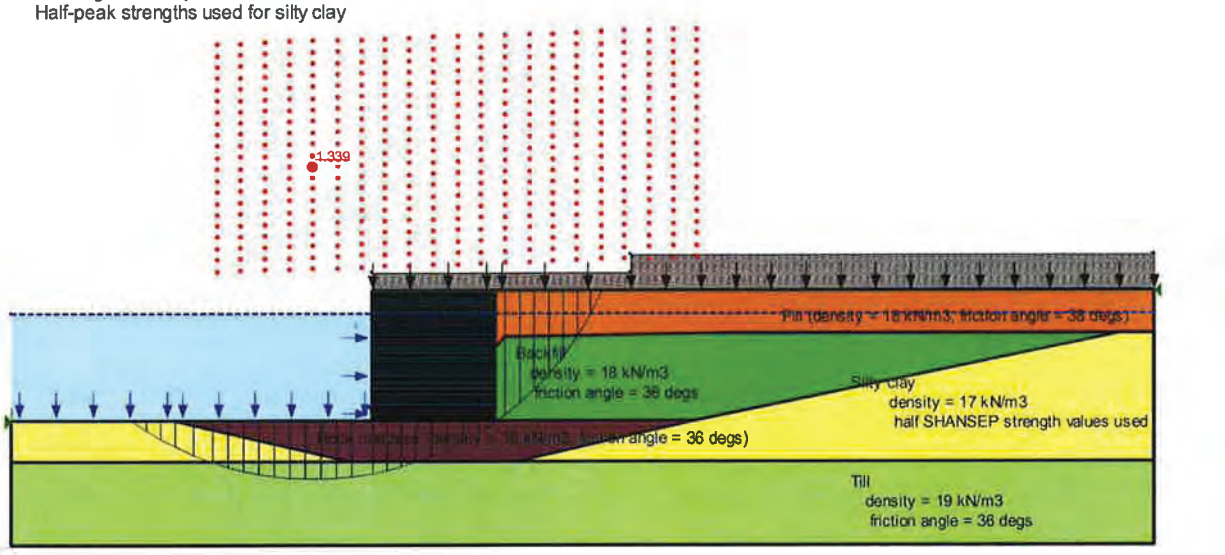
Caissons: Section B-B'

Structure: Caisson
Section: B-B'
Analysis: Static
Water table: LWL (elevation = 4.42 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 6m behind wall from berth face, 60 kPa thereafter
Half-peak strengths used for silty clay



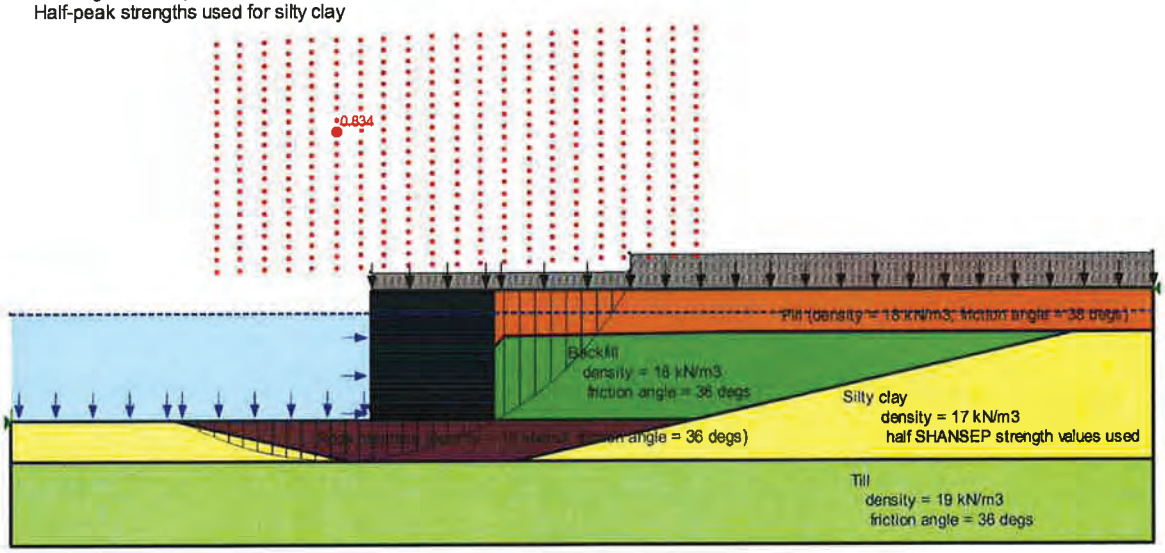
Static slope stability of caisson option, dredgeline at -7.58 m, and static loading

Structure: Caisson
Section: B-B'
Analysis: Pseudo-static (kh = 0.149 - 100 yrs return period earthquake)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face, and 48 kPa thereafter
Half-peak strengths used for silty clay



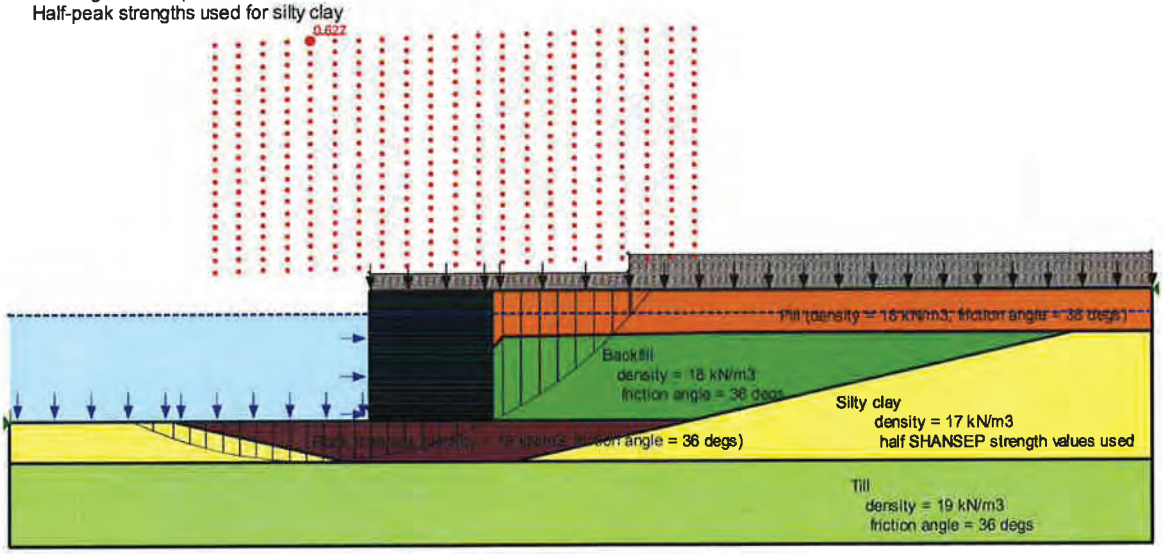
Pseudo-static (100yrs return period) slope stability of caisson option, dredgeline at -7.58 m, and seismic loading

Structure: Caisson
Section: B-B'
Analysis: Pseudo-static (kh = 0.366 - 475 yrs return period earthquake)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face, and 48 kPa thereafter
Half-peak strengths used for silty clay



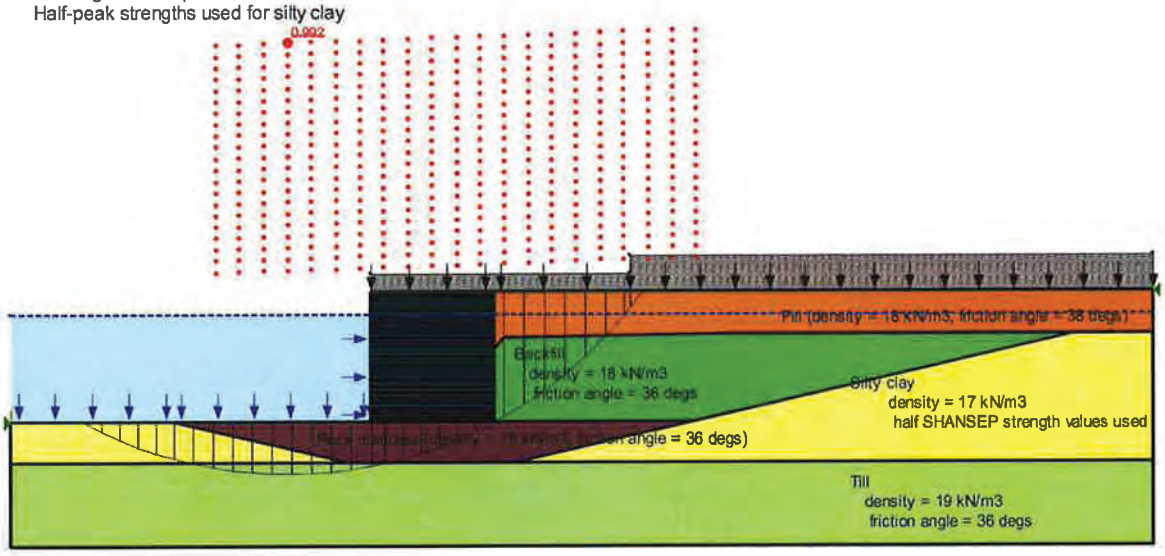
Pseudo-static (475yrs return period) slope stability of caisson option, dredgeline at -7.58 m, and seismic loading

Structure: Caisson
Section: B-B'
Analysis: Pseudo-static (kh = 0.526 - 2475 yrs return period earthquake)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face, and 48 kPa thereafter
Half-peak strengths used for silty clay



Pseudo-static (2475yrs return period) slope stability of caisson option, dredgeline at -7.58 m, and seismic loading

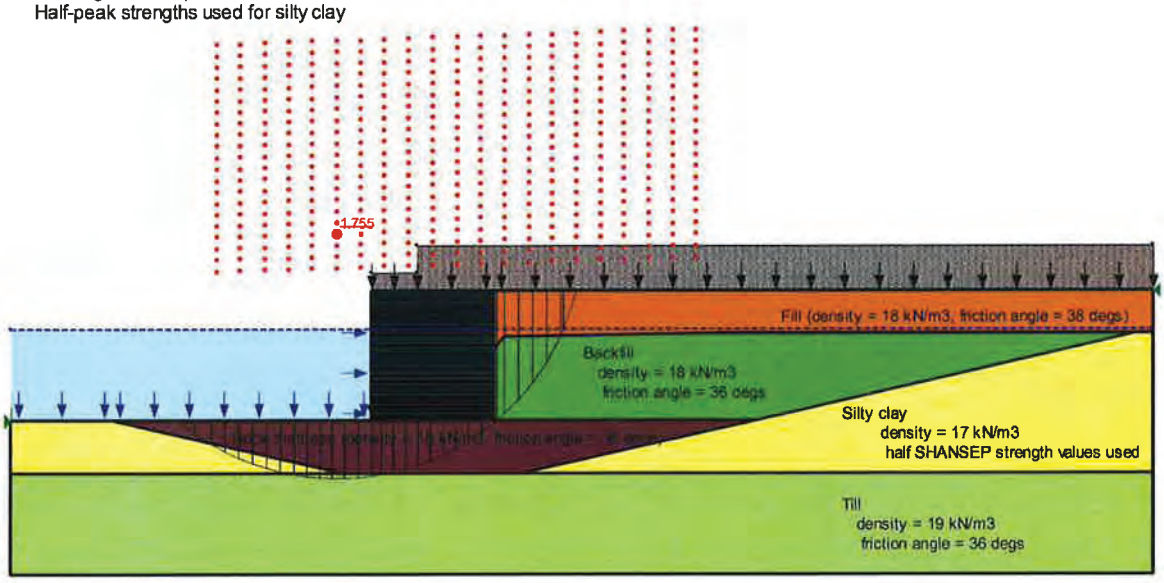
Structure: Caisson
Section: B-B'
Analysis: Pseudo-static (ky = 0.28 - yield acceleration)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face, and 48 kPa thereafter
Half-peak strengths used for silty clay



Pseudo-static (yield) slope stability of caisson option, dredgeline at -7.58 m, and seismic loading

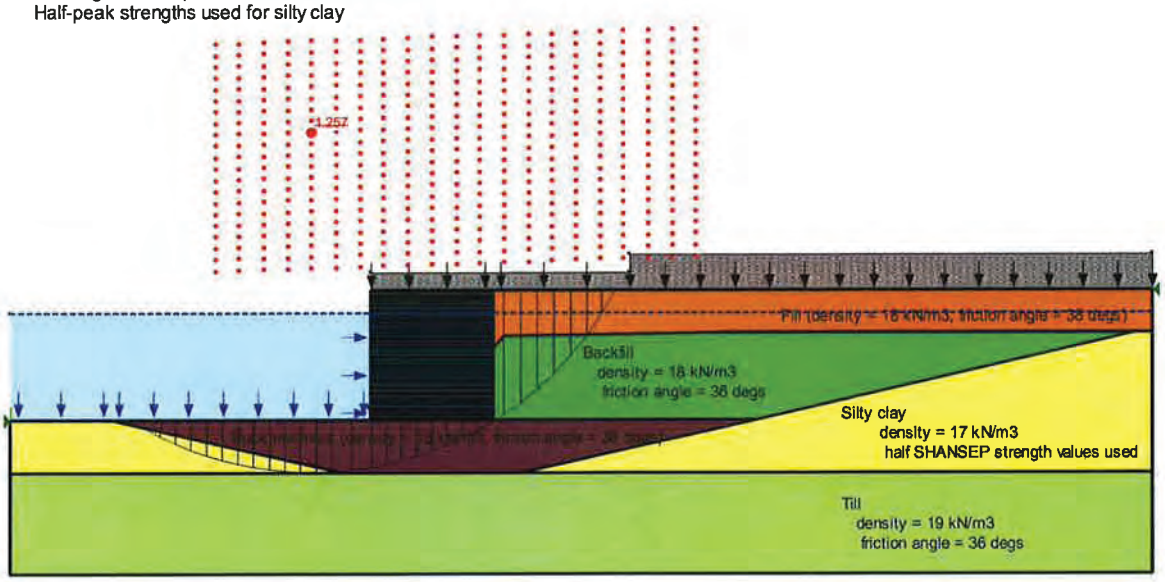
Caissons: Section C-C'

Structure: Caisson
Section: C-C'
Analysis: Static
Water table: LWL (elevation = 4.42 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 6m behind wall from berth face, and 60 kPa thereafter
Half-peak strengths used for silty clay



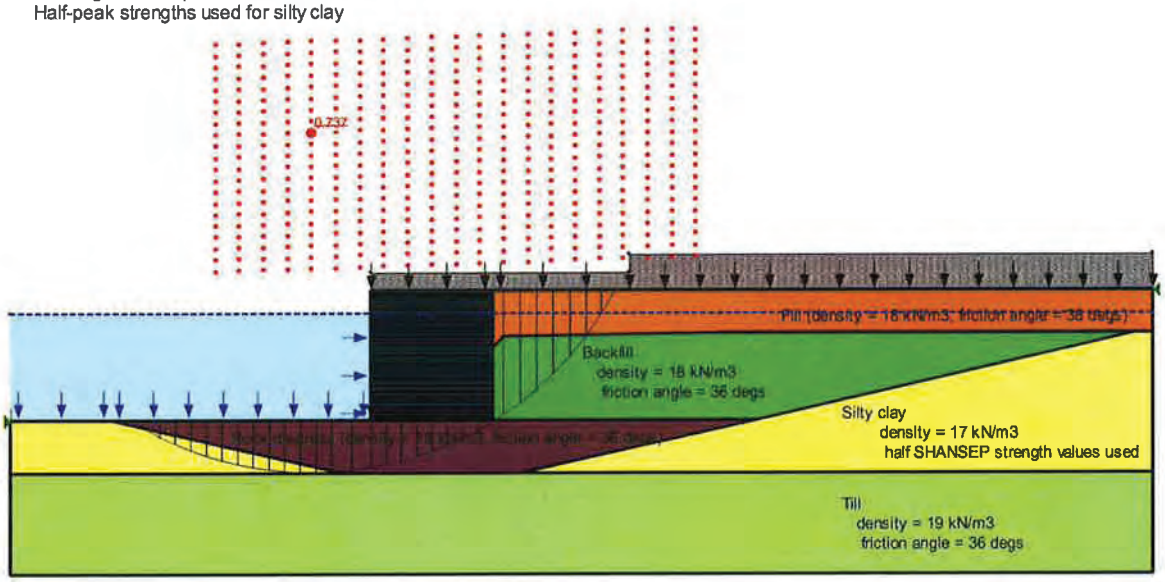
Static slope stability of caisson option, dredgeline at -7.58 m, and static loading

Structure: Caisson
Section: C-C' .
Analysis: Pseudo-static (kh = 0.149 - 100 yrs return period earthquake)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face, and 48 kPa thereafter
Half-peak strengths used for silty clay



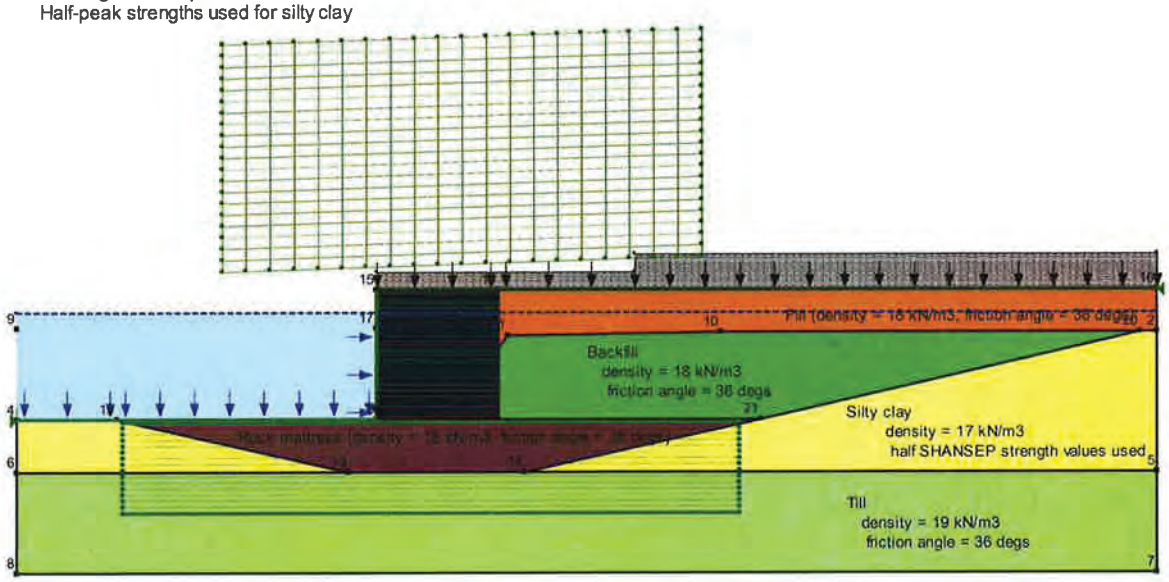
Pseudo-static (100yrs return period) slope stability of caisson option, dredgeline at -7.58 m, and seismic loading

Structure: Caisson
Section: C-C'
Analysis: Pseudo-static (kh = 0.366 - 475 yrs return period earthquake)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face, and 48 kPa thereafter
Half-peak strengths used for silty clay



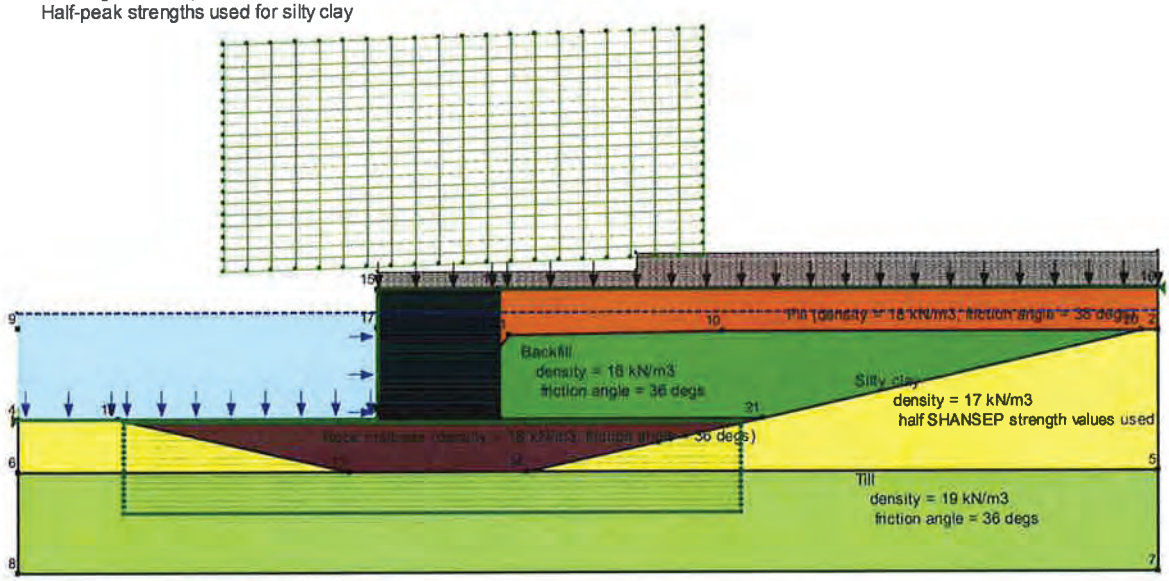
Pseudo-static (475yrs return period) slope stability of caisson option, dredgeline at -7.58 m, and seismic loading

Structure: Caisson
Section: C-C'
Analysis: Pseudo-static (kh = 0.526 - 2475 yrs return period earthquake)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face, and 48 kPa thereafter
Half-peak strengths used for silty clay



Pseudo-static (2475yrs return period) slope stability of caisson option, dredgeline at -7.58 m, and seismic loading

Structure: Caisson
Section: C-C'
Analysis: Pseudo-static (ky = 0.24 - yield acceleration)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face, and 48 kPa thereafter
Half-peak strengths used for silty clay

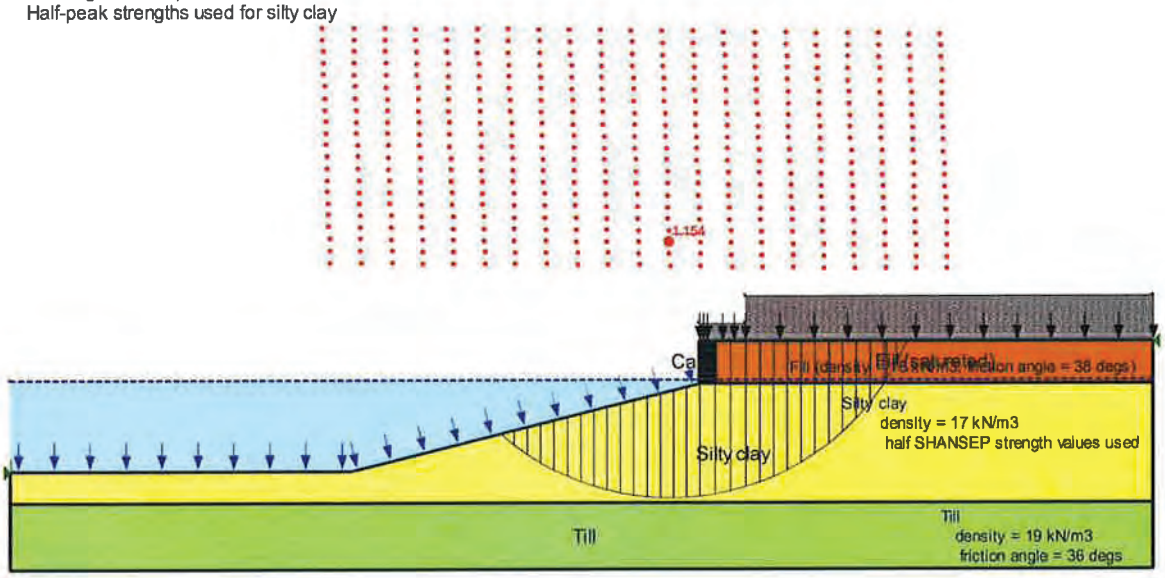


Pseudo-static (yield) slope stability of caisson option, dredgeline at -7.58 m, and seismic loading

APPENDIX D
Results of Pile and Deck Slope Stability Analyses

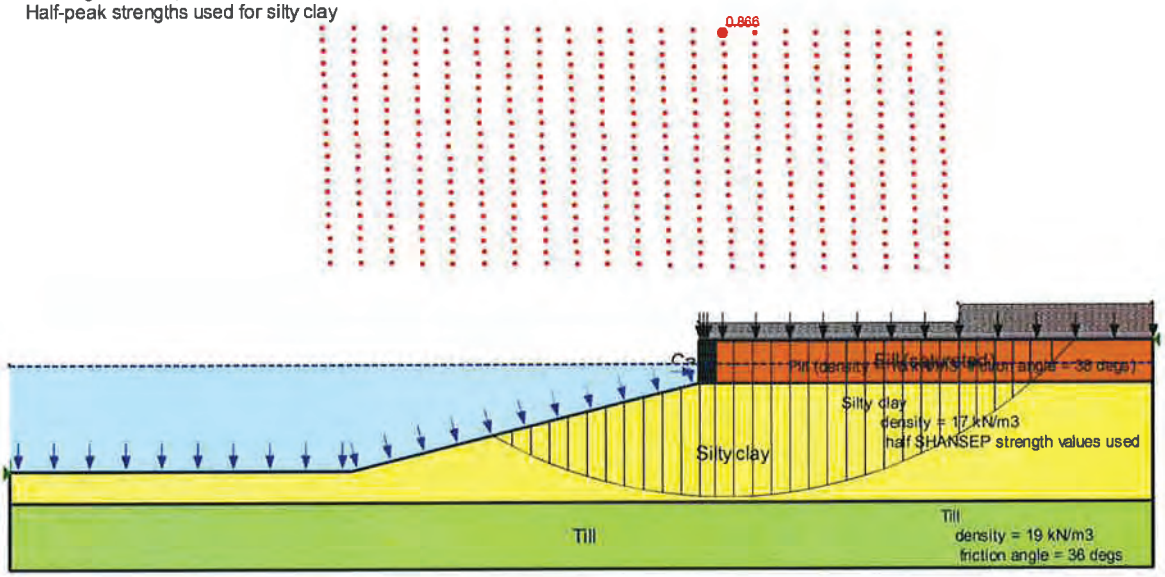
Pile and Deck: Section A-A'

Structure: Pile & Deck
Section: A-A'
Analysis: Static
Water table: LWL (elevation = 4.42 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 6m behind wall from berth face, 60 kPa thereafter
Half-peak strengths used for silty clay



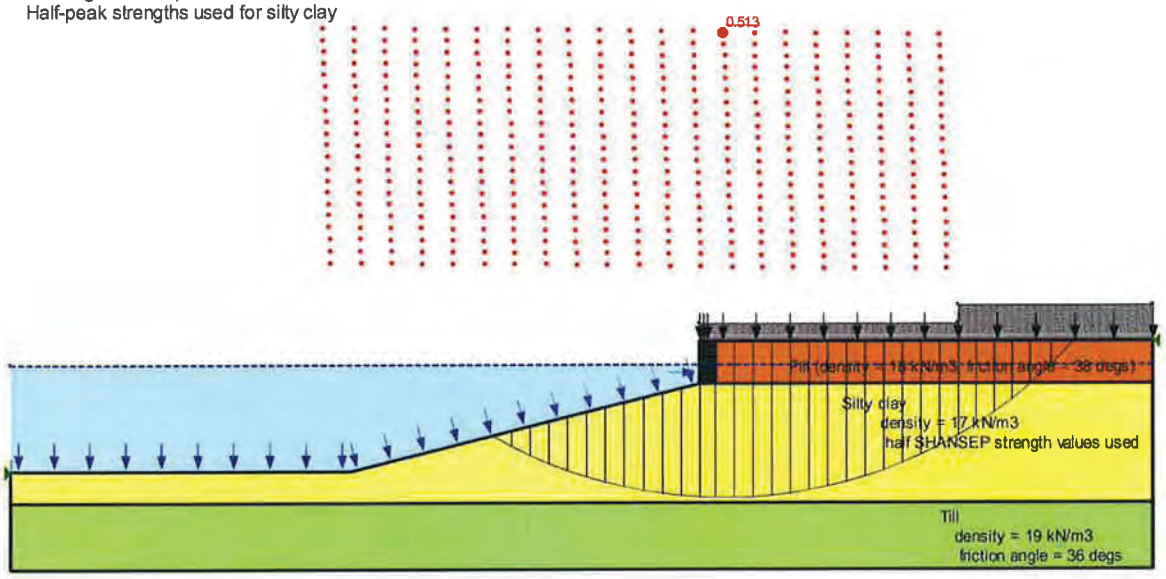
Static slope stability of pile-deck option, dredgeline at -7.58 m, and static loading

Structure: Pile & Deck
Section: A-A'
Analysis: Pseudo-static (kh = 0.149 - 100yrs return period earthquake)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face to crane rail, 48 kPa thereafter
Half-peak strengths used for silty clay



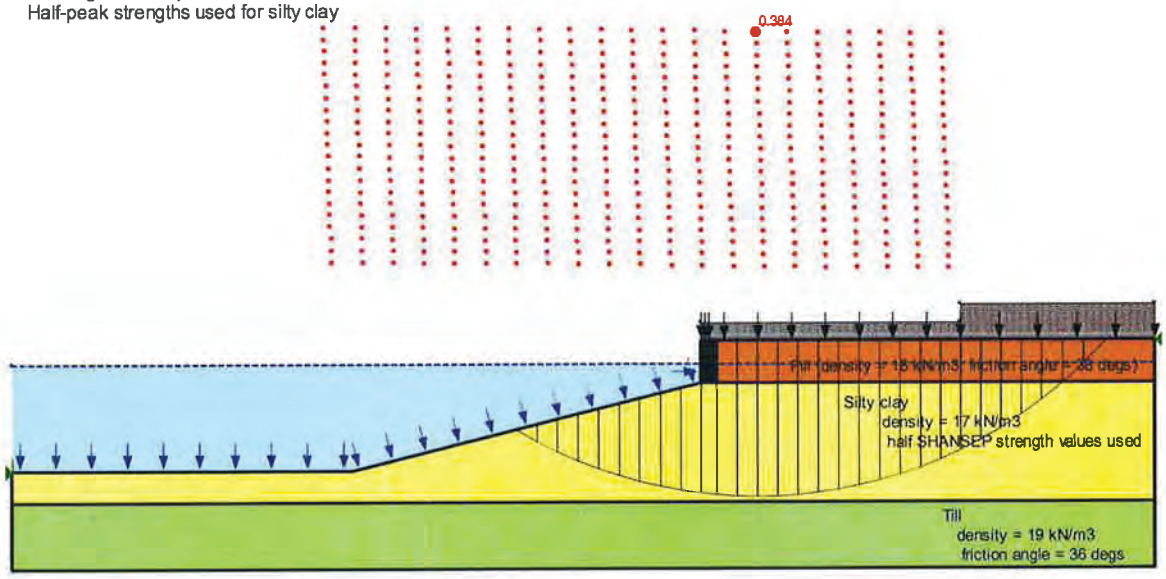
Pseudo-static (100yrs return period) slope stability of pile-deck option, dredgeline at -7.58 m, and seismic loading

Structure: Pile&Deck
Section: A-A'
Analysis: Pseudo-static (kh = 0.366 - 475yrs return period earthquake)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face to crane rail, 48 kPa thereafter
Half-peak strengths used for silty clay



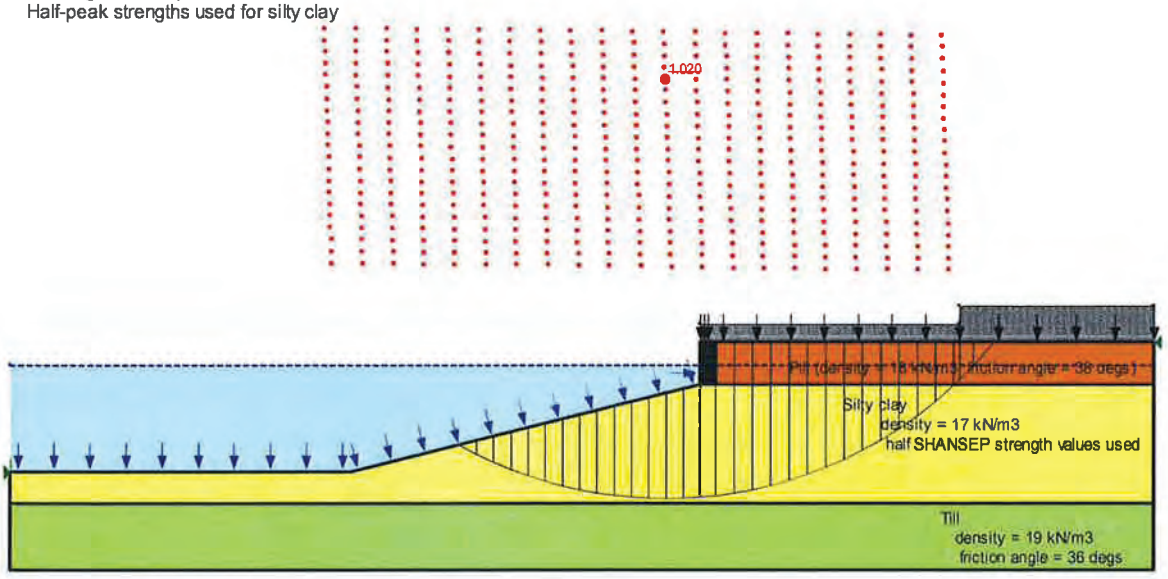
Pseudo-static (475yrs return period) slope stability of pile-deck option, dredgeline at -7.58 m, and seismic loading

Structure: Pile&Deck
Section: A-A'
Analysis: Pseudo-static (kh = 0.526 - 2475yrs return period earthquake)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face to crane rail, 48 kPa thereafter
Half-peak strengths used for silty clay



Pseudo-static (2475yrs return period) slope stability of pile-deck option, dredgeline at -7.58 m, and seismic loading

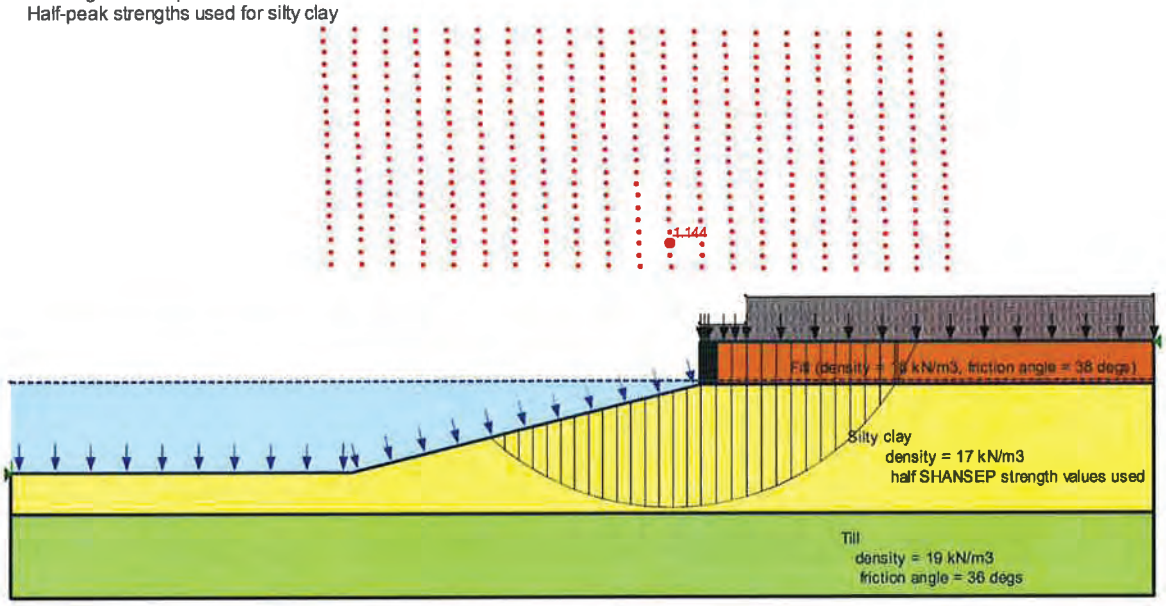
Structure: Pile & Deck
Section: A-A'
Analysis: Pseudo-static (ky = 0.11 - yield acceleration)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face to crane rail, 48 kPa thereafter
Half-peak strengths used for silty clay



Pseudo-static (yield) slope stability of pile-deck option, dredgeline at -7.58 m, and seismic loading

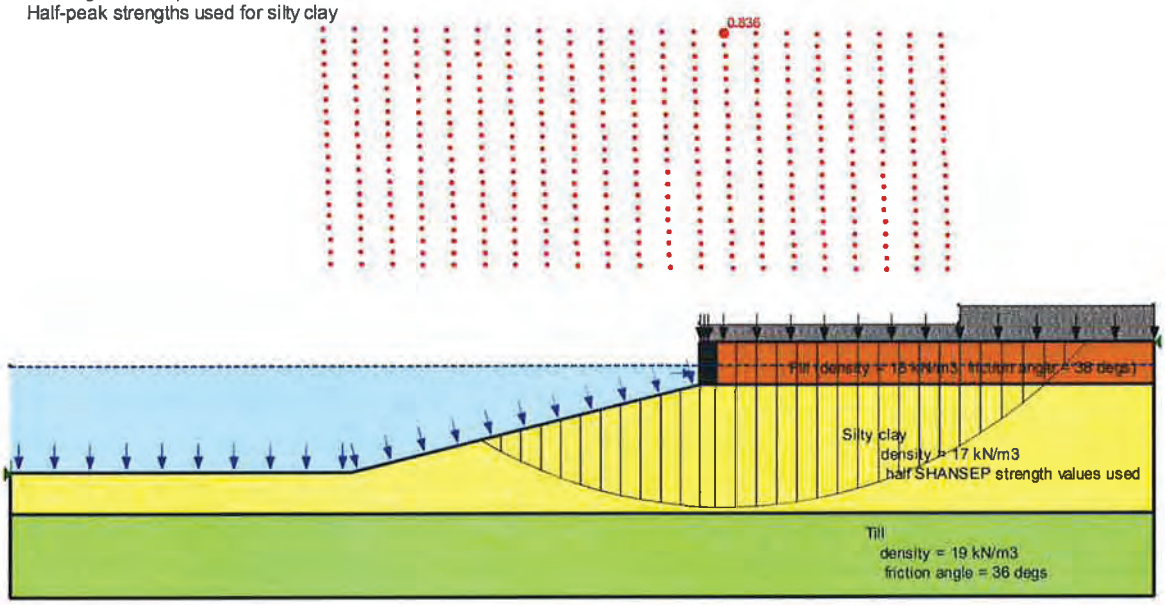
Pile and Deck: Section B-B'

Structure: Pile & Deck
Section: B-B'
Analysis: Static
Water table: LWL (elevation = 4.42 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 6m behind wall from berth face, 60 kPa thereafter
Half-peak strengths used for silty clay



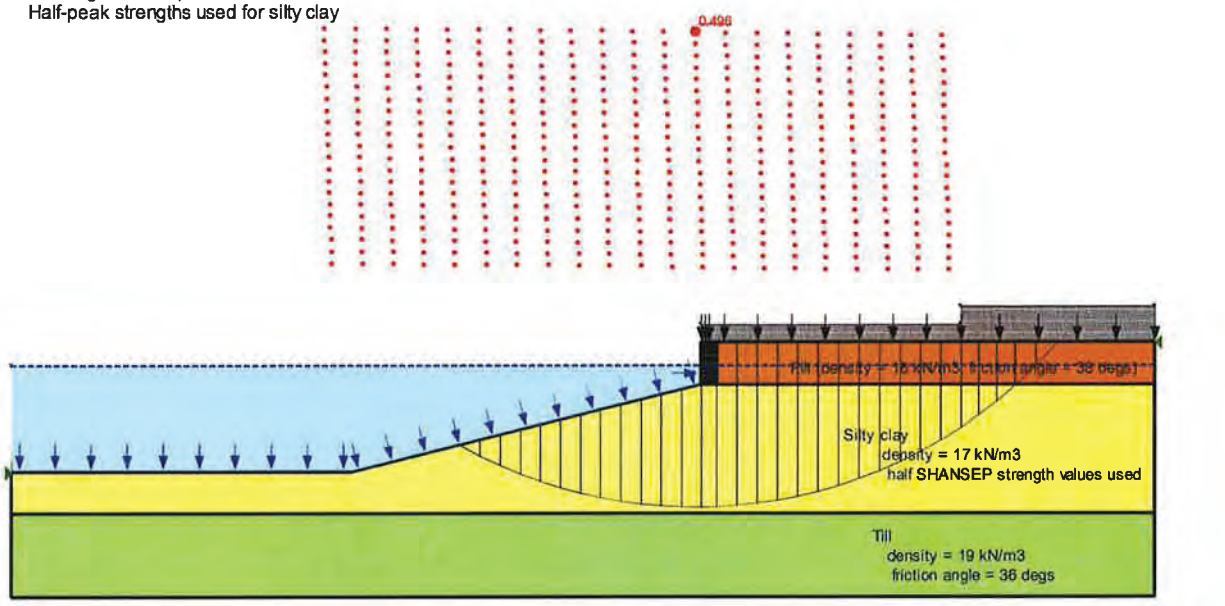
Static slope stability of pile-deck option, dredgeline at -7.58 m, and static loading

Structure: Pile & Deck
Section: B-B'
Analysis: Pseudo-static (kh = 0.149 - 100yrs return period earthquake)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face to crane rail, 48 kPa thereafter
Half-peak strengths used for silty clay



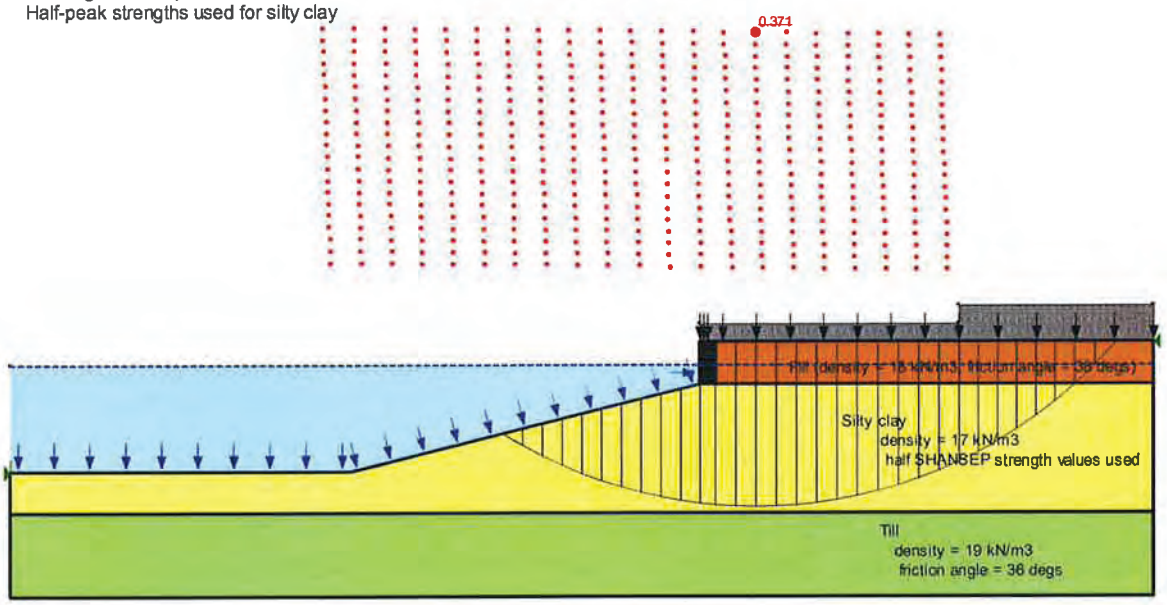
Pseudo-static (100yrs return period) slope stability of pile-deck option, dredgeline at -7.58 m, and seismic loading

Structure: Pile&Deck
Section: B-B'
Analysis: Pseudo-static (kh = 0.366 - 475yrs return period earthquake)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face to crane rail, 48 kPa thereafter
Half-peak strengths used for silty clay



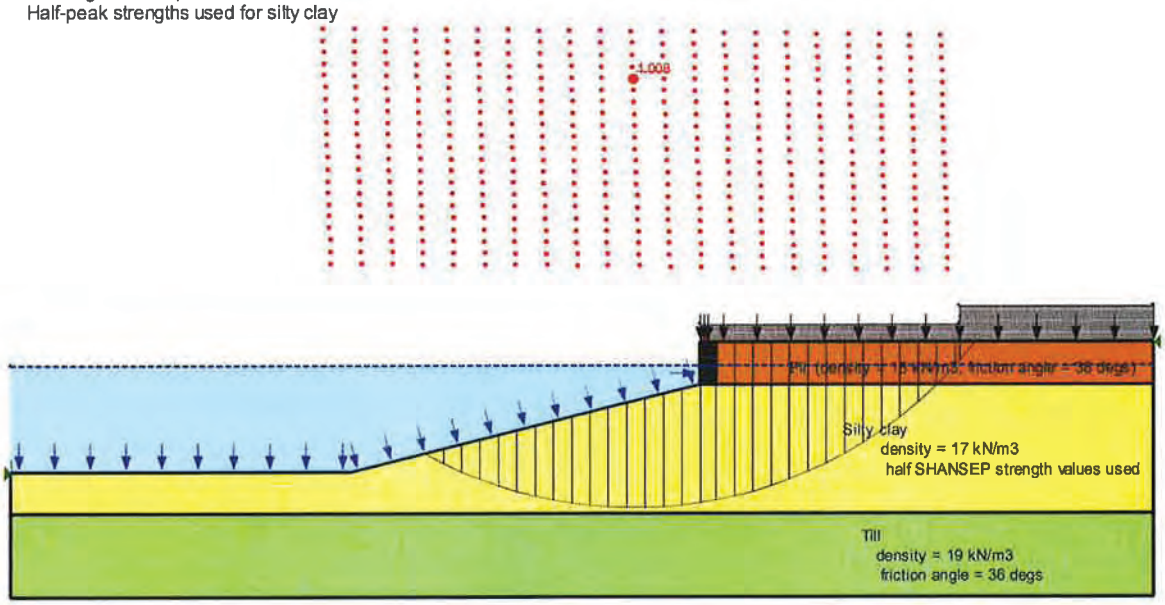
Pseudo-static (475yrs return period) slope stability of pile-deck option, dredgeline at -7.58 m, and seismic loading

Structure: Pile&Deck
Section: B-B'
Analysis: Pseudo-static (kh = 0.526 - 2475yrs return period earthquake)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face to crane rail, 48 kPa thereafter
Half-peak strengths used for silty clay



Pseudo-static (2475yrs return period) slope stability of pile-deck option, dredgeline at -7.58 m, and seismic loading

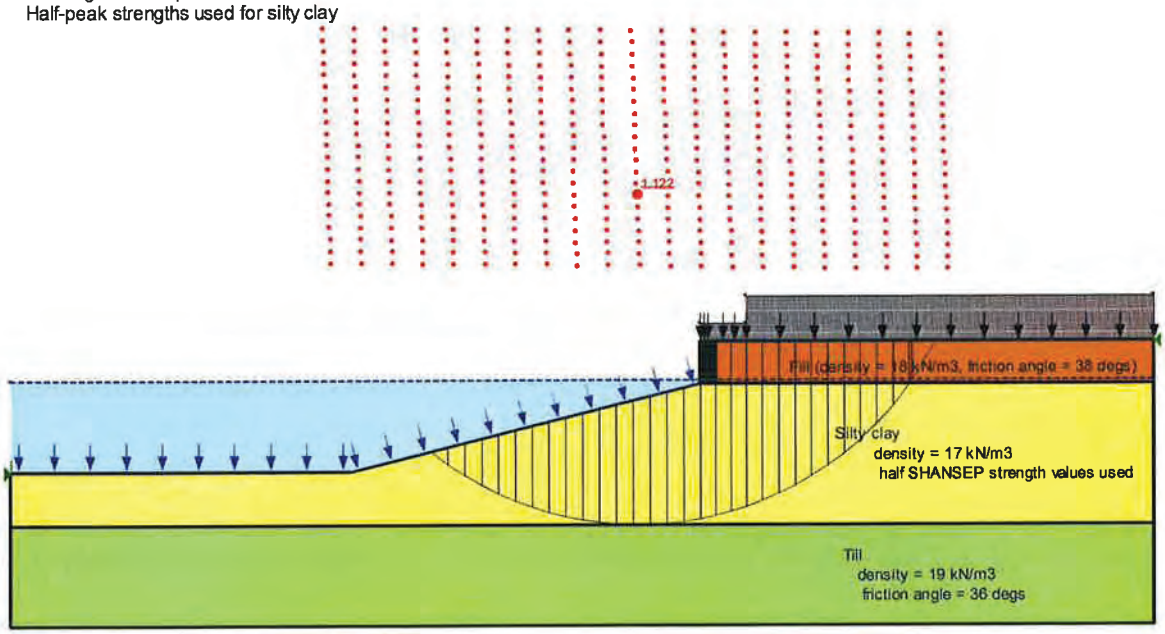
Structure: Pile & Deck
Section: B-B'
Analysis: Pseudo-static (ky = 0.11 - yield acceleration)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face to crane rail, 48 kPa thereafter
Half-peak strengths used for silty clay



Pseudo-static (yield) slope stability of pile-deck option, dredgeline at -7.58 m, and seismic loading

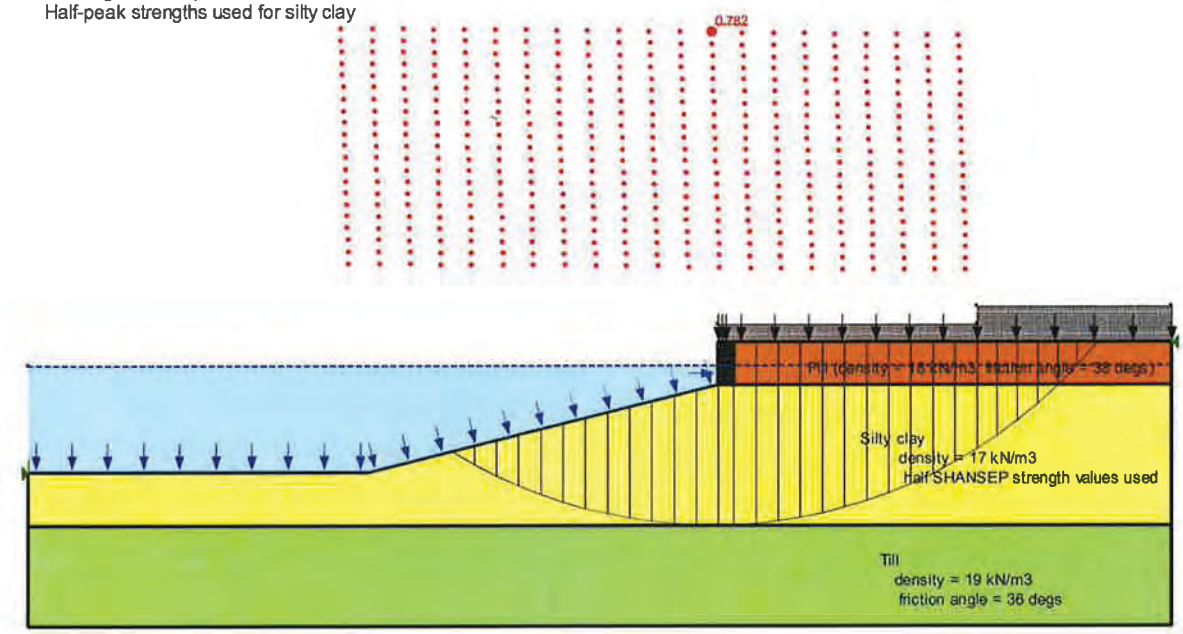
Pile and Deck: Section C-C'

Structure: Pile & Deck
Section: C-C'
Analysis: Static
Water table: LWL (elevation = 4.42 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 6m behind wall from berth face, 60 kPa thereafter
Half-peak strengths used for silty clay



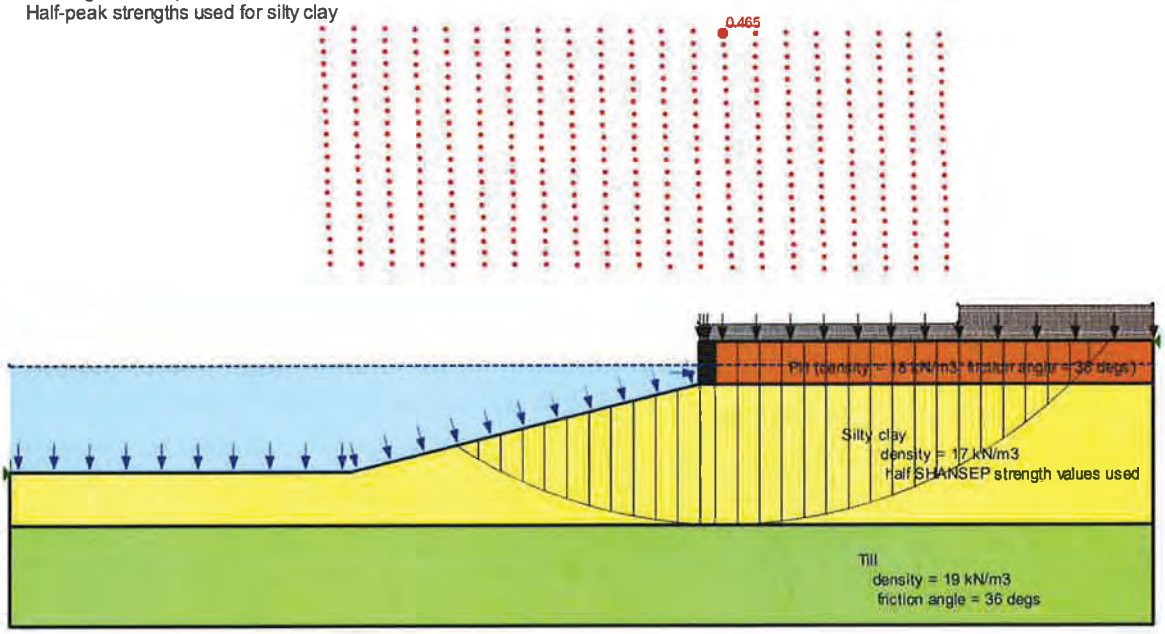
Static slope stability of pile-deck option, dredgeline at -7.58 m, and static loading

Structure: Pile & Deck
Section: C-C'
Analysis: Pseudo-static (kh = 0.149 - 100yrs return period earthquake)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face to crane rail, 48 kPa thereafter
Half-peak strengths used for silty clay



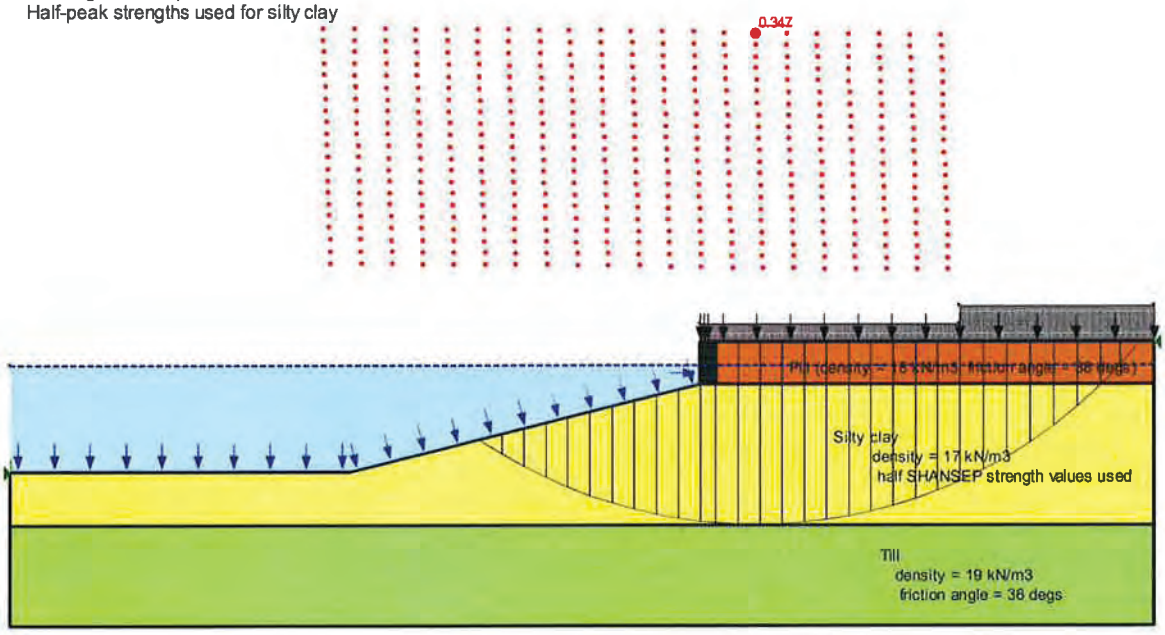
Pseudo-static (100yrs return period) slope stability of pile-deck option, dredgeline at -7.58 m, and seismic loading

Structure: Pile&Deck
Section: C-C'
Analysis: Pseudo-static (kh = 0.366 - 475yrs return period earthquake)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face to crane rail, 48 kPa thereafter
Half-peak strengths used for silty clay



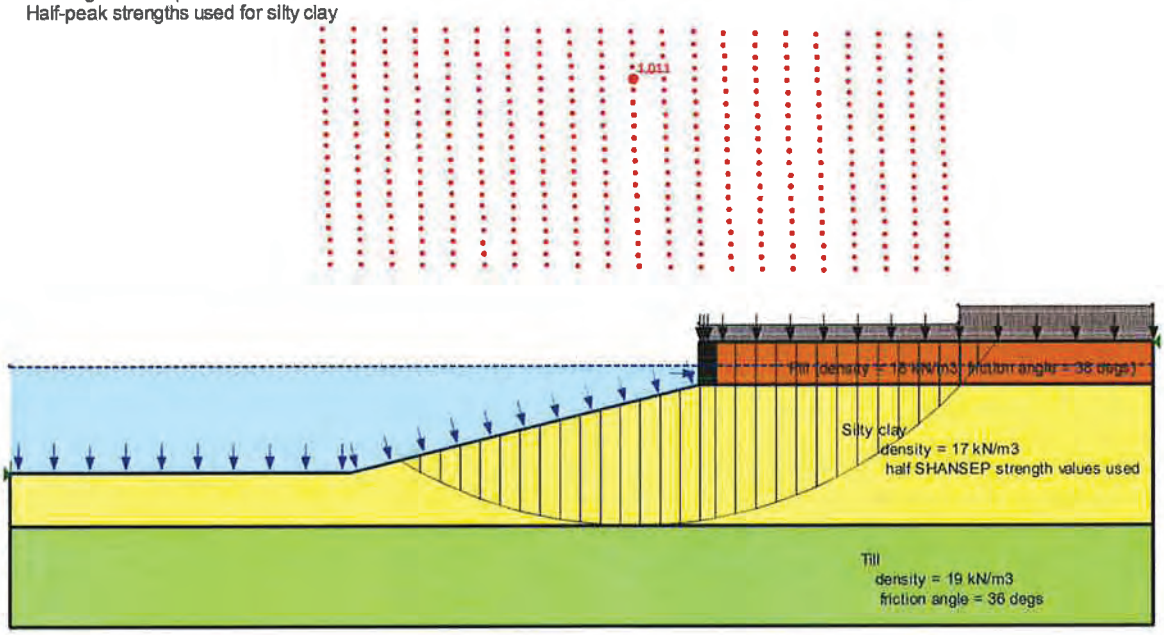
Pseudo-static (475yrs return period) slope stability of pile-deck option, dredgeline at -7.58 m, and seismic loading

Structure: Pile&Deck
Section: C-C'
Analysis: Pseudo-static (kh = 0.526 - 2475yrs return period earthquake)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face to crane rail, 48 kPa thereafter
Half-peak strengths used for silty clay



Pseudo-static (2475yrs return period) slope stability of pile-deck option, dredgeline at -7.58 m, and seismic loading

Structure: Pile & Deck
Section: C-C'
Analysis: Pseudo-static (ky = 0.09 - yield acceleration)
Water table: MWL (elevation = 6.49 m)
Dredgeline: -7.58 m
Loading: 24kPa up to 34m behind wall from berth face to crane rail, 48 kPa thereafter
Half-peak strengths used for silty clay



Pseudo-static (yield) slope stability of pile-deck option, dredgeline at -7.58 m, and seismic loading

Port of Montreal
Port de Montréal

PORT OF MONTREAL

CONTRECOEUR DEVELOPMENT MASTER PLAN

Design Criteria

FINAL

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August 4, 2010

M&N Project No. 7146

REV	DESCRIPTION	DATE	AUTHOR	CLIENT APPROVED
3	Final for Concept Review	August 4, 2010	HW	
2	Draft for Client Review	June 1, 2010	HW	
1	Draft for Client Review	May 21, 2010	HW	

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1. PROJECT OVERVIEW

1.1 Design Criteria Purpose

The Design Criteria as follows is intended to provide the requirements and guidance for the conceptual design of the major elements of the Project. It is also intended as a record of the assumptions taken during the conceptual design of the Project.

These Design Criteria are part of a "living document" that should be updated and expanded as the design process moves forward. While technical details regarding the design are expected to continue to evolve as the design process evolves, changes to the agreed upon functional performance requirements should only be revised through duly documented discussion and concurrence with the Montreal Port Authority (MPA).

1.2 Disclaimer

The Design Criteria is only part of the design process and provides a summary of the requirements and guidance as noted in Section 1.1. All details should be checked and verified by the designers of the final Project design who must exercise their own professional judgment before adopting the Design Criteria in this document.

1.3 Project Description

The project includes the planning for approximately 2229 meters of wharf that will provide 282 additional meters of berth for bulk products, and 1947 meters or 6 berths for container handling operations. The 6 berths will be operated as two separate terminals with 3 berths each. Two modes of operation for container handling will be reviewed including a conventional manned RTG storage yard and an automated RMG or ASC storage yard. Container terminal plans will include for berth, container yard, on-dock intermodal rail transfer operations, optical characteristic recognition truck gates and all necessary ancillary facilities. The two 3 berth terminals will be staged in phases over many years. Initial stages of the facility will include for one container terminal that provides for the following:

- Stage A: One berth facility with upland facilities able to handle approximately 500,000 TEUs per annum.
- Stage B: Two berth facility with a throughput capacity of approximately 1,000,000 TEUs per annum.

For a more detailed project description, see the Project Work Plan.

2. BASE SITE PLAN

A base plan for the site is shown on Drawing No. 7146-MP-1.0.

3. DESIGN STANDARDS, CODES AND GUIDELINES

3.1 Codes and Standards

Design of the Project facilities should be referenced to conform to the most current version of the following codes and standards where appropriate for design and in specifications to determine loads, performance, geometry and materials:

- National Building Code of Canada (NBCC);
- Design of Highway Bridges (CAN/CSA-S6-M);
- Division 1-A of AASHTO Standard Specifications for Highway Bridges 1996;
- Canadian Labour Code;
- CSA Standard A23.3 – Design of Concrete Structures;
- CSA Standard S16.1 – Steel Structures for Buildings – Limit State Design;
- Canadian Electrical Code;
- National Plumbing Code;
- National Fire Code of Canada;
- Model National Energy Code of Canada for Buildings;
- American Society of Heating, Refrigeration and Air Conditioning Engineers Standards;
- Canadian Sheet Steel Building Institute Standards;
- American Railway Engineering and Maintenance of Way Association (AREMA), Manual of Railway Engineering;
- TAC (Transportation Association of Canada) Geometric Design Guide for Canadian Roads;
- PIANC – World Association for Waterborne Transport Infrastructure;
- International Ship & Port Facility Security Code;
- Transport Canada – Marine Transportation Security Regulations;
- Canadian Council of Ministers of the Environment (CCME) Environmental Code of Practice for Aboveground and Underground Storage Tanks Containing Petroleum Products and Allied Petroleum Products;
- Port Designer's Handbook: Recommendations and Guidelines, pg. 137 (Carl A. Thoresen);
- Coastal Engineering Manual, US Army Corps of Engineers; and,
- Lighting Recommendations of the Illuminating Engineering Society.

4. PROJECT DATUM AND MEASUREMENT

4.1 Units of Measurement

Drawings and specifications will be in SI (metric) units. Exceptions may be made for track and rail works.

4.2 Project Datum

Geodetic (Geodesic) datum in metric units is the project vertical datum, unless otherwise noted, and is consistent with the topographic data provided by MPA.

Local Hydrographic Tide and Chart Datum (Zero des Cartes) in metric units is often used for bathymetric (river bottom) surveys. Because the project site is located along a river, the conversion between geodetic and chart datum varies along the river. Based on data provided by the MPA 0.0 m Canadian Hydrographic Services Chart Datum (CD) at the site = 4.42 m GEODETIC.

4.3 Project Grid

MTM NAD83 Zone 8 coordinates is the project grid, which is consistent with the base plans provided by MPA.

4.4 Survey Control

Survey controls will be based on existing monuments and bench marks identified by the MPA.

5. SERVICE LIFE

Assuming a regular and routine inspection and maintenance program is in place and will be completed as scheduled, all new facilities shall have a service life of minimum 50 years unless noted otherwise below.

New terminal buildings shall be designed for a service life of minimum 30 years.

Terminal pavements and the new fender systems shall be designed for a service life of minimum 20 years.

6. ENVIRONMENTAL LOADS

Environmental loads derived from data published in Table C-2 of the supplement to the NBCC for Contrecoeur.

6.1 Wind

Hourly Wind Pressure:	1/10	0.33 kPa
	1/50	0.43 kPa

6.2 Snow

Ground Snow Load:	S_S	2.8 kPa
	S_R	0.4 kPa

6.3 Temperature

Maximum Daily:	30 deg. C	
Minimum Daily:	-27 deg. C	

6.4 Rain

15 Minutes:	20 mm	
One Day:	102 mm	
Annual Total Precipitation:	810 mm	

6.5 Seismic

The peak firm ground accelerations for the various probabilities of exceedance will be as provided in Table C-2 of the Supplement to the NBCC and Table J-2 of the User's Guide to the NBCC:

Performance Level	Probability of Annual Exceedance	Peak Horizontal Ground Acceleration PHA	Probability of Exceedance in 50 Years	Average Return Period in Years
OLE	1.0000%	n/a	40%	100
CLE	0.2105%	0.18 g	10%	475
LSE	0.0404%	0.42 g	2%	2,475

7. SHORELINE PROTECTION AND DYKES

7.1 Water Levels and Depths

Daily average water levels as measured from local Hydrographic Tide and Chart Datum:

Max. Water Level (flow of 20,500 cu.m./s)	4.15 metres (200 yr. event)
Mean Water Level (flow of 9500 cu.m/s)	0.75 metres
Min. Water Level (flow of 6650 cu.m/s)	-0.54 metres

Daily average water levels as measured from Geodetic Datum:

Max. Water Level (flow of 20,500 cu.m./s)	8.57 metres (200 yr. event)
Mean Water Level (flow of 9500 cu.m/s)	5.17 metres
Min. Water Level (flow of 6650 cu.m/s)	3.88 metres

7.2 Currents, Waves and Vessel Wakes

Current Set Parallel to Berth Face:	to follow from Environment Canada
Current Set Perpendicular to Berth Face:	to follow from Environment Canada
Significant Wave Ht. & Period at Berth Face:	1.0 m, 2.8 s
Passing Vessel Wake, 250 m LOA Ship:	0.5 m, 2.0 s
Passing Vessel Wake, Tug:	0.8 m, 3.5 s

7.3 Ice

Ice loads shall be determined by the final designer and shall consider moving ice, ice buildup, sheet ice and ice anti-freeze. Historical ice thickness data from Environment Canada was collected upstream of the site (Station P1) between 1984 and 2001. Of the 68 samples, the maximum ice thickness was 68 cm. (This is considered to be a conservative estimate of future ice thicknesses at the site: Dr. Robert Frederking, National Research Council personal communication).

7.4 Design Basis

The basis for design of any armoured slope protection shall be a 20 year service life with 10% risk of exceedance for environmental factors such as waves, tides, ice, currents and the maximum credible operating conditions for vessel factors such as passing ship wakes, surges, propeller wash, etc.

A no damage criteria for slope materials shall be used and a maximum of 5 percent of stone displacement is permitted.

8. WHARFS

8.1 Marine Criteria

8.1.1 Water Levels

Daily average water levels as measured from local Hydrographic Tide and Chart Datum:

Max. Water Level (flow of 20,500 cu.m./s)	4.15 metres (200 yr. event)
Mean Water Level (flow of 9500 cu.m/s)	0.75 metres
Min. Water Level (flow of 6650 cu.m/s)	-0.54 metres

Daily average water levels as measured from Geodetic Datum:

Max. Water Level (flow of 20,500 cu.m./s)	8.57 metres (200 yr. event)
Mean Water Level (flow of 9500 cu.m/s)	5.17 metres
Min. Water Level (flow of 6650 cu.m/s)	3.88 metres

8.1.2 Water Depths

The minimum water depth of the container vessel berths shall be 11.3 meters below Chart Datum (- 6.88 meters GSC) with provision for future deepening to 12.0 meters below Chart Datum (- 7.58 m GSC).

The minimum water depth of the extended bulk berth shall be 10.7 meters below Chart Datum (-6.28 m GSC).

The minimum water depth for a new tug berth shall be 8.0 meters below Chart Datum (-3.58 m GSC).

8.1.3 Currents, Waves and Vessel Wakes

As per Clause 7.2.

8.1.4 Design Vessels

A variety of vessel types, sizes and capacities will need to be accommodated at various locations throughout the Project as follows:

Vessel Type	Berth Location	DWT (tonnes)	LOA (metres)	Beam (metres)	Max. Loaded Draught (metres)
5,800 TEU Container Ship (max.)	Container	72,200	300	40.7	13.4*
1,800 TEU Container Ship (min.)	Container	26,500	187	28.0	10.5*
Dry Bulk Carrier (max.)	Bulk	tbd	244	32.2	tbd
Tug	Tug	n/a	30.8	11.19	5.21

* *Vessel will not transit river at fully loaded draught*

8.1.5 Berthing Energy

The fendering system shall be designed as recommended in the PIANC Guidelines for the Design of Fender Systems: 2002. Further confirmation by the designer of actual berthing criteria at the Port is recommended.

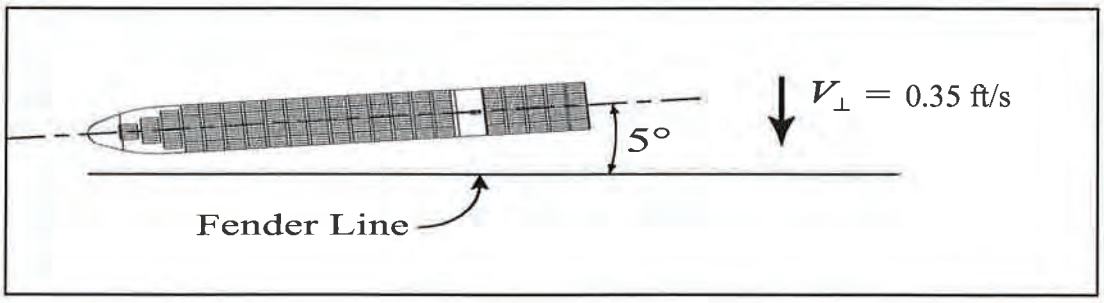
PIANC Guidelines Recommend:

For vessels greater than 10,000 dwt, berthing energy should be based upon:

- Approach velocity of 0.15 m/sec.
- Approach angle of 5 degrees.
- ¼ point berthing.

For vessels less than 10,000 dwt, berthing energy should be based upon:

- Approach velocity of 0.20 m/sec.
- Approach angle of 7.5 degrees.
- ¼ point berthing.



Vessel hull pressures should not exceed 25 tonnes/square meter.

Berthing forces shall be calculated in accordance with the recommendations of PIANC Guidelines for the Design of Fender Systems: 2002.

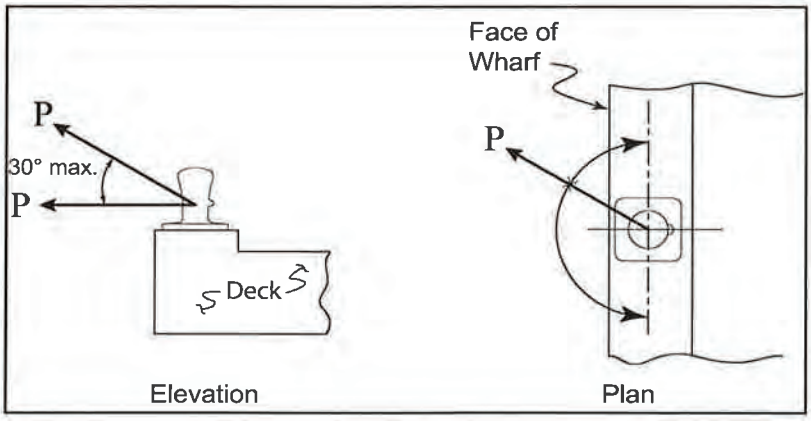
8.1.6 Mooring Forces

Bollards shall be designed to resist the most severe load combination of wind, wave and current. The mooring analysis shall consider the full range of design vessels at high and low water. The wind speed to be used for the mooring analysis will be a wind with 50 year mean recurrence interval, corrected for a 30 second gust duration and wind spectral effects. Wind directionality effects will be included consistent with available wind records from nearby sources.

Table 1: Bollard load P and approximate spacing

Ships with displacement in tons up to	Bollard load P in kN	Approximate spacing between bollards in metres	Bollard load normal from the berth in kN/m berth	Bollard load along the berth in kN/m berth
2000	100	5–10	15	10
5000	200	10–15	15	10
10 000	300	15	20	15
20 000	500	20	25	20
30 000	600	20	30	20
50 000	800	20 25	35	20
100 000	1000 (102t)	25	40	25
200 000	1500	30	50	30

Table 1 provides general guidelines for approximating bollard loads and bollard spacing based on ship displacements. For ships with displacement of up to 100,000 tons, a bollard load of 1000 kN (102 tons) at 25 m spacing can be expected. For preliminary design purposes, it is assumed that the bollards at the berth face will be designed for a maximum combined line pull of 100 tons acting over the range of vertical and horizontal directions noted below. This line pull is interpreted to be total force vector acting on the bollard regardless of the number of individual mooring lines deployed on that bollard. It is anticipated that terminal operational rules will require that no more than two mooring lines be deployed on any bollard.



A dynamic mooring analysis is recommended to be performed in the detailed design stage to determine the design mooring loads and verify bollard spacing.

8.2 Wharf Apron

8.2.1 Dead Loads

Shall be the self weight of all fixed structures and permanently fixed appurtenances.

8.2.2 Uniform Live Loads

Uniformly Distributed Storage Load (UDL) on the wharf apron at the new dry bulk berth shall be:

- To be provided by the Owner or Tenant

Uniformly Distributed Load on the wharf apron at the container berths from container stacks shall be:

- 40 foot containers stacked 4 high (30.5 tonnes/container)
  - UDL: 48 kPa
- 20 foot containers stacked 4 high (24 tonnes/container)
  - UDL: 72 kPa

Uniform Distributed Storage Load on the Container Wharf Apron when Simultaneous Container Crane Wheel loads are applied: 60 kPa. Under this loading scenario, the uniformly distributed storage load need not be applied within 1.5 meters of either side of the landside or waterside crane rails. UDL may be reduced to 24 kPa under seismic load conditions as container stacking on the wharf will be periodic.

Container wharf UDL outboard of the waterside crane rail: 24 kPa

Container Wharf UDL for Long Term Settlement: 10 kPa

8.2.3 Hatch Covers

Hatch Covers:

- Uniformly Distributed Load: 15 kPa
- Self Weight (each): 285 kN
- Corner Load (stacked five high): 430 kN

An impact allowance of 20% will be added to the above loads.

8.2.4 Container Crane Rail Loads (STS-Crane)

The Contrecoeur container terminals shall be designed for 80t "Tandem 40" Post-Panamax container cranes with a rail gauge of 30.48 m (100 ft).

Lifting Capacity: The crane is designed for handling ISO Containers 6.1 m (20 ft)., 12.2 m (40 ft) and 13.7 m (45 ft) lengths with the Safe Working Loads (SWL) as follows:

Tandem Lift Operation (2 x 40ft Containers) (Unlimited Outreach / Backreach) Capacity under Tandem Spreader Arrangement:	80.00 Tonnes
Single Lift Operation (unlimited outreach/backreach) Capacity under Single Lift Arrangement:	40.00 Tonnes
General Cargo (with Hook Beam) (unlimited outreach/backreach) Capacity under Hook Beam :	75.00 Tonnes
Heavy Lift (with Hook Beam) (restricted outreach/backreach) Capacity under Hook Beam:	90.00 Tonnes
Operating Wind Speed:	90.0 km/hr (56.0 mph)
Stored Wind Speed (Capacity of Stowage Pins):	150.0 km/hr (93.0 mph)

The maximum load occurs on the waterside rail when the load being lifted is at the extreme end of the derrick boom. The maximum load occurs on the landside rail when the load being lifted is at its furthermost inland point from the landside rail with the boom down.

Preliminary data for an 80t "Tandem 40" Container Crane, is as follows:

- Dead weight = 1,870 long tons (1,900 tonnes);
- Lifting capacity = 80 tonnes;
- Truck arrangement = 4 trucks, 8 wheels per truck;
- Distance between wheels at each truck = 1.375 m for Design Case I (minimum), or 1.500 m for Design Case II (maximum);
- Distance between the load centres of the two corners on a rail = 13.3 m for Case I (i.e. 3.675 m gap between centre wheels), or 14.1 m for Case II (i.e. 3.60 m gap between centre wheels);
- Overall length of crane (bumper to bumper) = 27.0 m (Note: this exceeds the commonly used value of 86'6" by about 24");
- Location of stowage pin slot: offset from rail centerline = 415 mm (same as existing);
- Normal Operating Condition:
- Waterside Wheel Load = 115 tonnes (254 kips) per wheel;
- Landside Wheel Load = 90 tonnes (199 kips) per wheel;
- Extreme Operating Condition:
- Waterside Wheel Load = 130 tonnes (287 kips) per wheel;
- Landside Wheel Load = 105 tonnes (232 kips) per wheel;

- Earthquake Condition:
- Waterside Wheel Load = 135 tonnes (298 kips) per wheel;
- Landside Wheel Load = 120 tonnes (265 kips) per wheel;
- Stowed (Storm Wind) Condition:
- Waterside Wheel Load = 130 tonnes (287 kips) per wheel;
- Landside Wheel Load = 110 tonnes (243 kips) per wheel; and,
- Max. Lateral Load (applied at top of rail) = 18.6 tonnes per wheel.

  (All the above loads are unfactored.)

Buffer (impact load): Crane buffers (stops) shall be designed to resist a horizontal impacting force of 1,500 kN for each rail, applied 1.8 metres above the top of the rail, and in a direction parallel to the rail.

8.2.5 Cargo Handling Equipment & Other Equipment Loads

The following equipment loads shall be considered. An impact allowance impact loading shall be added to the loads.

- Dry Bulk Terminal
  - Axle loads for highway trucks:
    - Single axle: 89 kN
    - Double axle: 152 kN
    - Triple axle: 189 kN
    - HS-25 loading as per AASHTO
  - Bulk handling and storage:
    - Caterpillar Model 988 Front End Loader
      - Front (Driving) Axle: 667 kN
      - Rear (Steering) Axle: 55 kN
      - Ground Contact Pressure: 448 kPa
    - Uniformly Distributed Loads
      - 100 kPa
  - Berth apron areas
    - Liebherr Harbour Mobile Crane Model Number LHM 320 (4 Axle - 8 tires per axle).
      - Wheel load: 56.4 kN and Outrigger load: 16.8 kPa.
    - 200 t Crawler Crane (Manitowoc 777 Series 2)
      - Working weight (excludes load): 169,830 kg

An impact allowance of 10% will be added to the above loads.

- Container Terminals

- Axle loads for highway trucks/bombcarts:
  - Single axle: 89 kN
  - Double axle: 152 kN
  - Triple axle: 189 kN
  - HS-25 Loading as per AASHTO
- Container stacking and storage:
  - Top-pick Container Handler (Taylor TEC-950L)
    - Front (Driving) Axle: 944 kN
    - Rear (Steering) Axle: 66 kN
    - Ground Contact Pressure: 825 kPa
  - Reachstacker Container Handler (TRSI-994L)
    - Front (Driving) Axle: 1160 kN
    - Rear (Steering) Axle: 349 kN
    - Ground Contact Pressure: 1050 kPa
  - Automated Guided Vehicles (AGVs)
    - Wheel Base: 8.8 m
    - AGV Width: 3.0 m
    - Maximum Payload: 590 kN
    - Tire Size (one each corner): 18.00 R25 (inches)
    - Self Weight: 25,000kg
    - Max. Tire Pressure: 9.6 bar
  - Shuttle Carriers (Kalmar SHC-250)
    - Wheel Base: 6.7 m
    - Wheel Width: 4.6 m
    - One Wheel Per Corner
    - Capacity Under Spreader: 50 ton
    - Service Weight: 45 ton
    - Wheel Load Fully Loaded: 23.8 ton

8.2.6 Seismic Loads

A probabilistic and risk based performance criteria is established for the project. The base peak firm ground accelerations for the various probabilities of exceedance have been determined based on site-specific ground motion parameters obtained from Geological Survey of Canada (GSC) and modified for the for site response values for the Project. The accompanying geotechnical assessments for liquefaction for the project site provide these site-specific ground motion parameters.

The performance criteria for the level of acceptable seismic damage are based on three seismic events.

8.2.7 Operating Level Earthquake (OLE)

The OLE is defined as the seismic event that produces ground motions associated with a 100-year return period which equates to a 40% probability of being exceeded in 50 years. The OLE is a more frequent occurrence, and the associated structural damage is repairable, and mainly superficial in nature. After the OLE event, the wharf should have minimal, if any, interruption of operations. The OLE level of associated damage precludes any loss of life.

8.2.8 Contingency Level Earthquake (CLE)

The target performance of the CLE is defined as the seismic event that produces ground motions associated with a 475-year return period which equates to a 10% probability of being exceeded in 50 years. The CLE event is of higher intensity, and considered less frequent, with an associated level of damage that precludes major structural damage and collapse. After a CLE event, there may be temporary loss of operations, which should be restored within a few months. All damages shall be repairable. The CLE level of associated damage precludes any loss of life.

8.2.9 Life Safety Earthquake (LSE)

The LSE is a major seismic event with a return period of 2,475 years which equates to a 2% chance of being exceeded in 50 years. After an LSE event, there may be complete loss of operations, with non-repairable damage to the structure. The LSE level of associated damage precludes any loss of life.

The seismic mass associated with the yard and apron loads is assumed to be 10% of the design live load.

The response frequency separation between the gantry crane and wharf is large enough to essentially isolate the higher period crane from the lower period wharf. As such, the horizontal seismic mass associated with the gantry crane need not be included with the seismic analysis. The vertical seismic forces resulting from the rocking motion of the crane under seismic motions shall be considered. If crane tie-downs are utilized, the additional dynamic restraining forces shall also be considered.

8.3 Load Combinations – Structural Performance Criteria

8.3.1 Limit States, Load Factors & Combinations

8.3.2 General

Piers and wharves should be proportioned to safely resist the load combinations represented in the two tables below. Each component of the structure and the foundation element should be analyzed for all the applicable combinations.

Load Symbols		
D	=	Dead Load
L*	=	Live Load
I	=	Impact Load
BU	=	Buoyancy Load
BE	=	Berthing Load
E	=	Earth Pressure Load
EQ	=	Earthquake Load
W	=	Wind Load on Structure
R	=	Creep/rib Shortening
S	=	Shrinkage
T	=	Temperature Load
M	=	Mooring Load
*	=	Includes Live Loads from bulk handling products such as belt tension, material, material upset, and plugged chutes.

8.3.3 Impact Loading

The following impact loading shall be considered in addition to the load factors:

LOADING	IMPACT
Uniform Load	0%
Truck Load	10%
Forklift & Container Handler Loading	10%
Mobile Harbour Crane	20%

8.3.4 Service Load Design (SLD)

The service load approach should be used for designing and checking foundation stability and long-term wharf loading. Mooring bollards and chains shall be sized based on service loads. Fittings (anchor bolts and embedded plates) shall be designed using factored loads. For the design of the pile foundations, a 20% reduction in live load shall be considered.

8.3.5 Limit States Load and Resistance Factor (LRFD) Design

Concrete and steel structures will be proportioned using the Limit States method, also known as Load and Resistance Factor Design (LRFD). However, they should be checked for serviceability and construction loads.

Load Combinations:

Load combinations are determined keeping in mind the overall applicability of these for various different parts of the master plan including a liquid berth, two container berths and bulk berths also. A review of current industry standards including MOTEMS, POLB design criteria were considered. Load Combinations I through VI (SLD & LRFD) shall be considered for the container terminal. Live Load factors for the bulk material handling structures should be included in the live load combinations.

LOAD FACTOR DESIGN (LFD)[a]									
Case	LOAD COMBINATION FACTORS								
	D	L[f]+I[b]	E	W	BE	R+S+T	EQ	BU	M
I	1.2	1.6	1.6	—	—	—	—	1.3	—
II	1.2	1.0	1.6	1.6	—	1.2	—	1.3	—
III[c]	0.9	—	1.6	1.6	—	1.3	—	1.3	—
IV	1.2	0.1[d]	1.6	1.0	1.6	—	—	1.3	—
V	1.2	1.0	1.6	1.3	—	—	—	1.3	1.3
VI	1±K[e]	0.1[d]	1.0	—	—	—	1.0	—	—

SERVICE LOAD DESIGN (SLD)										
Case	LOAD COMBINATION FACTORS									Allowable Stress
	D	L[f]+ I	E	W	BE	R+S+T	EQ	BU	M	
I	1.0	1.0	1.0	—	—	—	—	1.0	—	100%
II	1.0	1.0	1.0	1.0	—	1.0	—	1.0	—	133%
III	1.0	—	1.0	1.0	—	1.0	—	1.0	—	125%
IV	1.0	0.1[d]	1.0	0.3	1.0	—	—	1.0	—	100%
V	1.0	1.0	1.0	1.0	—	—	—	1.0	1.0	125%

[a] The Load Factor Design require the strength reduction factors, as specified in ACI-318 2005.

[b] The live load factor of crane load case should be 1.3.

[c] Reduce load factor to 0.9 for dead load (D) to check members for minimum axial load and maximum moment.

[d] For uniform live load only.

[e] K = 0.50 (PGA), to account for the affects of the vertical component of ground acceleration. The K-factor shall be applied to the vertical dead load (D) only, not to the inertia mass of the wharf.

[f] Includes Live Loads from bulk handling products such as belt tension, material, material upset, and plugged chutes.

9. CONTAINER, INTERMODAL AND BULK YARDS

9.1 Grades, Drainage and Storm Water

Grades in container and intermodal yards shall be 1% or less.

In bulk yards, grades shall be 2% or less.

In the rail and intermodal yards, grades parallel to the tracks shall be 0.2% or less. Grades perpendicular to the tracks shall be 1% or less.

Drainage structures shall be avoided in the intermodal yard.

Ponding shall not be permitted in grounded container storage areas during a 1 in 10 year rainstorm.

For RTG operations, grades along the wheel travel direction of the concrete runways will not exceed 0.8%. Grades perpendicular to the runways shall be 1% or less.

When traveling or at rest, all corner wheels of the RTG shall be in the same horizontal plane to prevent racking. Where this is not possible, the maximum deviation of any one wheel with respect to the other corners will be less than 75 mm.

For automated RMG or ASC operations, grades along the wheel travel direction of the concrete runways will not exceed 0.2%. Grades perpendicular to the runways shall be 0.1% or less.

When traveling or at rest, all corner wheels of the RMG or ASC shall be in the same horizontal plane to prevent racking. Where this is not possible, the maximum deviation of any one wheel with respect to the other corners will be less than 5 mm.

Grading contours, ridges and valleys shall be parallel to the grounded containers or break bulk storage areas. Where this is not possible, ridges and valleys should be located in aisles or between containers.

Manholes, electrical vaults, pull boxes, catch basins and trench drains shall be located in areas to avoid equipment operating areas, RTG/RMG/ASC runways, bulk stockpiles or container storage slots. However, all such structures shall be designed to carry loaded top-pick wheel loading of 10.5 kg/cm^2 over a 750 mm x 750 mm footprint.

Drainage systems shall be designed to accommodate rainfall flows generated from a 1 in 50 year rainstorm as well as maximum credible runoff from melting snow.

All collected drainage water shall pass through oil interceptors.

Minimum diameter of pipe shall be 450 mm.

Pipe 675 mm and smaller shall be Polyvinly Chloride (PVC), DR 35, or non-reinforced concrete pipe to ASTM C14M. Pipe larger than 675 mm shall be reinforced concrete circular pipe to ASTM C76M.

Trench drains shall be located more than 3 meters from any light mast pole.

Slots for guillotine gates shall be provided at junctions between trenches and storm sewer pipe and at a spacing not exceeding 20 m the length of the trench.

9.2 Potable Water and Fire Protection

Water supply will be required for the following new buildings:

- Container Terminals Administration Buildings; and,
- Container Terminals Maintenance/Labour/Lunchroom Buildings.

New water supply will be required for the new berths, and shall include vaults for both supplemental fire service as well as domestic water for vessels:

Fire hydrants shall be provided at the new Container Terminals at a nominal 100 metre spacing consistent with the National Fire Protection Association (NFPA), or every high mast light pole.

At the Container Terminals the water supply system shall consist of a separate fire and domestic portable water systems. For fire protection, except building sprinkler systems, river intake may be used.

New fire water systems shall consist of 305 mm diameter fire water main loops serving 150 mm ductile iron fire hydrants and 100 mm feeder lines to building sprinkler systems.

New domestic water supply shall consist of 100 mm domestic water main loops serving 50 mm feeder lines to berth water vaults and 50 mm feeder lines to new building faucets, showers and toilets.

All water lines shall be buried to prevent freezing and frost damage.

All existing and new water lines shall be installed in an encasement pipe beneath railroad tracks in accordance with AREMA criteria.

The NFPA Code 307 specifically calls for a minimum fire flow rate of 11,356 litres per minute (lpm) for a 4 hour duration in marine terminals and wharf structures.

Fire flow requirements to be confirmed with the Montreal Port Authority and City of Contrecoeur Fire Department.

Piping that is 100 mm or larger shall be ductile iron. Consideration can be given to High Density Polyethylene (HDPE) or Polyvinly Chloride (PVC) pipe where resistance to potential soil contaminants is warranted.

All underground utilities shall have identification tape buried at least 300 mm above top of utility.

9.3 Power, Lighting and Communications

9.3.1 Power

The Container Terminals will each require a new electrical substation. Each electrical substation will be fed from 25 kV overhead lines running from Autoroute 132.

25 kV substations shall be equipped with all required distribution equipment to feed the terminal's 12 kV, 347/600 V and 120/208 V loads. Exterior liquid filled power transformers shall be located next to each substation inside a fenced area.

All buildings listed in clause 11.1 shall receive power from the terminal's main substation. Smaller buildings may be fed at a voltage of 120/208 V. All other buildings shall receive 347/600 V power and be equipped with 120/208 V dry type transformers to accommodate general loads.

All cranes will be fed at medium voltage with appropriate 12 kV breakers, cabling and connection vaults.

Reefer storage area shall have it's own transformer enclosure. Transformer(s) may be 12 kV or 4.16 kV with 480 V secondary to suit the total number of plugs. If possible, distribution equipment will be installed under each tower for additional protection.

9.3.2 Lighting

Container storage yards and intermodal yards will use high mast lighting throughout. Poles shall meet MPA's standards and AASHTO standards.

Spacing shall be approximately 100 m and number of luminaires to suit following design criteria, based on the I.E.S. lighting handbook and the Canadian Labour Code:

- Average illuminance: 50 lux for container storage and intermodal yards, 30 lux for bulk yard; and,
- Illuminance uniformity: AVG/MIN 3:1 for container storage and intermodal yards, 5:1 for bulk yard.

Photometric studies shall use the following input criteria:

- Light dirt depreciation: 0.89;
- Lumen depreciation: 0.9 (high pressure sodium lamps); and,
- Equipment depreciation: 0.9.

Lighting equipment shall consist of the following:

- Galvanized steel poles with winches, steel cables, head end assembly, ring assembly and drive unit for raising and lowering luminaire ring;
- Mounting height of 36.5 m;
- High pressure sodium luminaires with lamps of 400 W or 1000 W;
- 347/600 V distribution cabinets installed near each high mast pole similar to existing MPA standard; and,
- FRE type conduits for underground distribution.

9.3.3 Communications

Communication wiring shall be distributed throughout container storage and intermodal yards.

Empty underground conduits and vaults shall provide basic distribution network to all buildings listed in clause 11.1, radiation portal monitors and closed circuit cameras. Communication cabinets will be installed at each high mast pole similar to existing MPA standard.

Empty conduits will also run up to each reefer tower allowing for future use of remote monitoring system on properly equipped containers.

All underground conduits will be FRE.

Fiber optic cables and telephone wiring would be installed by others i.e. tenants, MPA and Canadian Border Services Agency.

9.3.4 Shore Power (Cold Ironing, Alternative Maritime Power)

A shore power system will be provided for the purpose of allowing berthed vessels to turn off their onboard generators and connect to the landside electrical grid. The shore power facilities will supply 6.6 kV power in accordance with international standard ISO/IEC 60092-510. The shore power connection outlets will be located near the face of the wharf, in either below deck vaults or above deck power mounds.

9.4 Sanitary Sewer

Sanitary sewer system is required to serve each of the new buildings listed in Clause 11.1. Sanitary sewer for these buildings will tie into a new sanitary sewer system that shall be treated on-site and then discharged into the St. Lawrence River in accordance with municipal and provincial guidelines.

Sanitary sewer demands shall be estimated based on the number of persons that will occupy each building on a peak and sustained basis.

Provision shall be made for visiting truck drivers who may require use of restroom facilities.

Any interior work bay floor drains will be provided with oil-water separators prior to connection to the building sanitary sewer system. Wash bay and RTG maintenance area runoff shall be routed through an oily-water separator designed to remove emulsified and suspended oils prior to connection to the sanitary sewer system.

Pipe 675 mm and smaller shall be Polyvinly Chloride (PVC), DR 35, or non-reinforced concrete pipe to ASTM C14M. Pipe larger than 675 mm shall be reinforced concrete circular pipe to ASTM C76M.

9.5 Reefer Storage

Reefers shall be grounded in the reefer storage and stacked maximum 5 high.

Reefer access towers with stairs shall be provided for access to refrigeration end units for plugging in and monitoring. Reefer towers shall be single-sided. The towers will be constructed for 5 high container stacks.

Reefer towers shall have 480 v reefer plugs on one side.

Reefer towers shall be painted or galvanized structural steel construction with open grating stairs and walkways.

Towers shall provide adequate clearance for RTG/RMG/ASC access to grounded reefers.

9.6 Pavements and RTG/RMG/ASC Runways

New pavements will be required that will be subject to a variety of loads and load repetitions. An asphaltic concrete pavement structure consisting of asphalt top layers, granular base under layer, granular sub-base under layer and compacted sub-grade is expected for all terminal areas and roadways except for RTG/RMG/ASC runways which shall be reinforced concrete topped with 60 mm of asphalt for salt protection.

The following areas shall be designed for the following equipment and other loads:

- Container Terminals

- Axle loads for gate and highway truck/bombcart areas:
  - Single axle: 89 kN
  - Double axle: 152 kN
  - Triple axle: 189 kN
  - HS-25 Loading as per AASHTO
- Container stacking and storage areas
  - Top-pick Container Handler (Taylor TEC-950L)
    - Front (Driving) Axle: 944 kN
    - Rear (Steering) Axle: 66 kN
    - Ground Contact Pressure: 825 kPa
  - Reachstacker Container Handler (TRSI-994L)
    - Front (Driving) Axle: 1160 kN
    - Rear (Steering) Axle: 349 kN
    - Ground Contact Pressure: 1050 kPa
  - Rubber Tired Gantry

    Criteria for yard loading from rubber tyred gantry cranes shall be based on a Liebherr RTG 6/5/4/GS(T) with a gantry span of 23.16 meters and a wheel gage of 9.20 meters with 4 wheels per corner and an average wheel load of 14.20 tonnes per wheel.

    Note: This may be revised pending terminal layout.
  - Automated RMG (Rail Mounted Gantry)

    Criteria for yard loading from automated RMGs to follow once the terminal layout has been chosen as the size and span of the machine will be dependent on the selected stack width.

    Note: This may be revised pending terminal layout.
  - Automated ASC (Automated Stacking Cranes)

    Criteria for yard loading from ASCs to follow once the terminal layout has been chosen as the size and span of the machine will be dependent on the selected stack width.

    Note: This may be revised pending terminal layout.
  - Container Stacks
    - 40 foot containers stacked 5 high (30.5 tonnes/container)
      - UDL: 59 kPa
    - 20 foot containers stacked 5 high (24 tonnes/container)
      - UDL: 89 kPA
- Maintenance Building and Equipment Parking areas
  - Top-pick, reach stacker and RTG loads as per container stacking and storage areas

- Intermodal Yard
  - Rubber Tired Gantry

    Criteria for yard loading from rubber tyred gantry cranes shall be based on a Liebherr RTG 6/5/4/GS(T) with a gantry span of 23.16 meters and a wheel gage of 9.20 meters with 4 wheels per corner and an average wheel load of 14.20 tonnes per wheel.

    Note: This may be revised pending terminal layout.
  - Automated RMG (Rail Mounted Gantry)

    Criteria for loading from automated RMGs to follow once the terminal layout has been chosen as the size and span of the machine will be dependent on the selected track layout.

    Note: This may be revised pending terminal layout.

9.7 Striping

All pavement striping shall be minimum 100 mm wide either white or yellow, using high quality, anti-skid, high visibility reflective paint.

All letters and numbers shall be minimum 300 mm high. Stop markings shall be in accordance with provincial ministry standards. 1200 mm wide, diagonal striped walkways shall be painted in designated pedestrian routes.

Yellow diagonal striped areas shall be provided in keep clear safety areas at crane rails or in other safety areas.

Each RTG/RMG/ASC or top-pick container row plus each container storage slot, shall be uniquely numbered to be clearly visible to crane and tractor operators to identify block row and slot.

Signposts are not to be used in RTG/RMG/ASC areas.

Pavement stop striping should be located so the tractor driver has clear visibility in both directions from that point without extending into cross aisle.

Painted directional arrows will be placed throughout the terminal to assist in the orderly and efficient flow of traffic.

9.8 Fencing and Gates

All fencing shall meet ISPS and Transport Canada requirements as well as Port of Montreal Security Standards. At a minimum fencing shall be chain link at least 2.4 meters high with a minimum 3 strands of barbed wire on a 45 degree v-top-guard. The fence fabric shall be 9 gauge wire with a maximum 50 mm openings. The bottom of the fence shall be pegged. A maximum clearance of 150 mm under the fence fabric is permitted at any location along the security fence line.

All pedestrian turnstyles shall be full height with continuation of the barbed wire over. Turnstyles shall include provision for card reader and identity verification systems.

Vehicle gates may be rolling, lift or swing type depending on the location. Where gates cross unpaved rail tracks, a 1 meter wide strip of asphalt paving will be provided to the top of the rail aligned with the centerline of the closed gate position.

9.9 RMG/ASC Crane Rails

RMG/ASC crane rails will be designed in accordance with ISO 12488-1 track tolerances. RMG/ASC rails shall be designed for an ISO Class 2 construction tolerance under operational conditions. In cases of differential settlement, Class 3 construction tolerances are allowable under the condition that immediate maintenance actions are taken.

10. TRUCK GATES

10.1 Critical Dimensions

Truck gates shall meet the following critical dimensions:

- Standard lane: 3.65 meters wide.
- Bypass lane: 4.57 meters wide.
- Oversize lane: 4.57 meters wide.
- Booth island: 2.75 meters wide.
- Non-booth island: 1.22 meters wide.
- Canopy clearance: 5.48 meters minimum.

10.2 Grades, Drainage and Storm Water

Truck gate areas, including queuing lanes, shall be graded to avoid excessive ponding.

Grades shall not exceed 2% in the gate process areas.

Drainage systems shall be designed to accommodate rainfall flows generated from a 1 in 50 year rainstorm as well as maximum credible runoff from melting snow.

All collected drainage water shall pass through oil interceptors.

Existing drainage systems shall be re-used wherever possible.

Minimum diameter of pipe shall be 450 mm.

10.3 Power, lighting and communications for truck gates

10.3.1 General

Electrical installations at truck gates will conform with ISPS Code. Gates, fences, security turnstiles and access control systems shall be designed to deter unwanted entries and to record valuable information regarding vehicle and personnel presence inside terminal boundaries.

OCR systems where a truck's license plate as well as the number of the container carried shall also be part of the access control system. Traffic lights at each lane would guide trucks to their assigned lanes. Automated gates, card readers, biometric readers, intercoms, printers and closed circuit cameras would complete the access control system.

10.3.2 Power

Power to truck gates consists mainly in 120/208 V loads. Automated gates require 3 phase 208 V power for a typical 1 hp motor.

Power to the truck gates will come from the terminal's main 347/600 V distribution network, dry type, step-down transformers shall be installed near the truck gates inside suitable electrical rooms.

Emergency power from an on-site generator will also be necessary to maintain access control during power outages. UPS systems will supply power to sensitive access control software, controllers and computers.

10.3.3 Lighting

Lighting around truck gates is required for security of personnel and proper access control. Lighting levels will comply with I.E.S. standards and the Canadian Labour Code. Minimum design criteria are as follows:

- Average illuminance: 50 lux; and,
- Illuminance uniformity: AVG/MIN 3:1.

Photometric studies shall use the following input criteria:

- Light dirt depreciation: 0.69;
- Lumen depreciation: 0.9 (high pressure sodium lamps); and,
- Equipment depreciation: 0.9.

Lighting equipment shall consist of the following:

- Cobra type roadway luminaires with type 2 or 3 distributions;
- Mounting heights between 9.75 m and 12 m;
- 1.8 m to 3.0 m consoles on steel or aluminum poles;
- Square luminaires for under canopy mounting; and,
- High pressure sodium lamps, 400 W for roadway luminaires and 150 W to 250 W for canopy luminaires.

All underground conduits will be fiberglass reinforced epoxy (FRE.)

Fiber optic cables and telephone wiring for tenant's use would be installed by others. All wiring required for access control and cameras will be installed.

10.3.4 Communications

Communication wiring will be required for access control components including controllers, computers, OCR systems, intercoms and closed circuit cameras.

Telephone and data lines are also required in guard houses and may be required for remote connections depending on the tenant's needs.

10.4 Pavements

See Clause 9.6

10.5 Striping

See Clause 9.7

10.6 Fencing

See Clause 9.8

10.7 Communication Pedestals

Shall be of concrete construction meeting CSA A23.3 and sized to accommodate furnished communications/process equipment including intercom, printer, biometric scanner, ID proximity card reader.

10.8 Canopies

Shall be of structural steel and metal cladding construction meeting the requirements of the National Building Code of Canada, and Clause 11.

11. BUILDINGS

11.1 Overview

The following new buildings are part of the works:

- Administration buildings;
- Maintenance/labour/lunchroom buildings; and,
- Gate guard houses.

The overriding requirement is that the buildings are fit for their intended purpose and suitable in all respects for safe, efficient and continuous use and occupancy under operational conditions at the terminals which are in a modern heavy industrial port setting.

The exterior façade of the buildings should reflect the nature of the facility and their surroundings. The buildings should be functional and aesthetically pleasing.

Final selection of material finishes shall take into account the industrial marine setting within an active port. The facilities are expected to withstand a high level of wear and abuse and therefore durable finishes subject to physical and mechanical contact are necessary.

All buildings shall conform to the requirements of the National Building Code of Canada (NBCC).

Where practical, all buildings shall be designed to meet at least 1st Level (Bronze) LEED certification criteria.

11.2 Structural

Building frames shall be of structural steel construction meeting the requirements of CSA-S16.1.

Concrete, including substructures and floors shall be of concrete meeting the requirements of CSA A23.1 and A23.3. Minimum compressive strengths shall be:

- Foundations: 25 MPa
- Slabs on Grade: 35 MPa
- Floor toppings: 35 MPa
- Structural Concrete: 35 MPa

Standing seam steel roofing and metal roof deck shall conform to CSSBI 10M-96, "Standard for Steel Deck". Structural metal roof decking shall be fabricated from hot-dip galvanized steel meeting ASTM Specification A-653/A653M Grade 230 and minimum zinc coating designation Z275.

11.3 Exterior

Exterior steel cladding shall be hot-dip galvanized steel meeting ASTM specification A653/A653M Grade 230, minimum core thickness of 0.91 mm and minimum zinc coating designation Z275. Cladding shall receive a factory applied coating suitable for a cold climate industrial marine environment.

Interior steel liner sheet shall be hot-dip galvanized steel meeting ASTM specification A653/A653M Grade 230, minimum core thickness of 0.61 mm and minimum zinc coating designation Z275. Cladding shall receive a factory applied coating suitable for a cold climate industrial marine environment.

Flashings, subgirts, channels and closures shall be hot-dip galvanized steel meeting ASTM specification A653/A653M Grade 230, minimum core thickness of 0.61 mm and minimum zinc coating designation Z275. Flashings and exposed closures shall receive a factory applied coating matching that of the cladding to which they are attached.

Lumber shall be kiln dried Hemlock Fir No. 2 or better meeting the requirements of CAN/CSA O141.

Exterior doors shall be of unitized steel grid construction of minimum 1.6 mm thick steel sheet. Fire doors shall meet the requirements of the NBCC.

Steel roller doors shall be heavy duty galvanized industrial doors with minimum steel thickness of 1.6 mm and fitted with pushbutton electric motor operation, wind lock and auxiliary chain hoist.

Exterior windows should be aluminum, double glazed, thermally broken, argon filled units with high performance coating or anodized finish conforming to CSA A440.

11.4 HVAC

Buildings shall be heated and mechanically ventilated in accordance with Part 6 of the NBCC and federal health and safety regulations.

Office spaces, washrooms, locker rooms, storage rooms and lunch rooms shall be air conditioned to provide effective temperature and humidity control.

All heating, ventilating and air conditioning systems shall meet the indoor air quality requirements of relevant ASHRAE standards.

All HVAC equipment shall be manufactured and tested in accordance with the following regulations, standards and specifications.

- ACGIH American Conference of Governmental Industrial Hygienists.
- AMCA Air Movements and Control Association.
- ANSI American National Standards Institute.
- ARI Air Conditioning and Refrigeration Institute.
- ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers.
- ASME American Society of Mechanical Engineers.
- ASTM American Society of Testing and Materials.
- CEC Canadian Electrical Code.
- CGA Canadian Gas Association.
- CSA Canadian Standards Association.

- ICBO International Conference of Building Officials.
- IEEE Institute of Electrical and Electronics Engineers.
- NAIMA North American Insulation Manufacturers Association.
- NFPA National Fire Protection Association.
- SMACNA Sheet Metal and Air Conditioning Contractors National Association.
- ULC Underwriters Laboratories of Canada.

Design of HVAC systems for the following:

- Summer design outdoor dry bulbs. Temperature: 30 deg. C.
- Summer design outdoor coincidental wet bulbs. Temperature: 26 deg. C.
- Winter design outdoor temperature: -26 deg. C.
- Site elevation (meters above sea level): 50 meters.

All ventilation systems shall be mechanical forced-air type with powered exhaust fans to discharge air to the outdoors. All washrooms shall have powered exhaust fans.

Provide filtered outdoor air at a supply rate of no less than required by ASHRAE Standard 62-2001 for ventilation of occupied areas.

Washrooms and shower areas shall be exhausted at a rate of no less than 15 air changes per hour.

HVAC controls shall consist of commercial microprocessor based programmable thermostats designed for conventional heating and cooling applications. Remote mounted temperature sensors with inputs into the programmable thermostats shall be incorporated.

11.5 Plumbing

The following plumbing facilities shall be provided in their entirety:

- Building water supply and distribution;
- Plumbing fixtures including toilets, urinals, washbasins (lavatories), emergency eyewash, showers, etc.;
- Drain, waste and vent systems; and,
- Rainwater drainage systems.

All plumbing systems and facilities shall be in accordance with the National Plumbing Code.

Sanitary drainage system shall consist of regular waste, indirect waste and industrial waste. Regular waste and venting shall be provided for each fixture and piece of equipment. Indirect waste from mechanical equipment shall discharge into the sanitary drainage system through an indirect waste connection.

Potable water system shall include building distribution system to plumbing fixtures, hose bibs and water heaters. Each building water supply shall be connected to a water meter.

Industrial water system shall have a cold water distribution system protected with a reduced pressure type back flow preventer. Hot water system shall include water heaters for each building. Zone valves and branch valves shall be provided for interior hot water distribution.

All floor drains and other fixtures subject to non-use shall be provided with a trap primer.

Lavatory faucets shall have automatic shut-off after a specified time.

Hard drawn copper piping shall be used for all piping installed above finished floor. All piping shall be insulated.

All sanitary and waste drain piping shall have a slope of 7 mm per 305 mm.

All rain gutter and roof drain systems shall be connected to the site storm drainage.

Provide each washroom with toilet paper dispensers for each toilet, electrical hand dryers, soap dispensers, hand towel dispensers, mirrors and soap dispensers for each lavatory.

Each washroom shall have handicap accessible toilet and lavatory as per NBCC. All grab bars and other fixtures shall be stainless steel.

11.6 Electrical

Buildings shall receive 347/600 V power from the main substations. 120/208 V feeds may be acceptable for smaller buildings not requiring a higher voltage.

Electrical distribution systems shall include breaker panels, transformers, motor control centers, wiring, etc.

Breakers panels will have aluminum bus bars and a full capacity neutral bar. 25% additional space shall be provided in each panel for future use. Short circuit interrupting capacity shall meet distribution network's available fault current.

Power transformers 600 V and less will be dry type with copper windings and class H insulation.

All motor loads will have a safety switch installed nearby. When fuses are required they shall be class J, form I.

Motor loads shall be equipped with manual or magnetic starters with appropriate overloads, Man-O-Auto selector switch and auxiliary contacts to suit application.

E.M.T. type conduits will be used throughout buildings except in the following conditions:

- In hazardous locations;
- Rigid galvanized steel conduit; and,
- In wet locations: PVC conduits.

Conductors will have RW-90, 1000 V insulation for main feeder and RW-90, 600 V insulation for all other runs. Only copper wiring will be used, minimum #12 AWG. AC-90 type armored cables will be used in concealed spaces only such as suspended ceilings and wall partitions and for final connection of equipment for a maximum length of 3 meters. Seal-Tite flexible conduits will be used for final connection of all vibrating equipment (motors, heaters, etc.).

General purpose receptacles will be installed throughout buildings. Exterior receptacles will have weather proof enclosures and ground fault interrupting mechanisms in maintenance shops and other similar areas, all outlets will be installed on cast aluminum oulet boxes. Cover plates will be stainless steel.

Lighting in all buildings shall use energy efficient lamps such as T8, T5 and compact fluorescent lamps in office spaces and metal halide lamps in areas with very high ceilings. When possible, electronic type ballasts shall be used. Exterior lighting fixtures shall use high pressure sodium lamps and be controlled by a photocell, exit signs shall use leds. Emergency lighting will be required in all areas and shall meet NBCC requirements.

Empty conduits will be installed in ceiling spaces and outlets in all rooms for data and telephone systems. These systems will be installed by others.

A fire alarm system shall be installed in each building c/w detection devices, manual pull stations, audible and visual signaling devices.

Electrical heating will be installed in all offices spaces and similar areas. Maintenance and garage areas may use electrical or gas heaters.

Intrusion alarm systems will be installed in each building. Magnetic contacts are required for each door and movement detectors in all main corridors. Access control shall be part of the system and include card readers, door latches and other accessories for proper system operation. Controllers shall be connected to the truck gate network.

Electric hand dryers will be installed in each washroom.

11.7 Interiors and Finishes

Ceiling suspension system shall be used in offices, locker rooms, change rooms, washrooms, storage rooms, lunch rooms, etc. Ceiling system shall be intermediate duty two directional exposed tee bar grid system to ASTM C635 fabricated from commercial quality cold rolled steel, zinc coated.

Ceiling installation shall be seismically restrained to meet CISCA (Ceilings and Interior Systems Construction Association) "Guidelines for Seismic Restraint Direct Hung Suspended Ceiling Assemblies Seismic Zones 3 and 4".

Ceiling tiles shall be water-felted rigid mineral fibre boards 1200 mm by 600 mm acoustical panels meeting the requirements of ASTM E1264, Type III, Form 2, minimum thickness 15.9 mm.

Interior walls or non-moveable partitions shall be of strong durable construction with cleanable surfaces. All walls and partitions shall be painted.

Gypsum board for walls and partitions and ceilings shall be standard 15.0 mm thick with a rating of Type X or C for fire rated areas. Junctions between board sheets shall be sealed with reinforced tape.

Ceramic floor tiles shall be heavy duty non-slip and nominal 200 mm by 200 mm by 6.0 mm thick.

Ceramic wall tiles shall be Grade A ceramic, size 200 mm by 200 mm by 6.0 mm thick.

Steel vinyl flooring shall be heavy duty commercial grade glass fibre reinforced sheet minimum 2.5 mm thick.

Carpeting shall be minimum 30 ounce high quality durable industrial carpet.

Interior doors shall be solid core construction set in hollow metal frames with durable and cleanable surfaces.

Fire doors shall be unitized steel grid construction fabricated from minimum 1.6 mm steel sheet.

Toilet doors and partitions shall be steel minimum 1.9 mm thickness with factory baked enamel finish both sides.

All doors shall be provided with locksets and hinges. Kick plates shall be provided on both sides of all doors except individual offices.

Minimum 600 mm by 900 mm deep vision panels of fully tempered glass shall be installed in all doors except fire doors, washroom doors and doors to service and storage rooms.

Cabinetry shall be first quality wood cabinets with doors and cabinet boxes constructed of 5/8 inch industrial board or plywood laminated with HDPL or High Quality Thermo fused Melamine. Countertops shall be laminate, 45 pound industrial grade.

11.8 Equipment

Provision shall be made for providing compressed air piping to each work space fed from a suitably sized compressor which will be located in a separate compressor room.

Structural steel frame of the maintenance buildings shall have provision for overhead crane support system full width of repair bays.

12. FUELING FACILITY

12.1 Fueling Facility

A fueling facility shall be provided at each Container Terminal with a 2000 liter gasoline tank and a 5000 liter diesel tank. The facility will consist of above ground, double wall, monitored tanks with integral fill and dispensing equipment so that no piping exists external to the tanks. The tanks shall be protected with fixed bollards and placed on a concrete pad. The concrete pad shall be designed to aid in spill cleanup and prevent fuel from entering the storm drain system. The dispensing system shall be lockable and be provided with remote controlled access systems located in the maintenance buildings and shall include alarms, auto shutoff and fire prevention measures. The entire facility shall be in accordance with the Canadian Council of Ministers of the Environment (CCEM) guidelines.

13. ROAD WORKS

13.1 Layout

The roadway layout will be arranged to accommodate the addition of two new Container Terminals and their connection to Route 132. Roadway design speed shall be 60 km/hr for a posted speed of 50 km/hr. Sight distances at rail crossings will be a minimum of 85 meters.

13.2 Grading and Drainage

New roadways will maintain an maximum 2% cross slope for drainage. Longitudinal grades will meet design standards of the Ministry of Transport of Quebec.

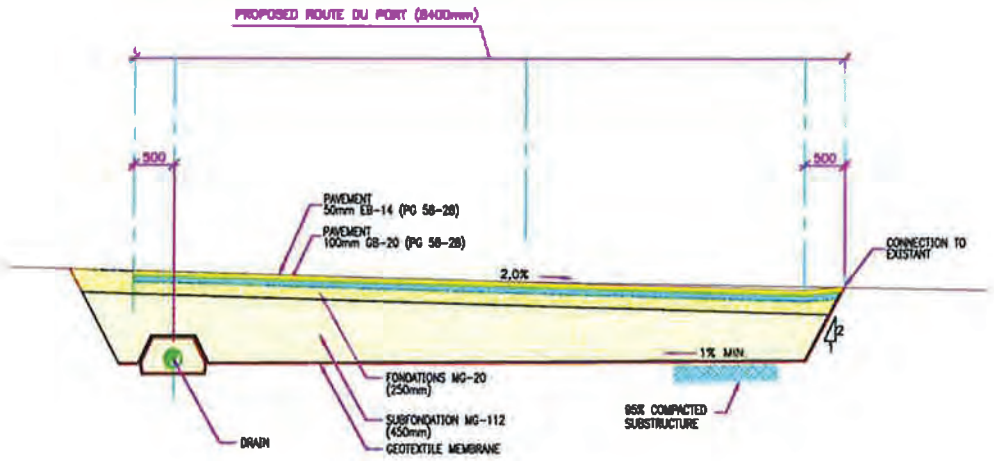
Drainage shall be designed for a 50 year storm. Minimum drainage pipe size shall be 450 mm and shall be concrete ASTM C14M or equal for pipes smaller than 675 mm and reinforced concrete ASTM C76M for pipes larger than 675 mm.

13.3 Curb and Gutter

New roadways may be provided with curb and gutter.

13.4 Pavements

Pavement sections shall conform with the latest standards of the Ministry of Transport of Quebec. A representative roadway section is shown below.



13.5 Roadway Lighting

Roadway lighting must comply with I.E.S. Standard no RP-8, the I.E.S. Lighting Handbook and the Canadian Labour Code. Minimum design criteria are as follows:

- Average illuminance: 10 lux;
- Illuminance uniformity: AVG/MIN 4:1;
- Veiling luminance: 0.4 (ratio);
- Average luminance: 0.4 CD/M^2; and,
- Luminance uniformity: AVG/MIN 4:1.

The Canadian Labour Code requires a minimum illuminance of 10 lux on roads (or areas) that may be used by personnel and mobile equipment; however in areas where light pole setback exceeds normal values because of local conditions, a minimum average illuminance of 6 lux is acceptable as defined in I.E.S. Standards.

Photometric studies shall use the following input criteria:

- Pavement classification: R3;
- Light dirt depreciation: 0.82;
- Lumen depreciation: 0.9 (high pressure sodium lamps); and,
- Equipment depreciation: 0.9.

Lighting equipment shall consist of the following:

- Cobra type roadway luminaires with type 2 or 3 distributions;
- Mounting heights between 9.75 M and 12 M;
- 1.8 M to 3.0 M consoles on steel or aluminum poles;
- High pressure sodium lamps, 250 W to 400 W; and,
- All underground conduits will be FRE.

13.6 Communication network

The new network will include new fiber optic and telephone cable runs alongside the medium voltage distribution network.

14. RAIL WORKS

14.1 Track Alignment and Clearances

The maximum degree of curvature shall not be exceeded as follows:

- Intermodal yard track: 10 degrees
- Intermodal yard lead track: 10 degrees
- Network support track: 10 degrees

Minimum track centers, the distance between centerlines of two tracks, shall be as follows:

- Intermodal yard track: 13.5 feet
- Intermodal yard lead track: 13.5 feet
- Network support track: 13.5 feet

Turnouts shall be minimums as follows:

- Intermodal yard track: No. 10
- Intermodal yard lead track: No. 10
- Network support track: No. 10

If absolutely necessary No. 8 turnouts may be substituted where approved by CN Rail and owner.

Minimum tangent length between curves shall be 30.5 meters.

Track spacing on curves shall have their centers increased 5 cm. per degree of curve.

The profile grade shall represent the elevation of the top of the low rail:

- Intermodal yard track: 0.0 %
- Intermodal yard lead track: 1.0 %
- Network support track: 2.0 %

It is desirable for storage tracks to have a sag in the middle of their profile to prevent rail cars from rolling to either end.

It is desirable for the grade of a stub end track to descend toward the stub end. If it is necessary to grade a storage track up toward a stub end, the grade shall not exceed 0.20 percent.

Vertical curvature in intermodal tracks: The minimum length of vertical curves shall be at least 30.5 metres.

Horizontal Clearances to any physical object that projects higher than 200 mm above top of rail shall be:

- Centerline of straight track to any obstruction: 2.6 meters.
- Centerline of track curved greater than 5 degrees to any obstruction: 3 meters.

Vertical clearance as measured from top of rail shall be 7.18 meters to underside of any highway or roadway overpass and 8.3 meters to overhead wire lines.

14.2 Track Construction

All tracks shall be 115 RE continuous welded rail.

Standard track gauge shall be 1.4351 meters.

Standard type of track construction shall be ballasted track consisting of sub-ballast, ballast, cross ties, rails and rail fasteners.

All new track and turnouts shall be supported by steel ties as manufactured by Narstco, Inc. and shall be Type M for Class 2 Track.

Minimum depth of sub-ballast shall be 30.5 cm for all track.

Minimum depth of ballast from the bottom of tie at track centerline to top of sub-ballast shall be 30.5 cm for mainline tracks and 15.3 cm for all other track.

Shoulders shall be minimum 30.5 cm wide. If safety walkways are required then ballasted shoulders shall be 76.2 cm.

Within the intermodal yards, the ballast shall be covered by a firm aggregate base material between track sets to provide a stable walking surface.

Frogs shall be railbound manganese.

Elastic fasteners shall be used on turnouts.

14.3 Rail Corridor Lighting

Where rail operations involve maneuvers and frequent pedestrian traffic lighting levels of new trackage shall conform to I.E.S. standards and exceed the minimum required of 20 lux with a 3:1 uniformity ratio. All other trackage installed adjacent to current rail corridors shall have a minimum illuminance of 5 lux with a uniformity ratio of 8:1; this will provide sufficient security lighting for occasional pedestrian traffic and allow the Port Authority and CN Rail to properly monitor surrounding areas.

Lighting equipment shall consist of the following:

- Wide area projectors with NEMA 6 x 6 or NEMA 7 x 6 distributions;
- Mounting heights between 9.75 M and 12 M;
- High pressure sodium lamps, 150 W to 400 W;
- Wood poles; and,
- Aerial cables.

END OF DOCUMENT

APPENDIX D

PLANNING CRITERIA

Port of Montreal
Port de Montréal

Port of Montreal

Contrecoeur Development Master Plan

Planning Criteria

FINAL

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May 27, 2010

M&N Project No. 7146

REV	DESCRIPTION	DATE	AUTHOR	CLIENT APPROVED
3	Final	May 27, 2010	HW	
2	Draft for Client Review	May 20, 2010	HW	
1	Draft for Client Review	May 07, 2010	HW	

1.0 PROJECT DEFINITION

1.1 TITLE OF PROJECT

Port of Montreal, Contrecoeur Development Master Plan

1.2 PROJECT DESCRIPTION

The project includes the planning for 2300 meters of wharf that will provide an additional 300 meters +/- of berth for bulk products, and 2000 meters +/- or 6 berths for container handling operations. The 6 berths will be operated as two separate terminals with 3 berths each. Two modes of operation for container handling will be reviewed including a conventional manned RTG storage yard and an automated RMG or ASC storage yard. Container terminal plans will include for berth, container yard, on-dock intermodal rail transfer operations, optical characteristic recognition truck gates and all necessary ancillary facilities. The two 3 berth terminals will be staged in phases over many years. Initial stages of the facility will include for one container terminal that provides for the following:

- Stage 1: One berth facility with upland facilities able to handle 500,000 TEUs per annum.
- Stage 2: Two berth facility with a throughput capacity of 500,000 TEUs per annum.
- Stage 3: Two berth facility with a throughput capacity of 1,000,000 TEUs per annum.

For a more detailed project description, see the Project Work Plan.

2.0 TERMINAL PLANNING CRITERIA

2.1 PLANNING CRITERIA FOR BERTHS

The berth alignments and locations shall balance the requirements for dredging and fill at the site, ensure safe navigation to and from the berths from the primary shipping channel, be resistant to environmental and operating loads and minimize environmental impacts.

At the berths the horizontal transport of containers between the ship to shore gantry cranes and container storage yard shall be:

- Manned single hostlers and bombcarts (conventional terminal)
- Automated Guided Vehicles - AGVs (automated terminal)

Berth layout and throughput capacity shall also be based upon the following primary factors.

2.1.1 Bulk Terminal Berth Dimensions

- Max. Vessel LOA: 244 m
- Max. Vessel Beam: 32.2 m
- Max. Vessel Tonnage: 44,920 GRT
- Total berth length for bulk facility shall be maximum 600 m that shall include the existing 228.9 m berth and one new berth.

2.1.2 Container Terminals Berth Dimensions

- Max. Vessel LOA: 300 m
- Max. Vessel Beam: 40.7 m
- Max. Vessel Loaded Draft: 13.4 m
- Max. Vessel DWT: 72,200 t
- Required Water Depth @ 0.0 CD: 11.3 m
- Stage 1 plan shall be one berth.
- Stage 2 plan shall be two berths.
- Stage 3 plan shall be two berths.
- Full build out plan shall be two 3 berth facilities.

2.1.3 Number of Cranes per Berth

- 2 to 3 cranes per berths.
- Cranes shall be 30.48 m (100') gauge.

2.1.4 Gross Crane Rate

Total productive container lifts by the ship to shore cranes from the start of the first lift to the end of the last lift, including breaks and downtimes.

- Gross Crane Rate Single Trolley Cranes to Bombcarts: 25 moves per hour
- Gross Crane Rate Double Trolley Cranes to AGVs: 29 moves per hour

2.1.5 Seasonal Peaking Factor

Factor to account for seasonal fluctuations in terminal throughput.

- Seasonal Peaking Factor: 1.10

2.1.6 Berth Occupancy

Target percentage of time that the berth is physically occupied by a vessel to ensure a berth is available to a vessel upon arrival and avoid the need to anchor.

Berth occupancy:

- One berth: 45%
- Two berths: 55%
- Three or more berths: 65%

2.1.7 Net Crane Percentage to Gross Working Hours

The average amount of time each crane at berth will work the vessel as a percentage of the gross vessel working time.

- Net Crane Percentage: 85%

2.1.8 *Net Vessel Working Time*

The percentage of time while the vessel is at berth that it can be worked. Accounts for time to handle lines, final lashing, etc.

- 95%

2.2 PLANNING CRITERIA FOR CONTAINER YARD

Two modes of operation shall be examined for the container storage yard. These are;

- Conventional manned RTG operation with 1 over 5 high stacking, 6 or 7 wide storage blocks parallel to the berth alignment.
- Automated RMG or ASC cranes, double crossover or end to end with 1 over 5 stacking, 8 to 12 wide blocks perpendicular to the berth alignment.

The following primary operating and market criteria shall be used to further determine the container yard layout and throughput capacity.

2.2.1 *Operating Efficiency*

The operating efficiency is the average percentage of time container storage slots are occupied on a peak month.

- Manual RTG or Top-Pick Operating Efficiency: 70%
- Automated RMG or ASC Operating Efficiency: 85%

2.2.2 *Dwell Time*

Dwell time, expressed in days, is the average time that containers remain in the container yard. This includes the time from when the containers are initially stacked to the time that they are taken out for transport.

- Rail Import: 3.0 days
- Rail Export: 6.0 days
- Truck Import: 4.5 days
- Truck Export: 4.0 days
- Empty Storage: 15.0 days

2.2.3 *Percentages of Throughput by Rail and Truck*

The percentage of total container berth throughput split between rail and truck:

- % Total Throughput by Rail: 52%
- % Total Throughput by Truck: 48%

The percentage of laden container berth throughput split between rail and truck:

- % Laden Throughput by Rail: 51%
- % Laden Throughput by Truck: 49%

2.2.4 *Seasonal Peaking Factor*

The seasonal peaking factor is used to ensure that the container yard is adequate in size to accommodate seasonal fluctuations and peaks in traffic. Factor is volume from busiest month ÷ average monthly volume.

- Seasonal Peaking Factor: 1.15

2.2.5 *Percentages of Rail Import/Export and Percentages of Truck Import/Export*

The total import/export split for rail and truck expressed as a percentage.

- % of Total Rail is Import: 48%
- % of Total Rail is Export: 52%
- % of Total Truck is Import: 48%
- % of Total Truck is Export: 52%

The laden import/export split for rail and truck expressed as a percentage.

- % of Laden Rail is Import: 45%
- % of Laden Rail is Export: 55%
- % of Laden Truck is Import: 45%
- % of Laden Truck is Export: 55%

2.2.6 *Percentage of TEU for Transshipment*

Transshipments are containers that cross the berth, stored in the container yard and then loaded to another vessel.

- % Transshipment: 0%

2.2.7 *Percentage of TEU for Repositioned Depot Empties*

Repositioned depot empties are empty containers that enter and leave the terminal though the intermodal yard or truck gate but never cross the berth expressed as a percentage of total berth throughput.

- % Re-positioned Depot Empties: 7%

2.3 PLANNING CRITERIA FOR INTERMODAL YARD

The rail intermodal yard shall be located "on-dock" with transfer between the container storage yard and intermodal yard by hostler/bombcart, manned shuttle carrier or AGV. Discharge and loading of rail shall be by RTG or automated RMG. The layout and throughput capacity of the intermodal yard shall be determined using the primary factors below.

2.3.1 *Percentage of Terminal Throughput Handled by Rail*

- 60%

2.3.2 *Market Share By Class 1 Railways*

- Scenario One: CN: 100%
  CP: 0%
- Scenario Two: CN: 70%
  CP: 30%
- Scenario Three: CN: 30%
  CP: 70%

2.3.3 *Average Equipment Lift Rate*

The average lift on and lift off rates that the IY equipment can achieve throughout the year. This rate is measured between rail switches so as not include switching downtime or breakdowns.

	Maximum Lifts per Hour
Imports:	25
Exports:	25

2.3.4 *Rail Footage to TEU Ratio*

The ratio of rail footage to volume of TEU loaded within that footage.

- Rail Footage/TEU Ratio (CN Rail): 18
- Rail Footage/TEU Ratio (CP Rail): 27

2.3.5 *Downtime Due to Switching, Shift Change, Breakdowns, Etc.*

The duration of time during a shift that IY equipment is unable to work due to rail switching and other activities expressed as a percentage of total shift time.

- Downtime for manned RTGs: 25% (to be confirmed following layout selection)
- Downtime for automated RMGs: 25% (to be confirmed following layout selection)

2.3.6 *Daily Peaking Factor*

- Assuming relatively even vessel schedules: 1.25

2.4 PLANNING CRITERIA FOR TRUCK GATE

The truck gates shall use a two stage in-gate with optical character recognition pre-gates and the out-gate shall also use optical character recognition. The following criteria are used to determine the truck gate layout and throughput capacity.

2.4.1 *Percentage of Terminal Throughput Moved by Truck*

- 50%

2.4.2 *Gate Processing Rate: Ingate/Outgate*

The gate processing rate, expressed in minutes per truck, is the rate for a single gate lane to process one truck. In-gate processing includes assignments, inspection and replacement.

- OCR Pre-gate: 10 to 15 sec/truck
- In-gate: 60 to 120 sec/truck
- OCR Out-gate: 15 to 25 sec/truck

2.4.3 *Truck Queuing Capacity*

In-gates shall be sized to hold 15 minutes of peak truck traffic.

Out-gates shall be sized to hold 10 minutes of peak truck traffic.

2.4.4 *Hourly Peaking Factor*

The ratio of the busiest hour of the busiest day within a year to the average hour on the average day:

- Hourly Truck Flow Peaking Factor: 2.0 (Assumes no reservation system)

2.4.5 *Gate Operation Hours per Day*

The number of hours that the truck gates are opened:

- Gate Operating Hours: 06h00 – 23h00

2.4.6 *Evening Gate Volumes*

On average 20% of daily volume will move through truck gates between 16h00 and 23h00

2.4.7 *Double Transaction Percentage*

The percentage of trucks performing two transactions:

- 39%

2.4.8 *Gate TEUs vs. Vessel TEUs*

The ratio of truck gate TEUs over local vessel TEUs:

- 1.43

2.5 GENERAL TERMINAL PLANNING CRITERIA

2.5.1 *TEU to Container Ratio*

The TEU to container ratio factor is the ratio of TEUs to actual containers handled.

- TEU/Container Ratio: 1.63

2.5.2 *Terminal Operating Hours per Day*

- Manned Operation: 22.5 hours
- Automated Container Yard: 24 hours

2.5.3 *Terminal Operating Days per Year*

- 355.5

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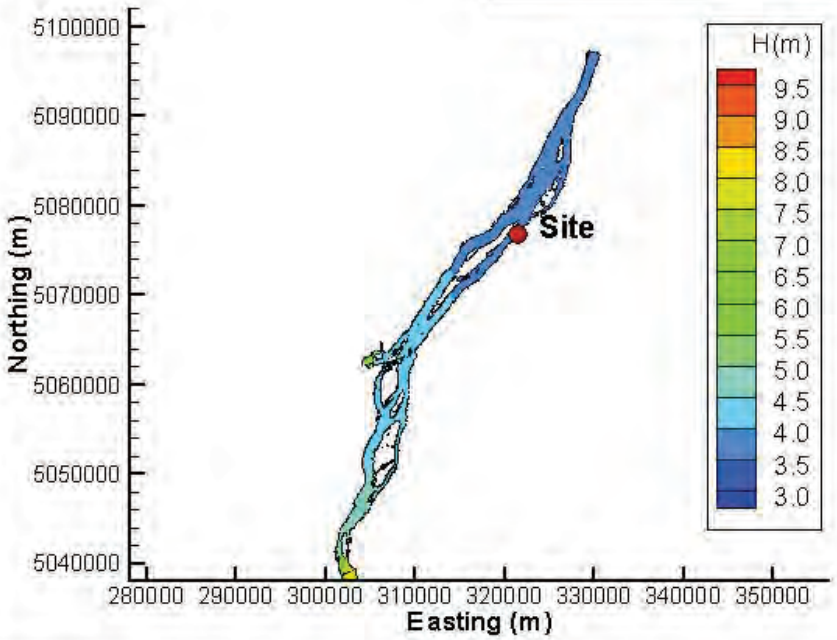
APPENDIX C

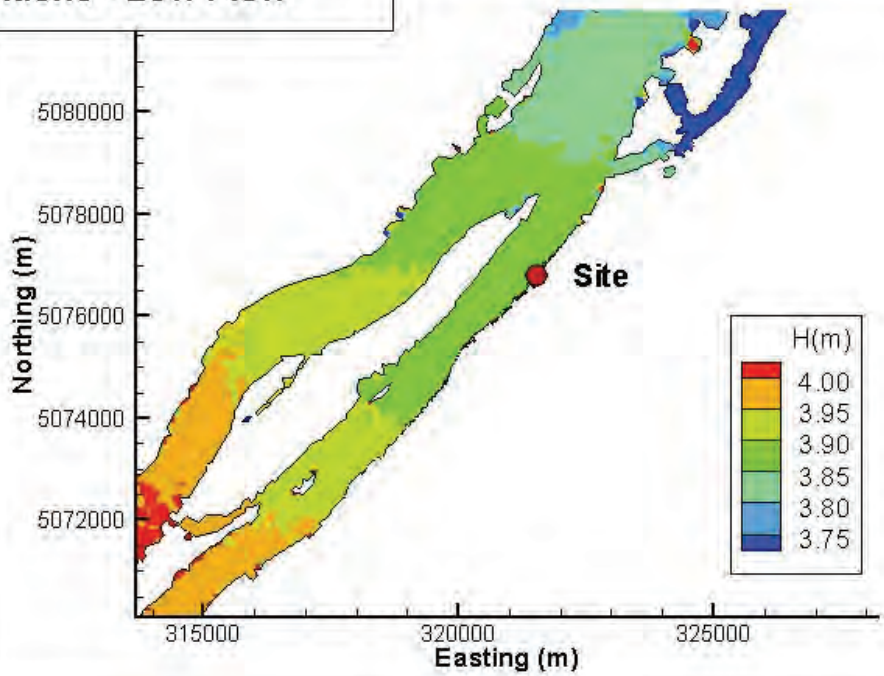
ENGINEERING DESIGN CRITERIA

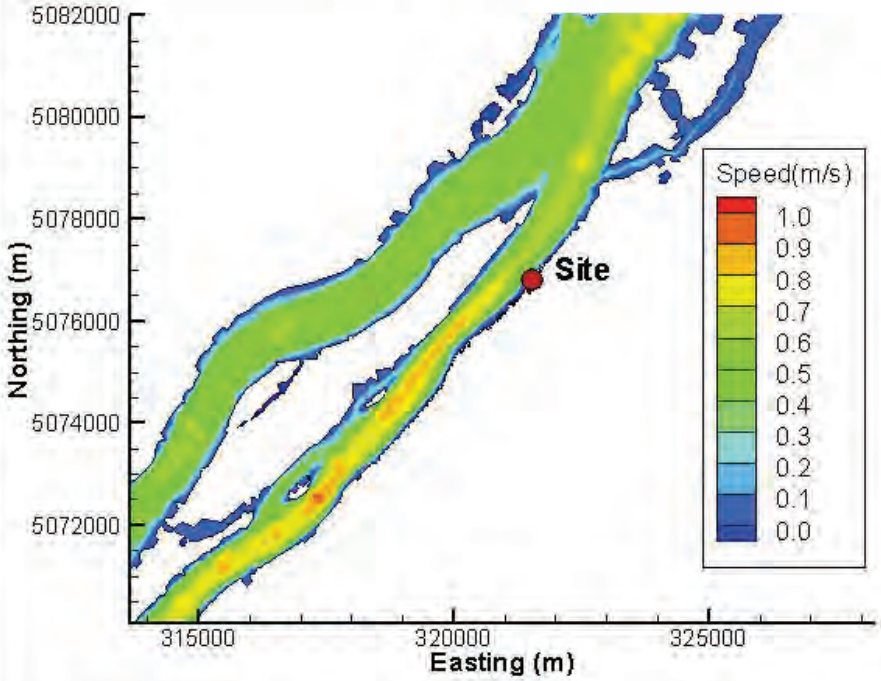
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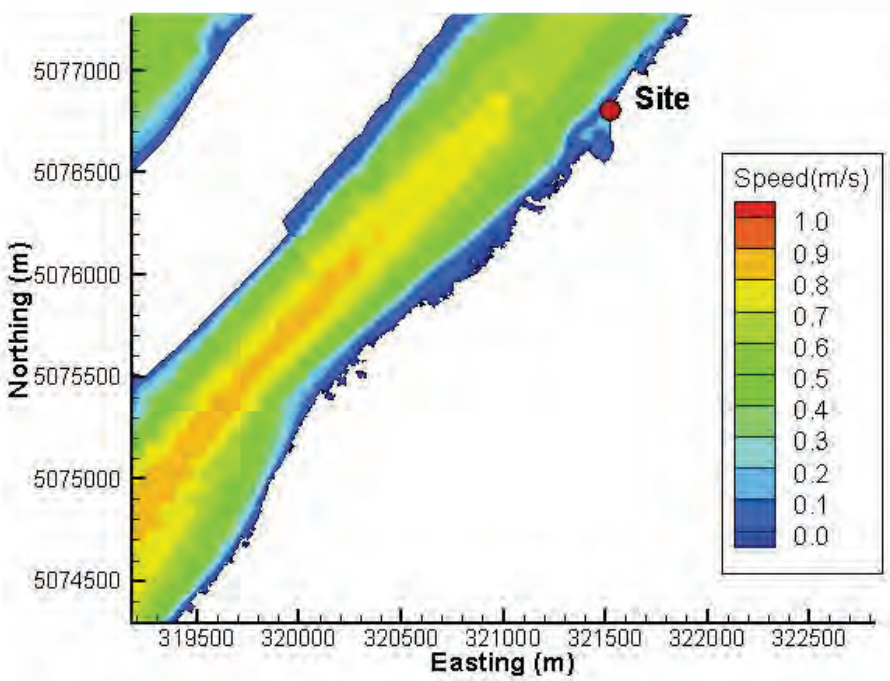
HYDRAULIC MODELING PLOTS

Plot 1: Existing Conditions - Low Flow

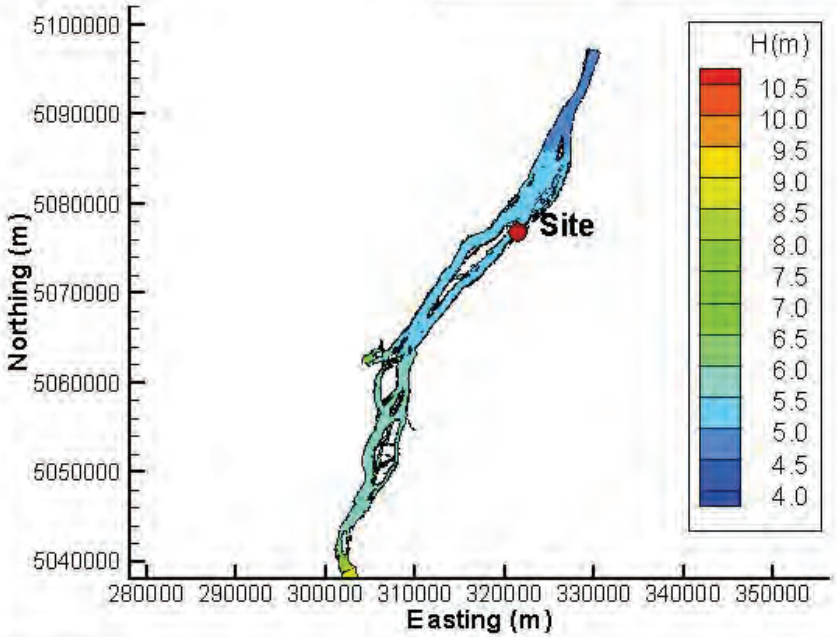


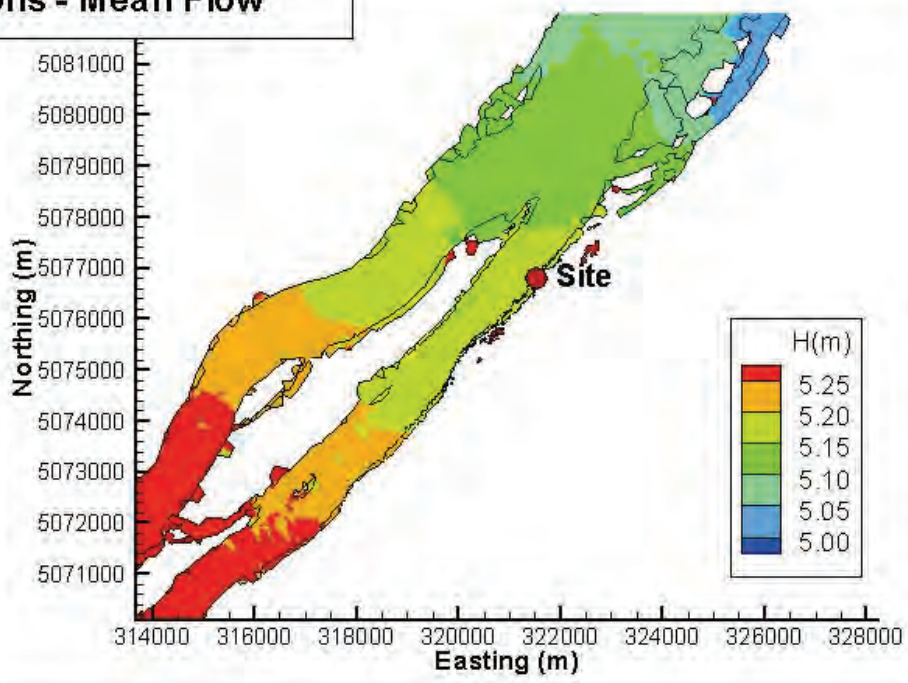


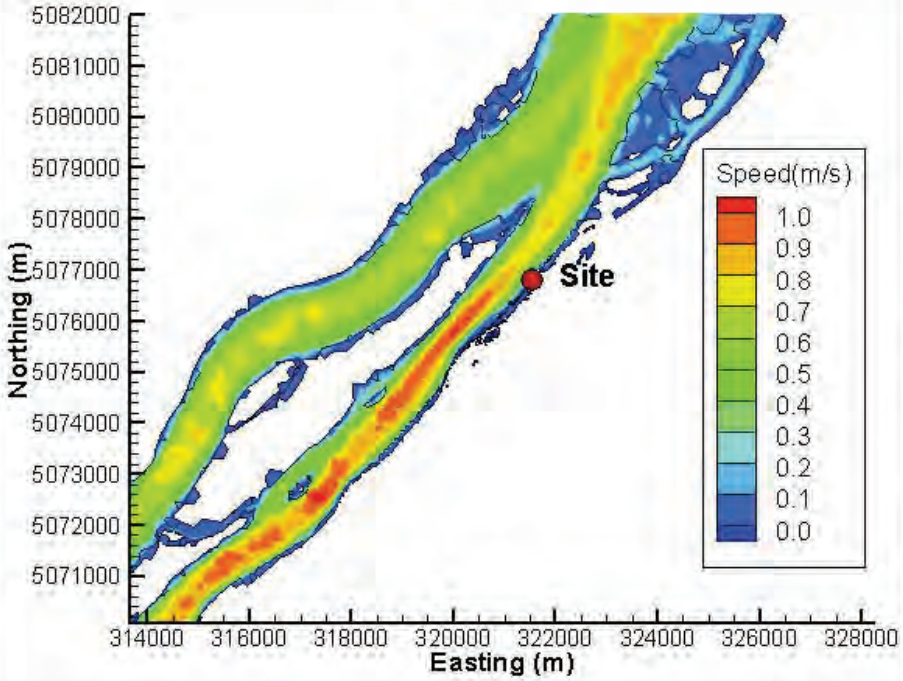


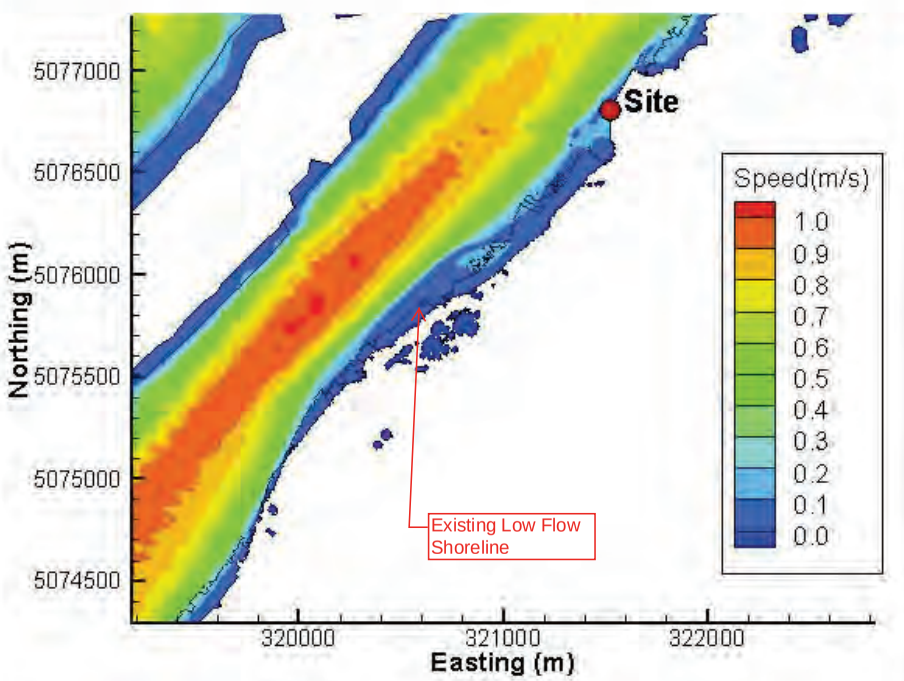


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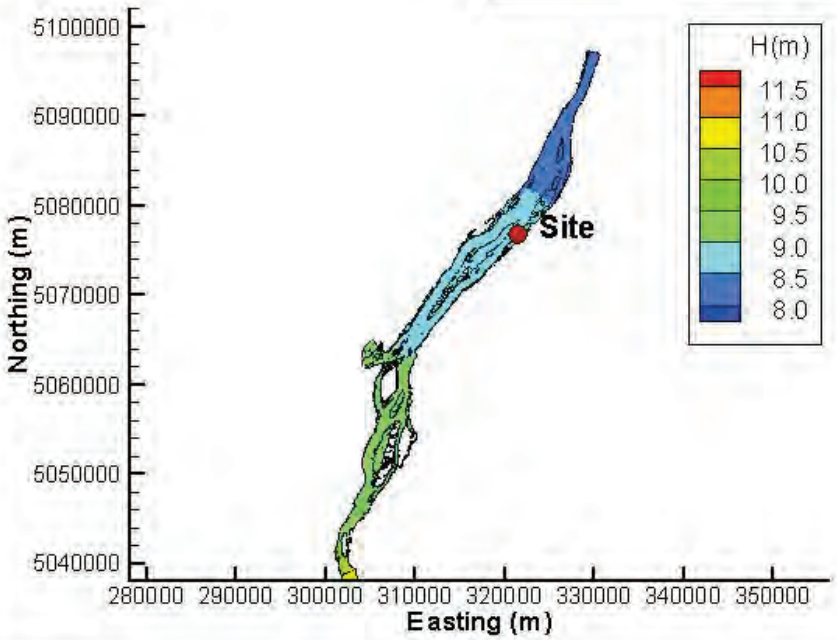


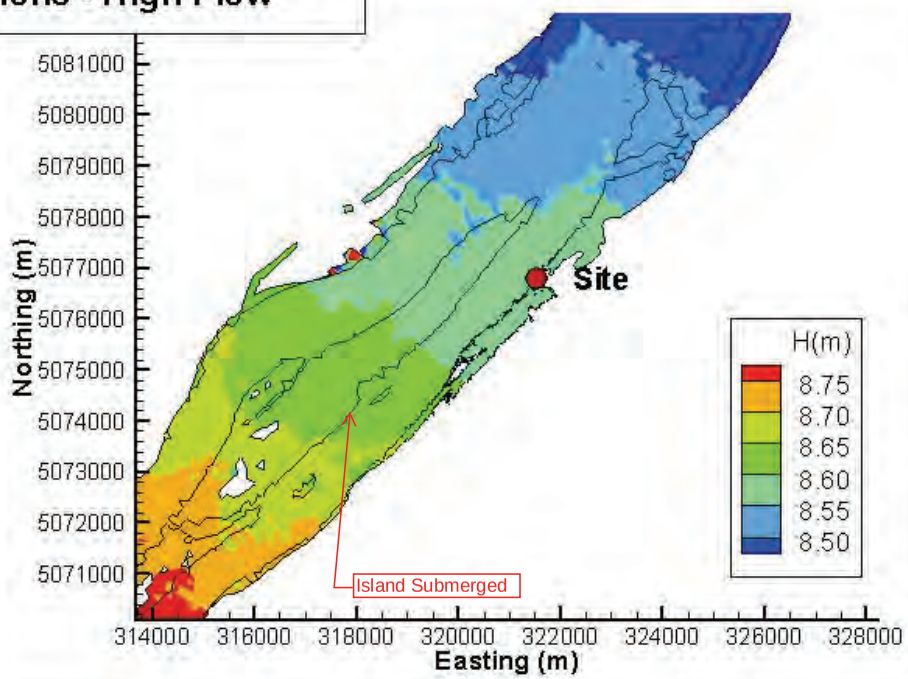


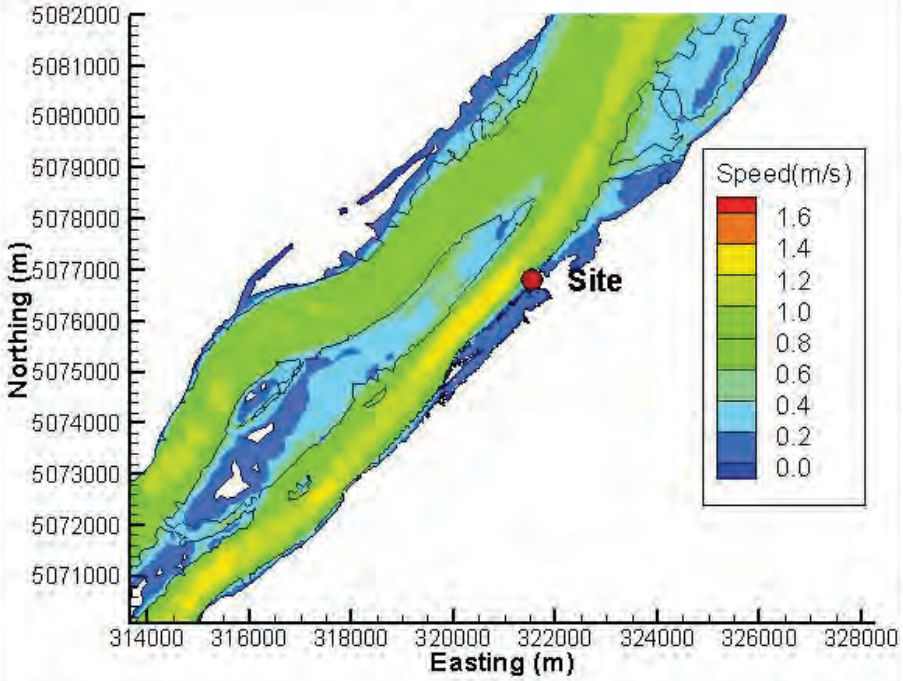


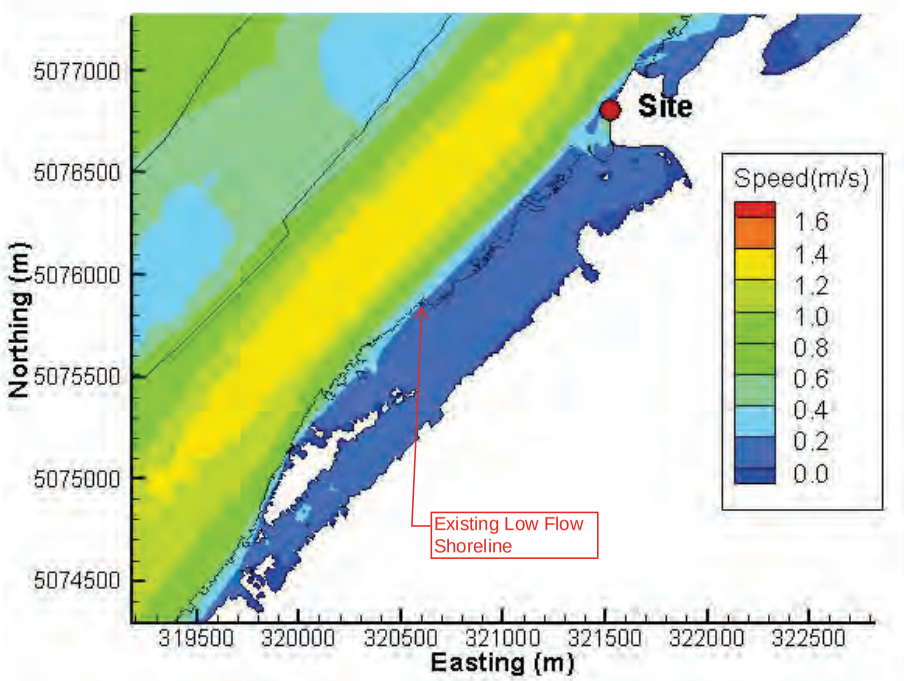


Plot 3: Existing Conditions - High Flow

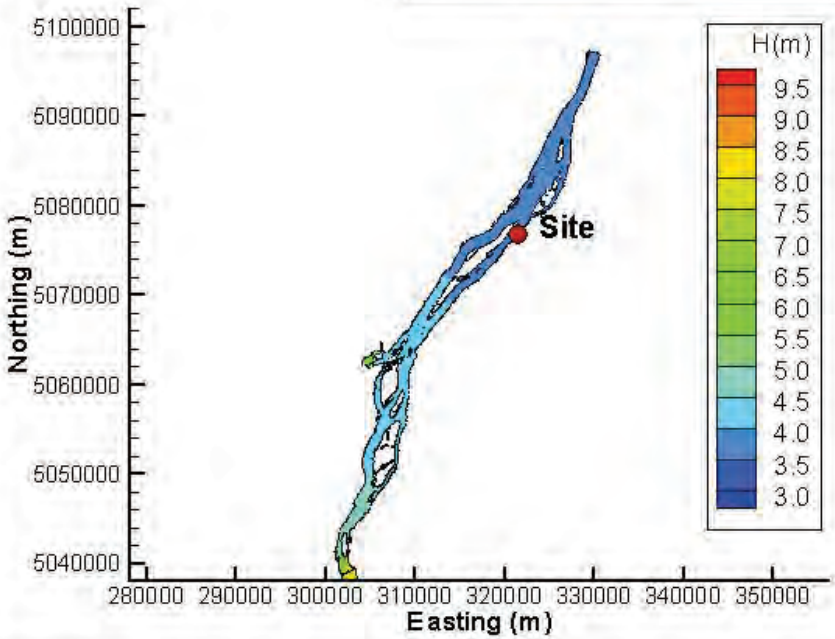


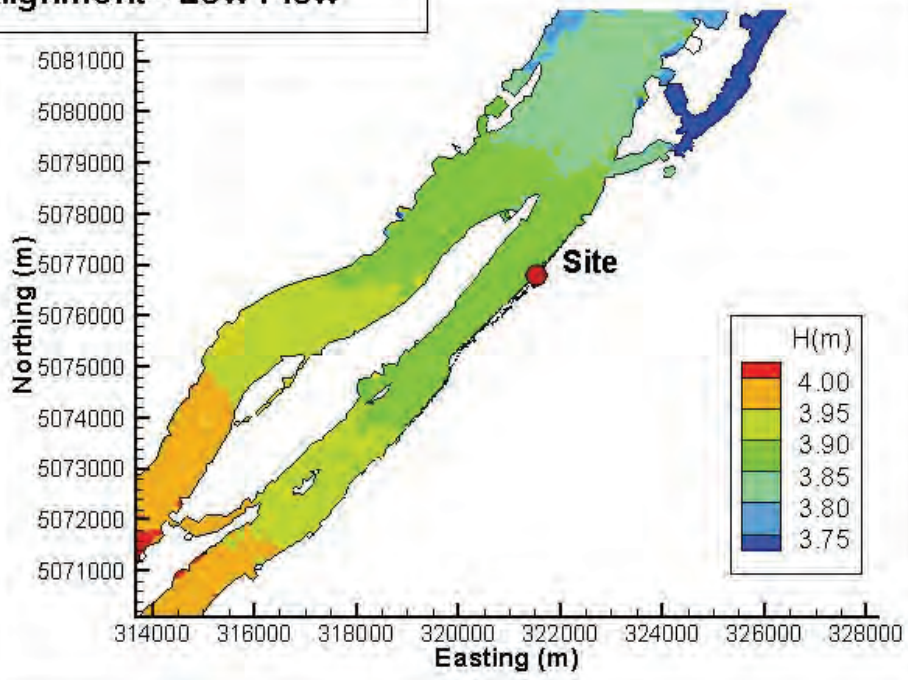


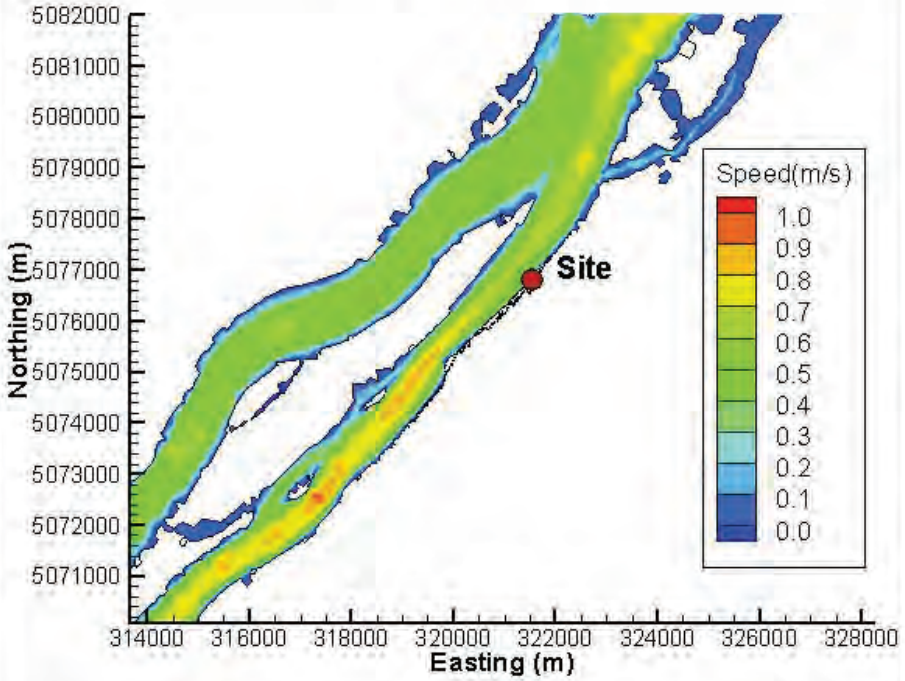


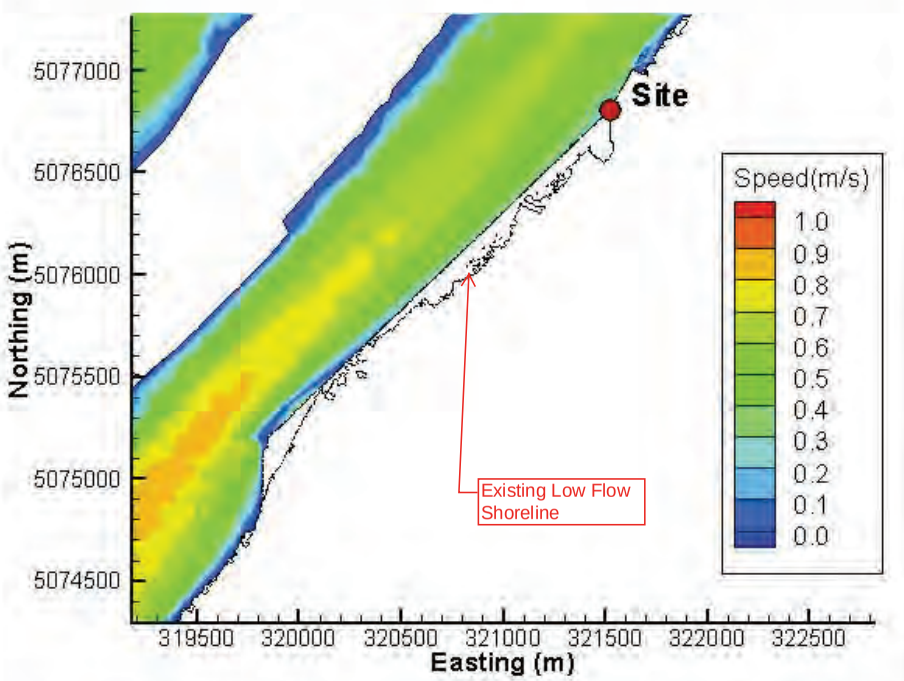


Plot 4: Buildout Preferred Alignment - Low Flow

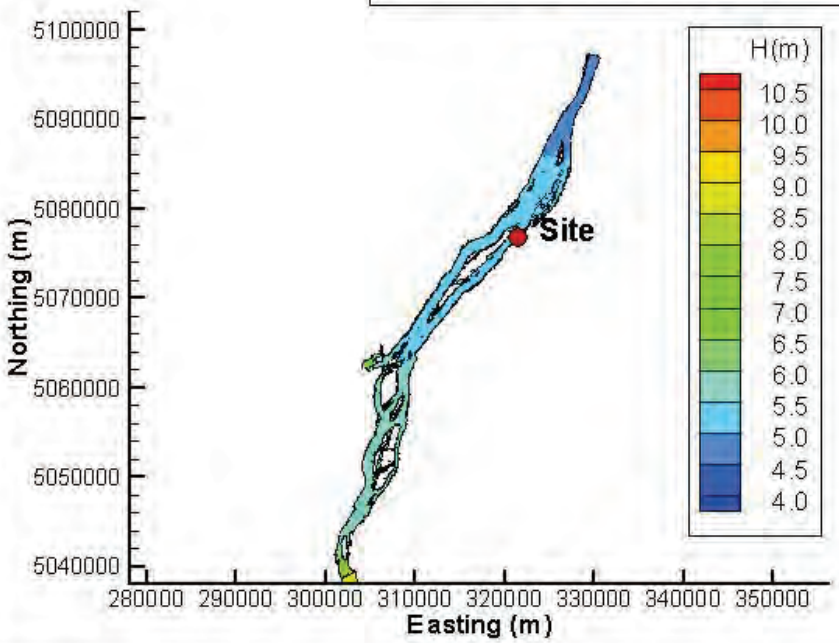


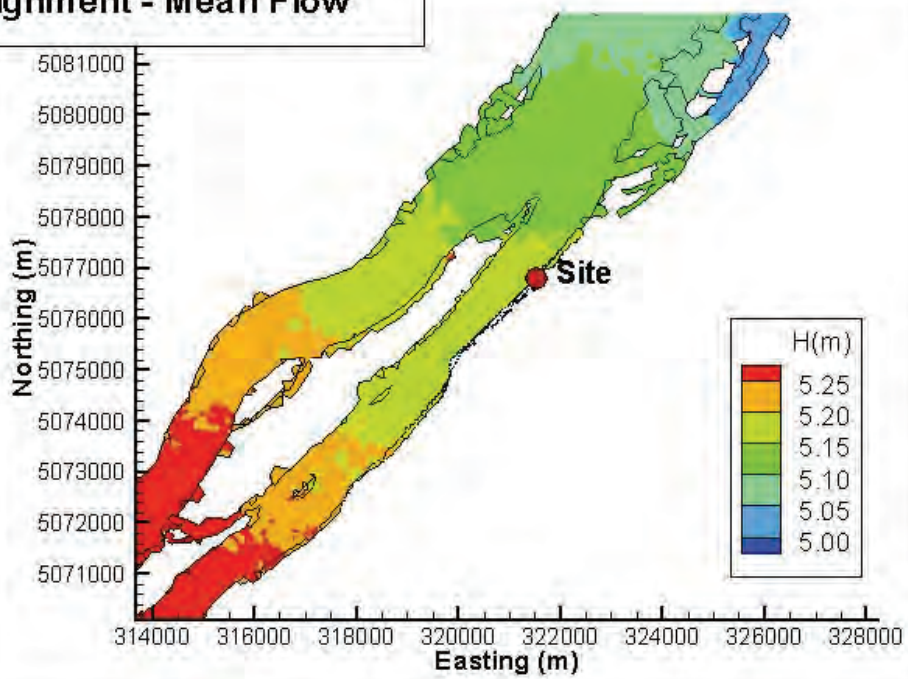


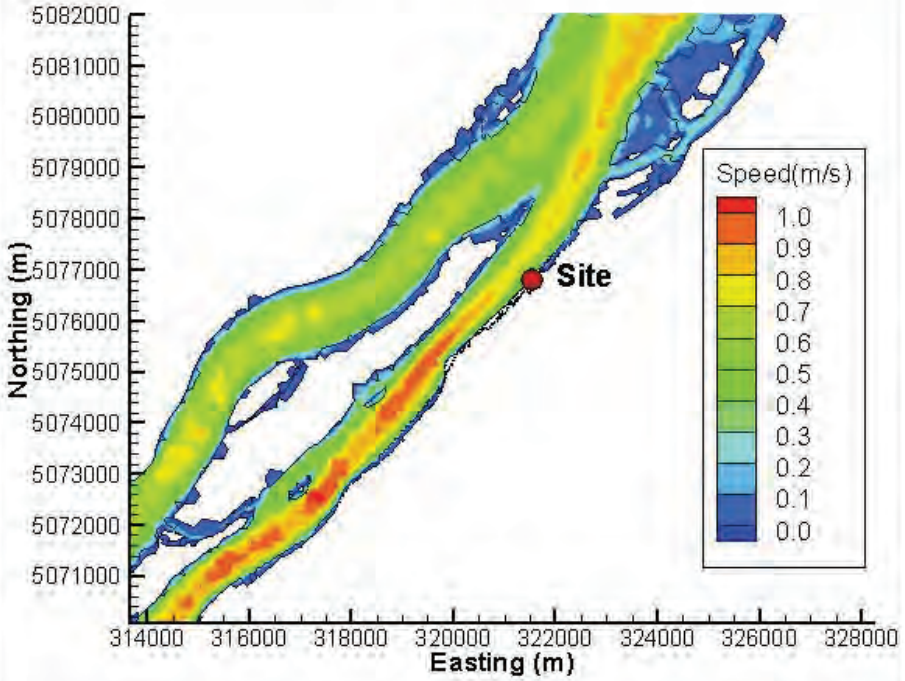


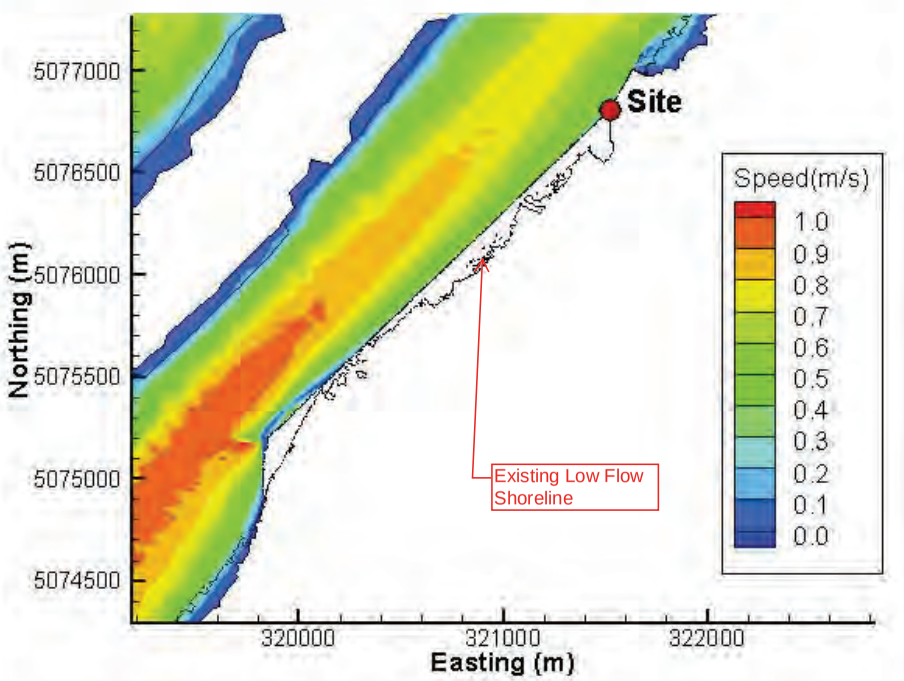


Plot 5: Buildout Preferred Alignment - Mean Flow

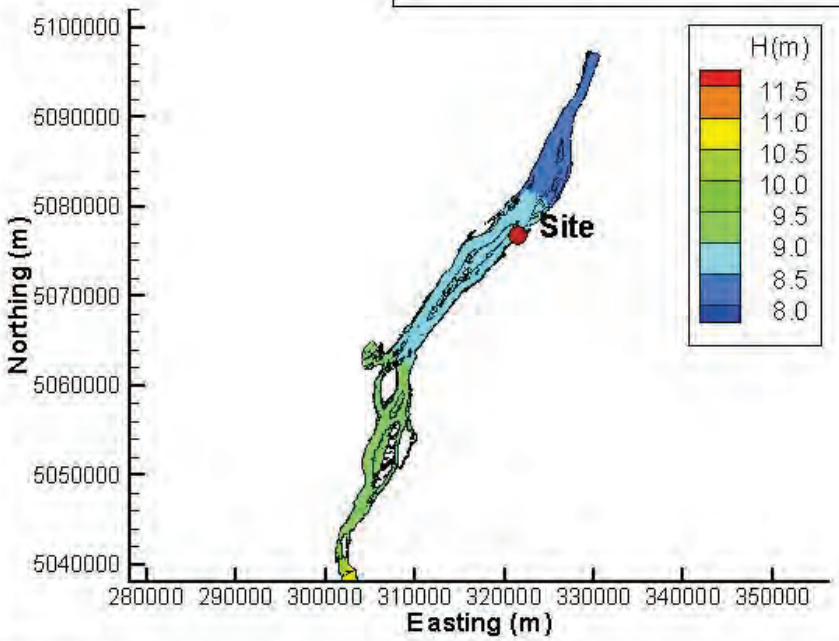


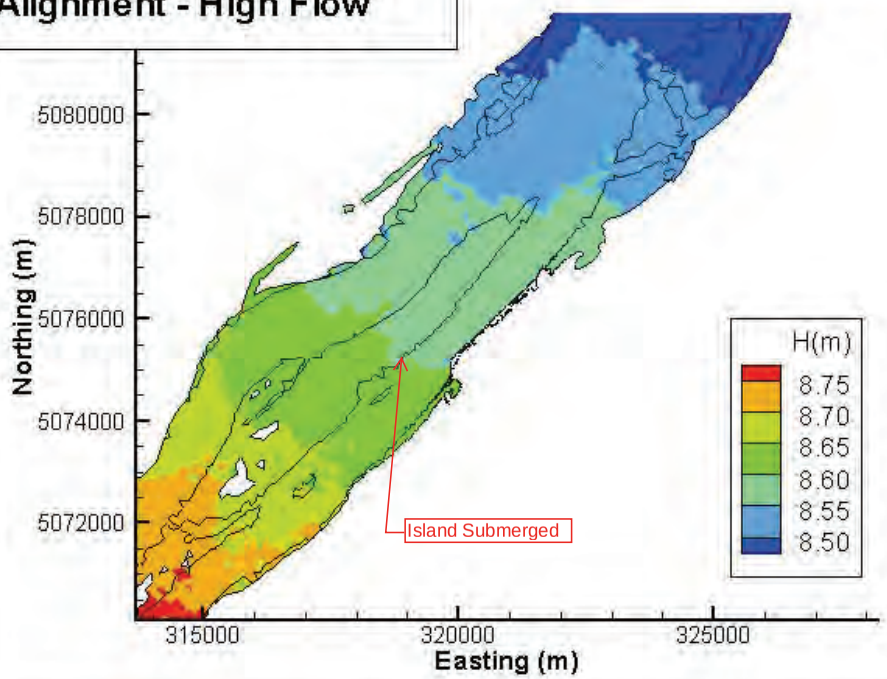


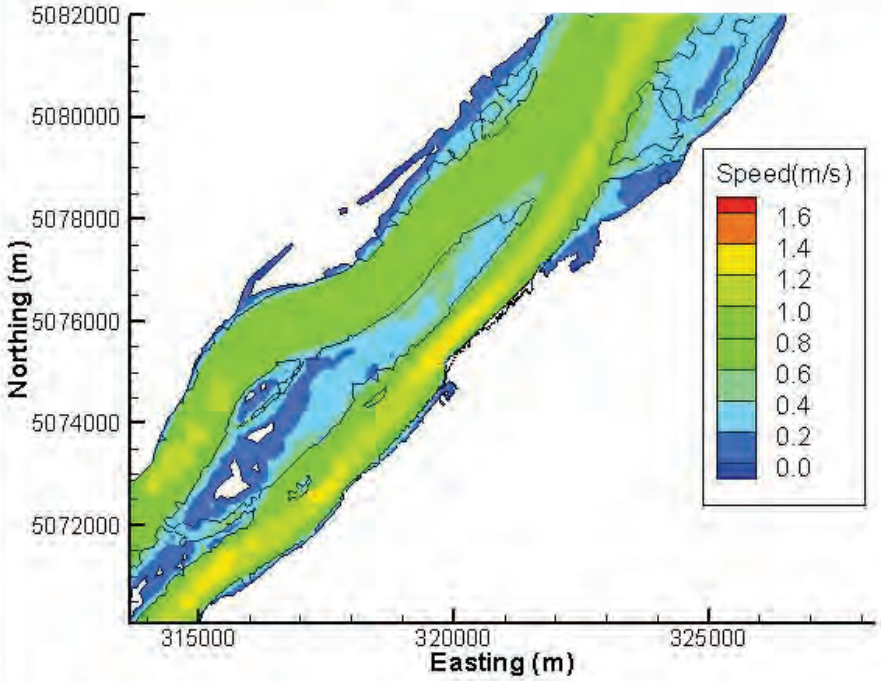


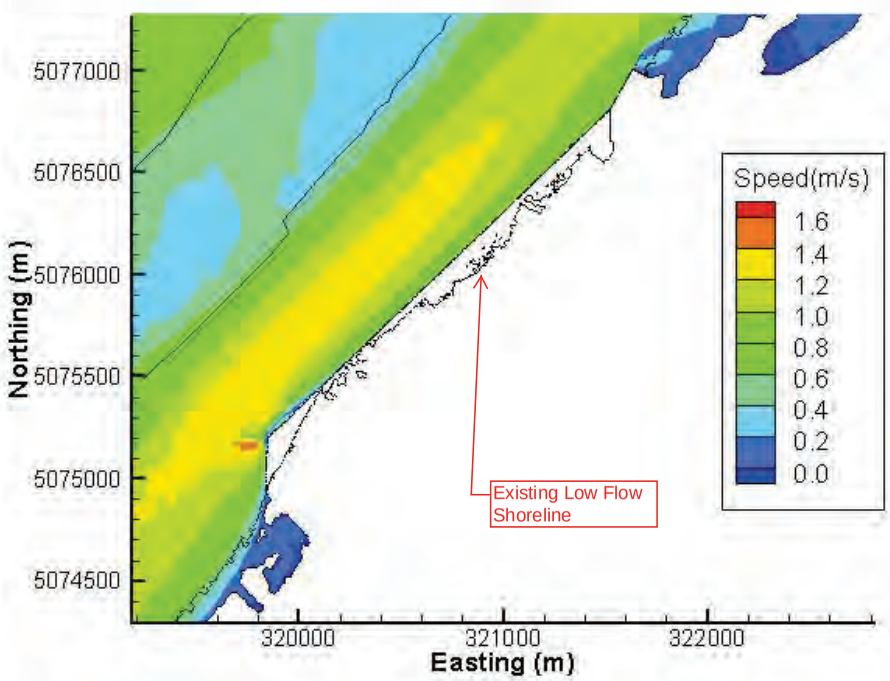


Plot 6: Buildout Preferred Alignment - High Flow

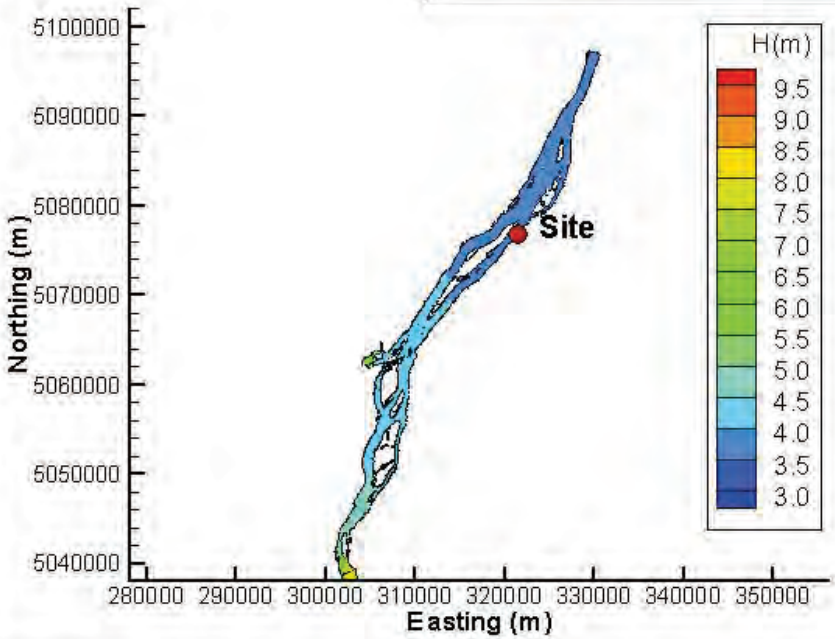


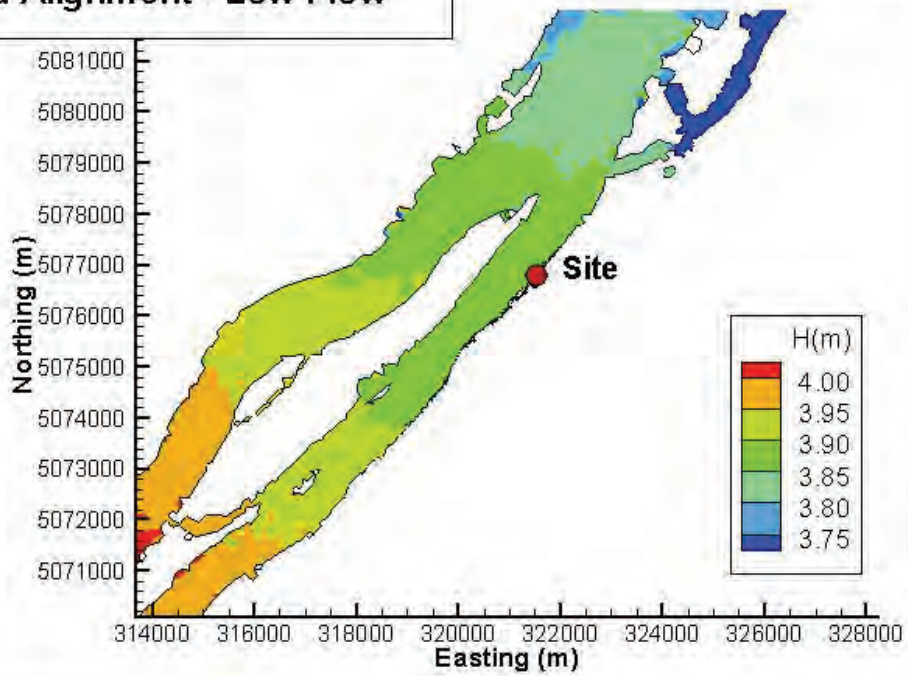


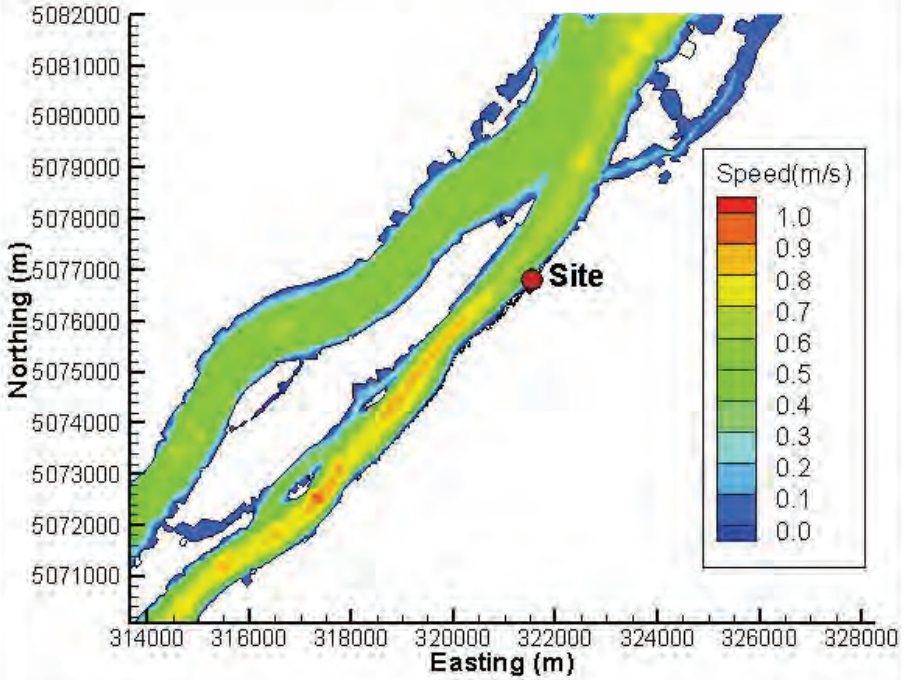


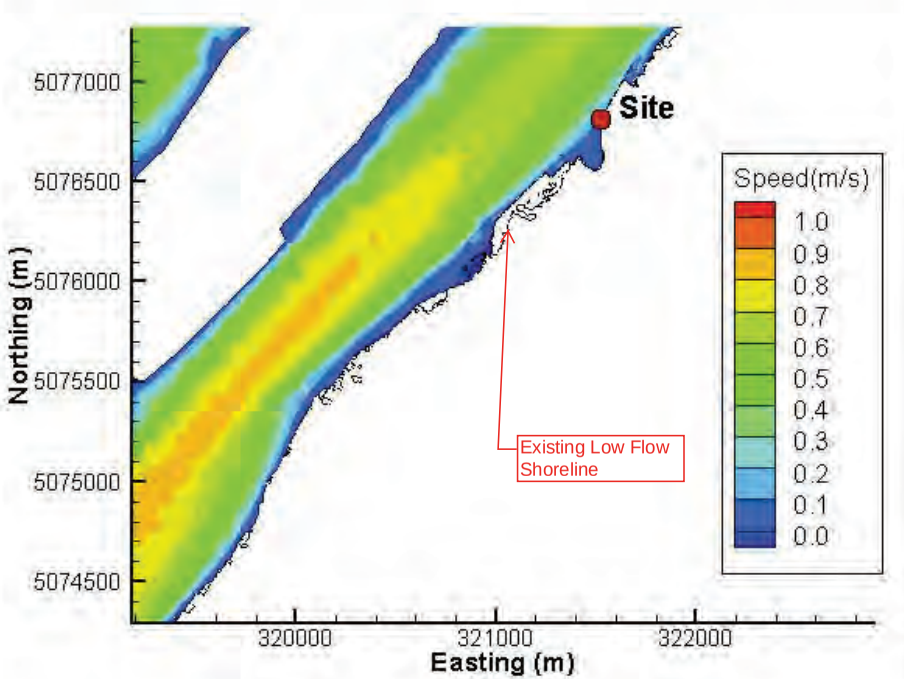


Plot 7: Phase A Preferred Alignment - Low Flow

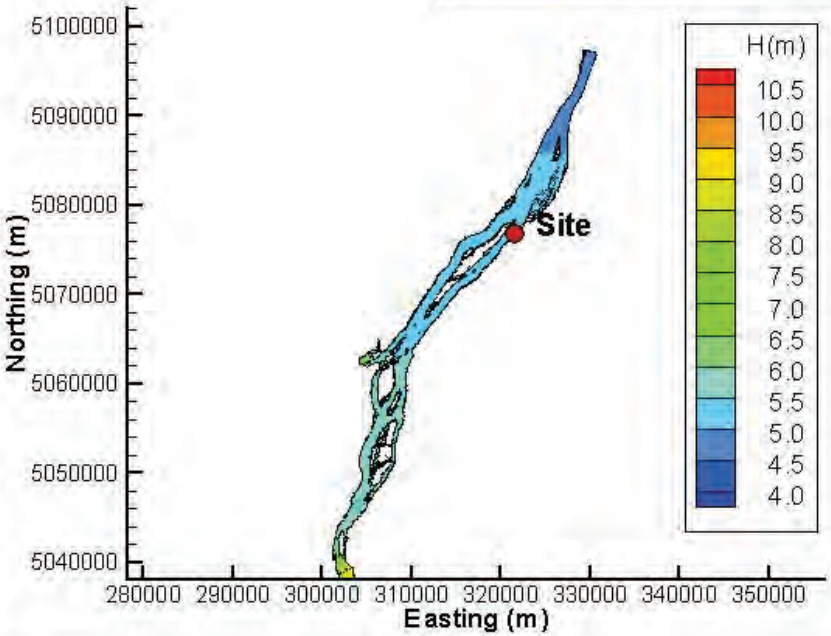


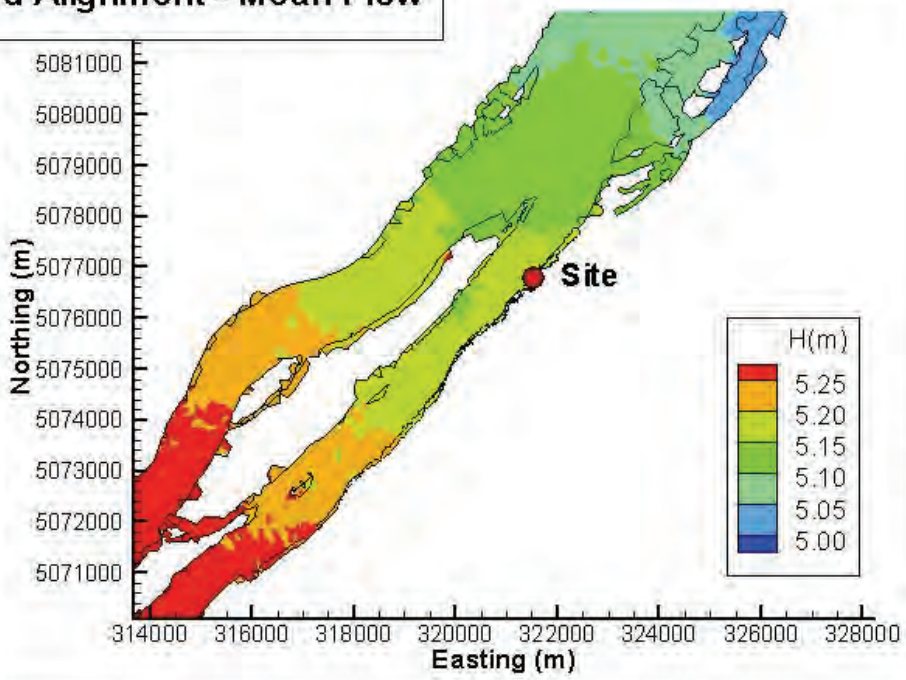


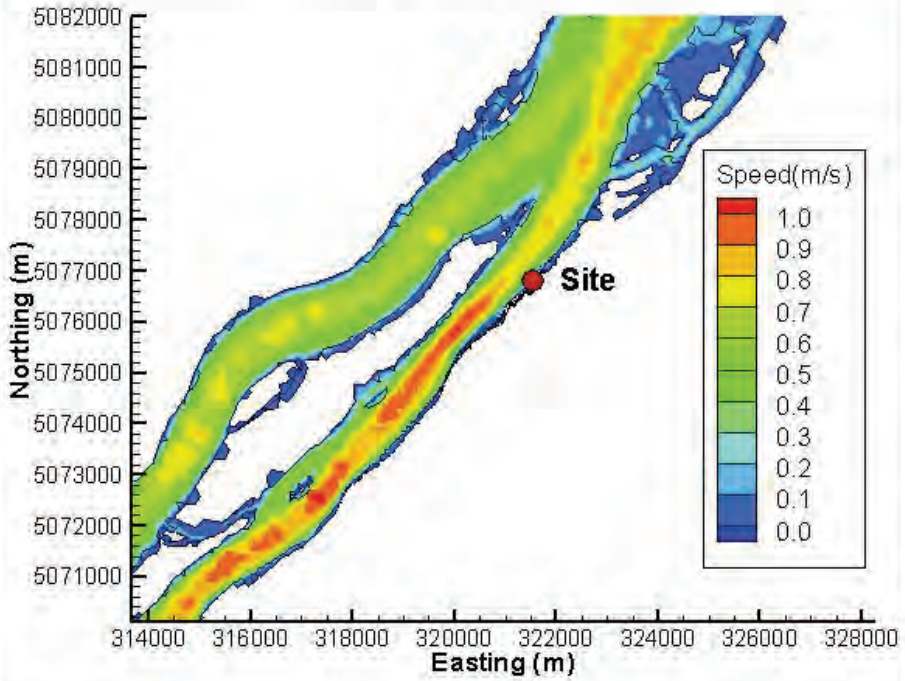


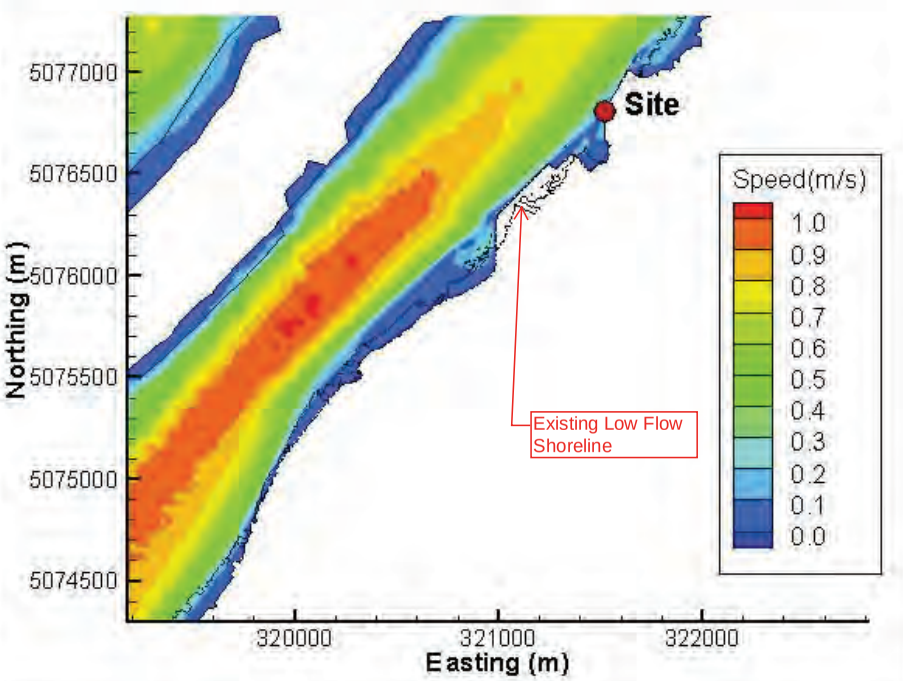


Plot 8: Phase A Preferred Alignment - Mean Flow

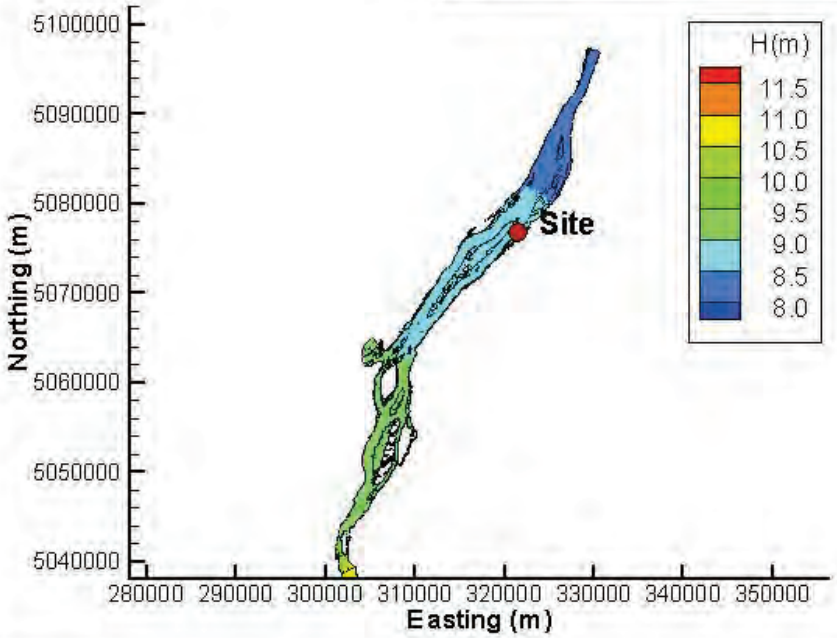


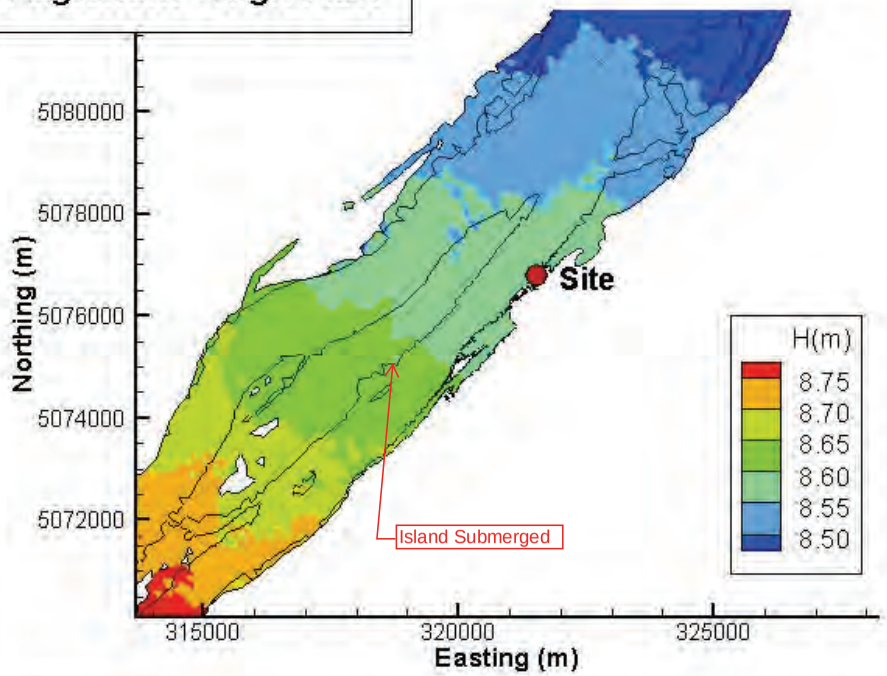


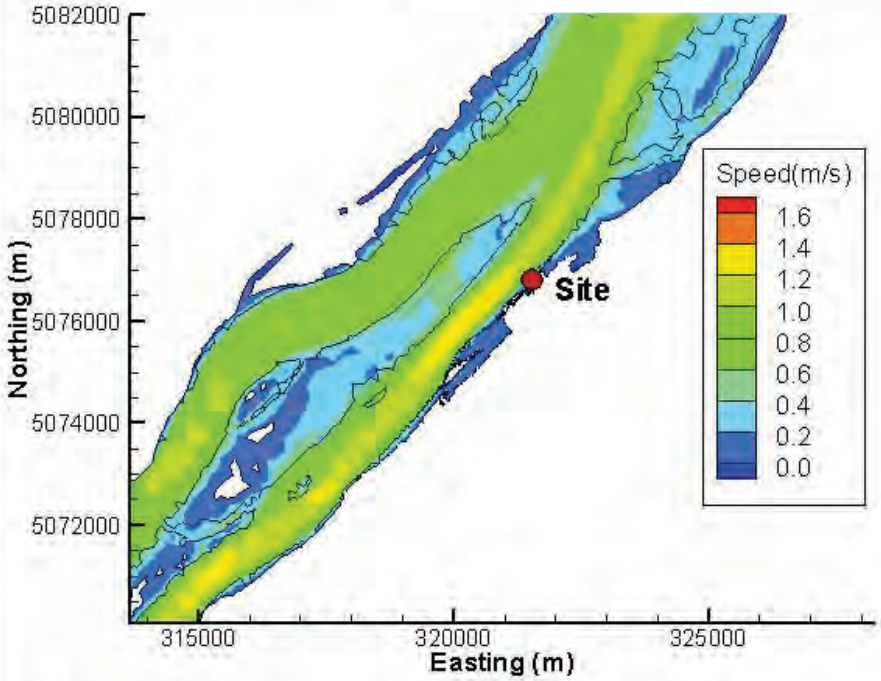


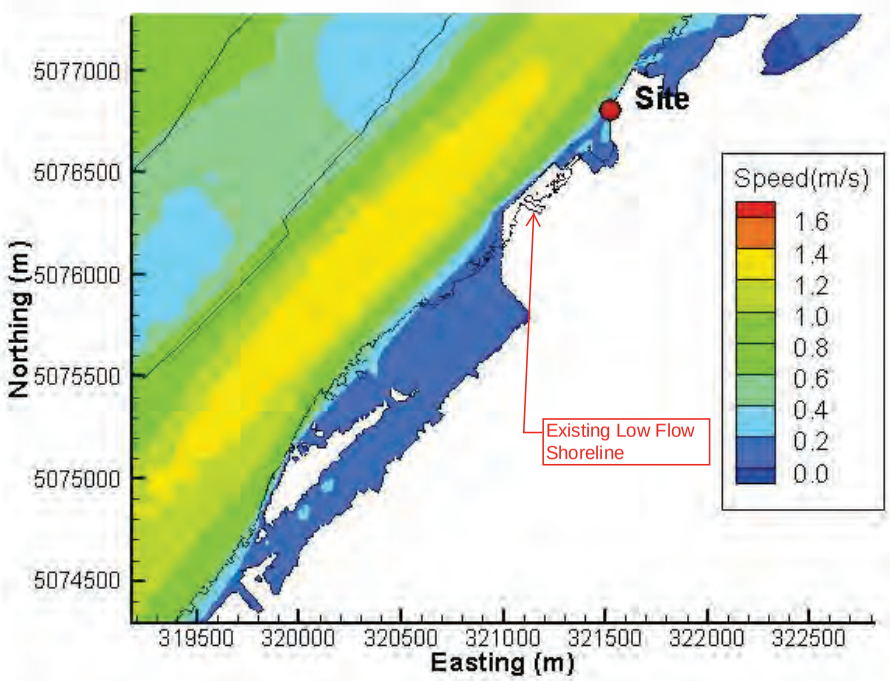


Plot 9: Phase A Preferred Alignment - High Flow

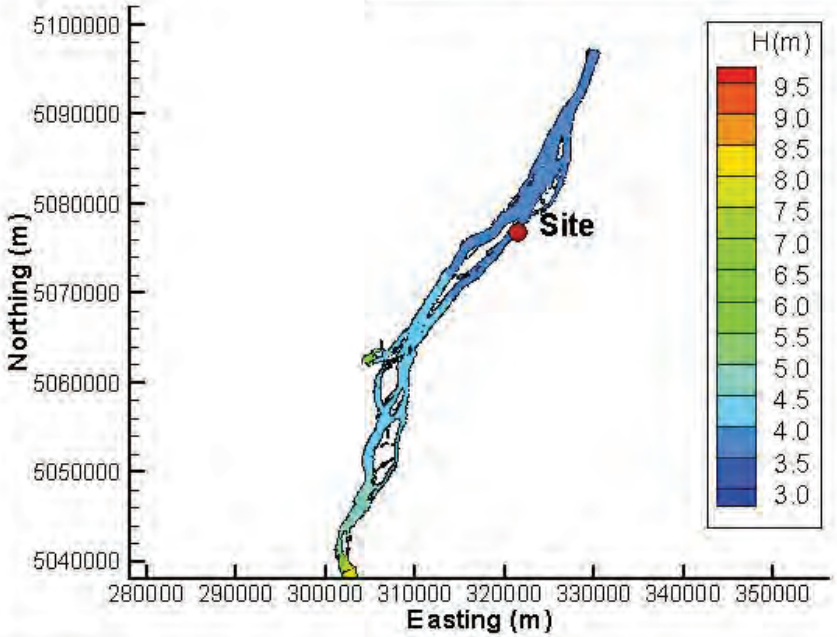


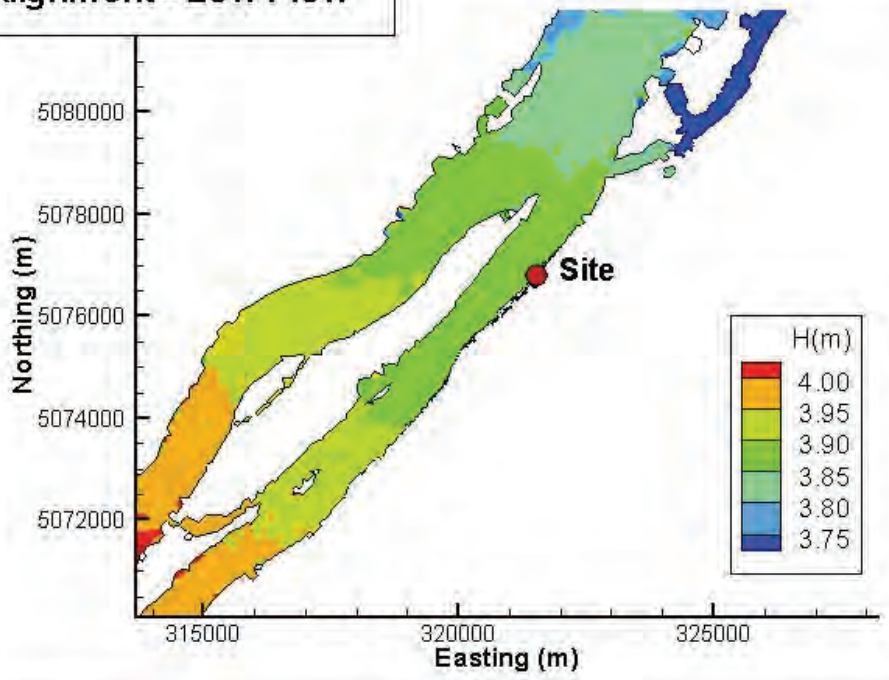


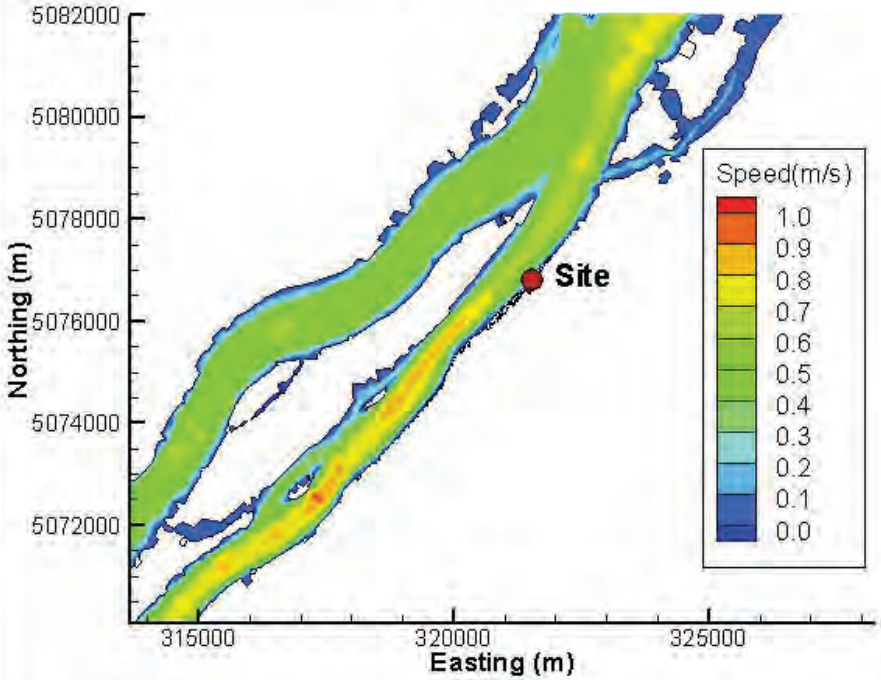


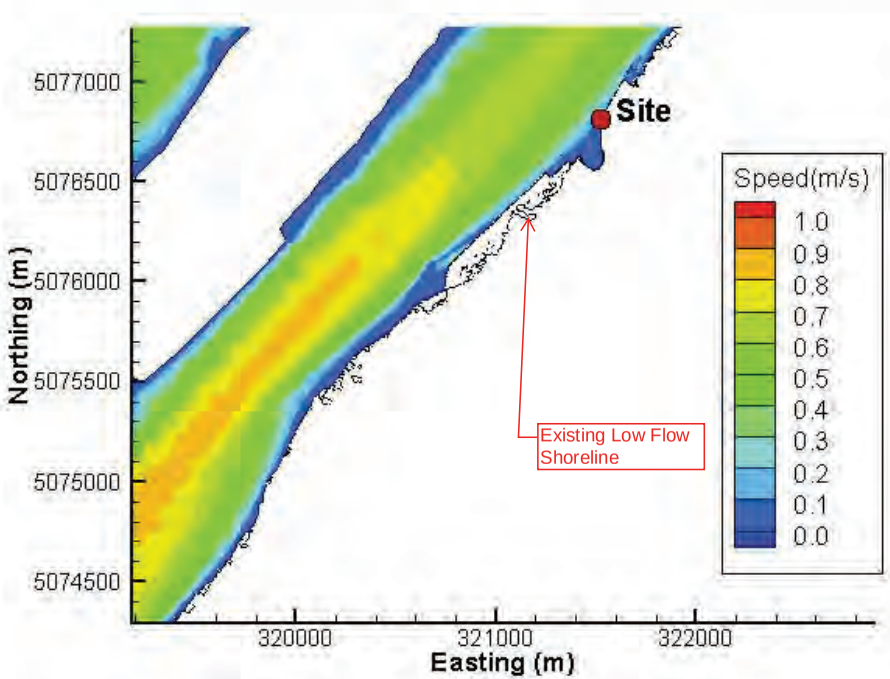


Plot 10: Phase B Preferred Alignment - Low Flow

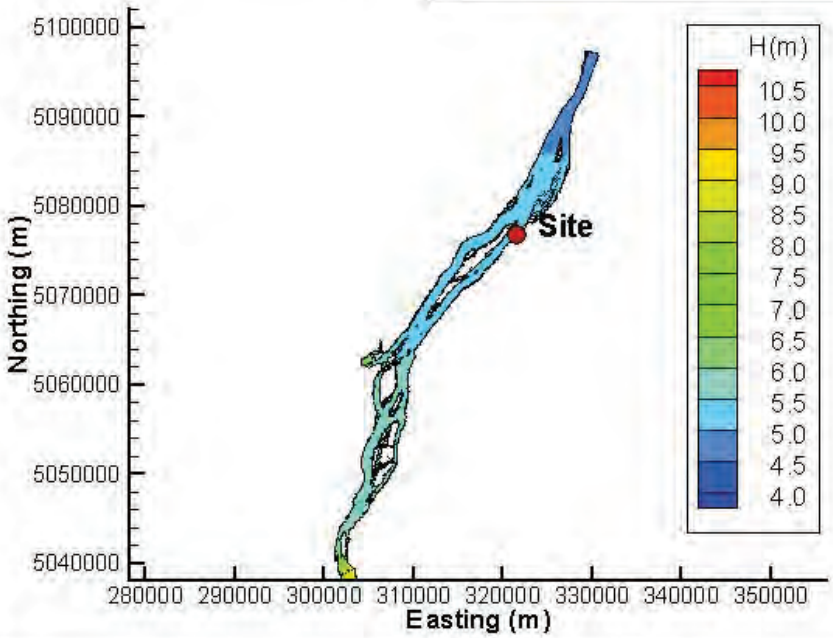


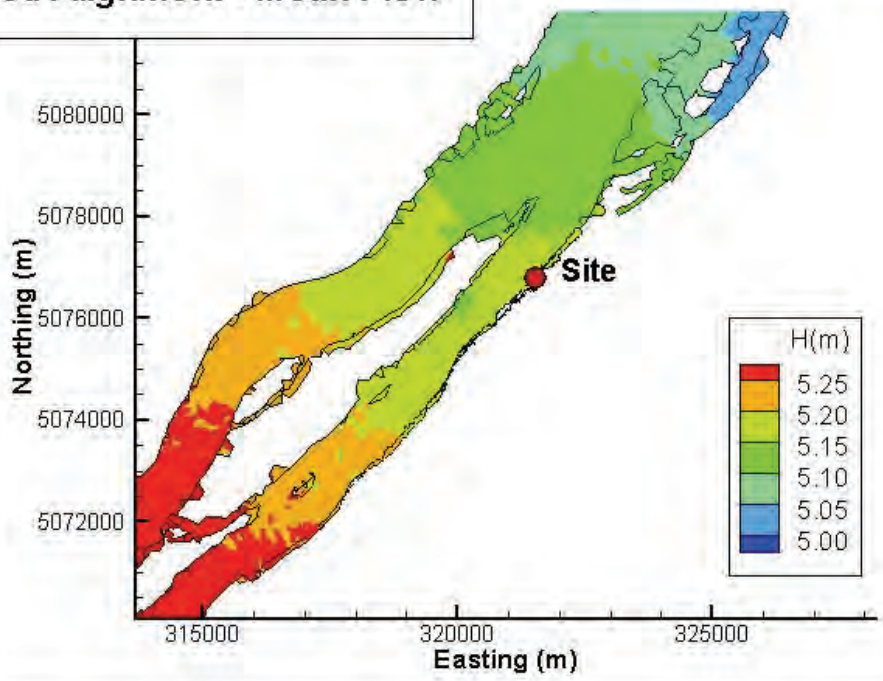


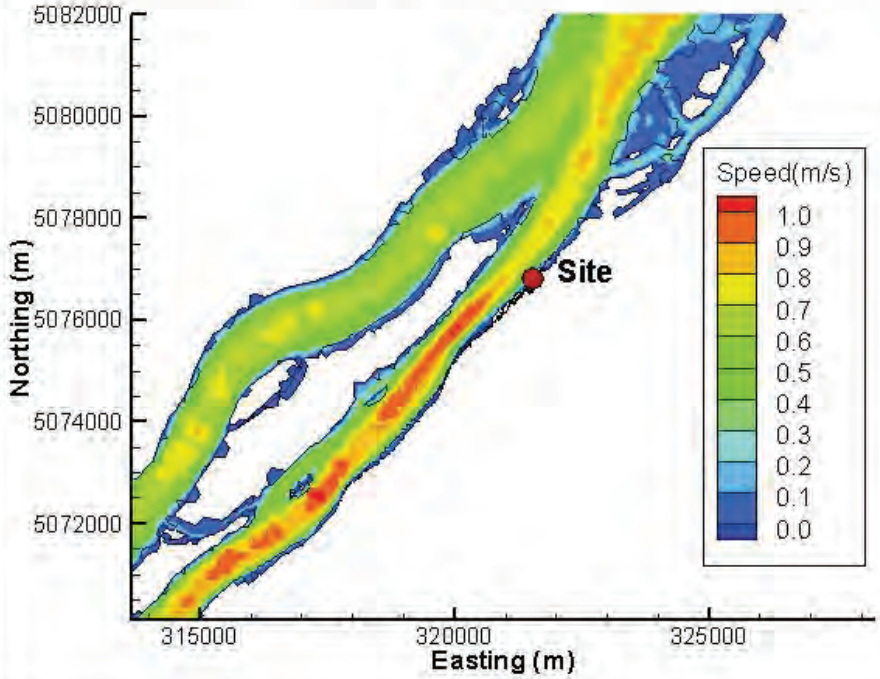


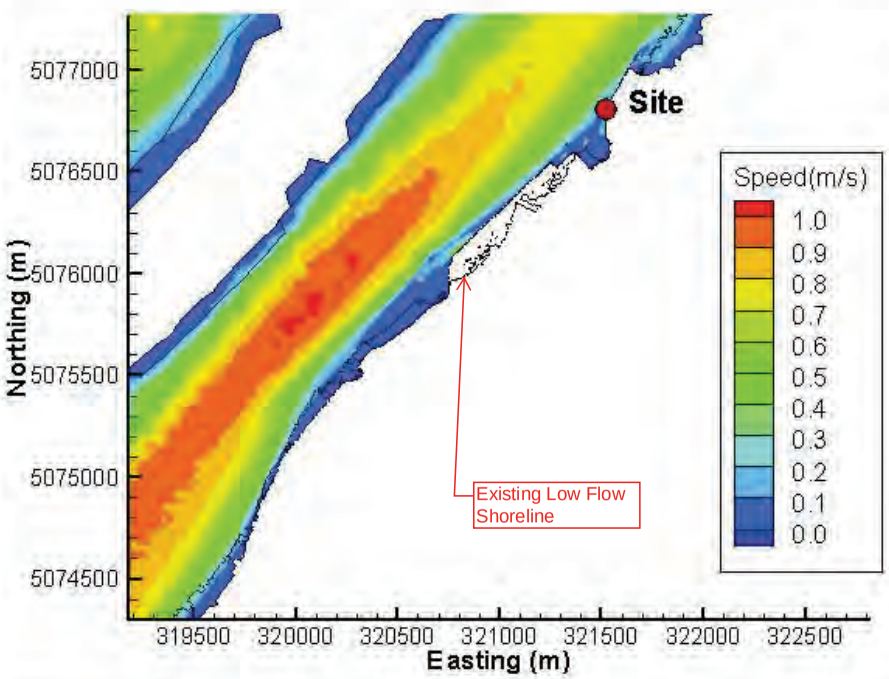


Plot 11: Phase B Preferred Alignment - Mean Flow

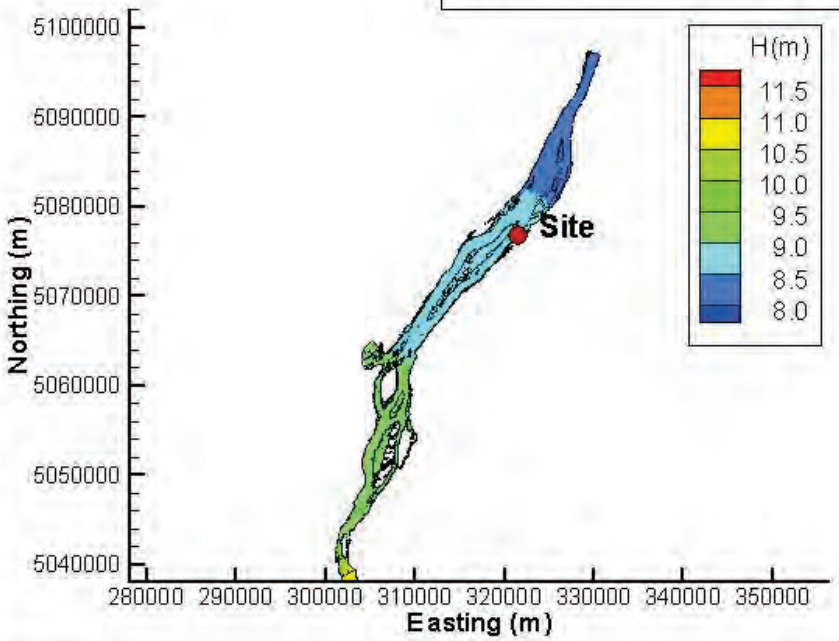


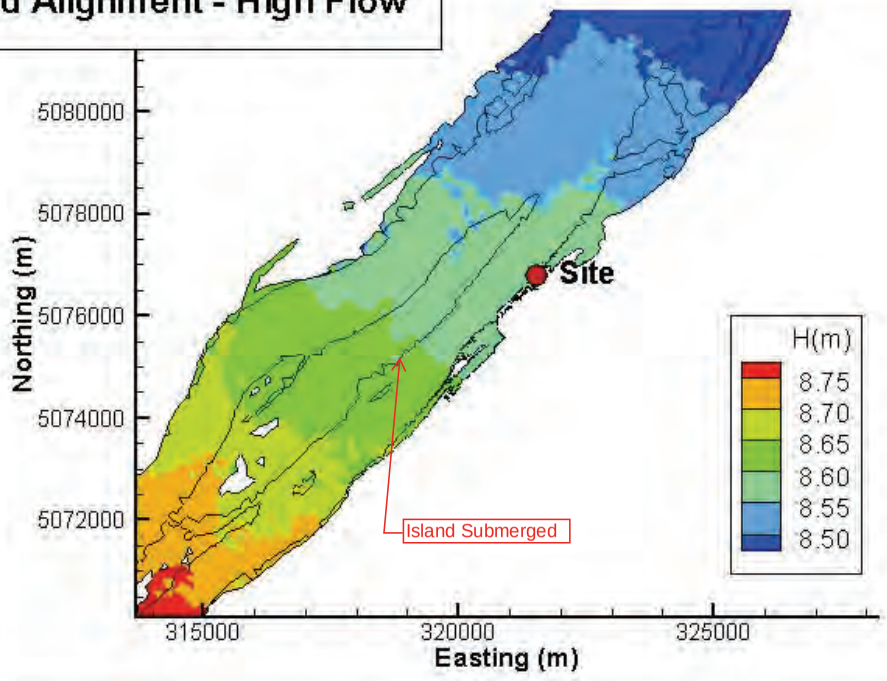


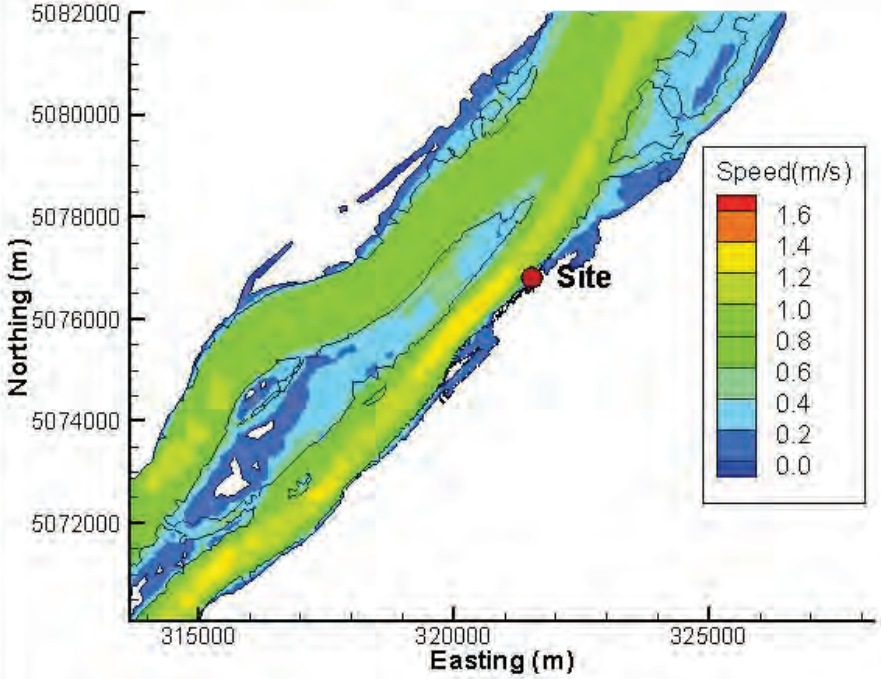


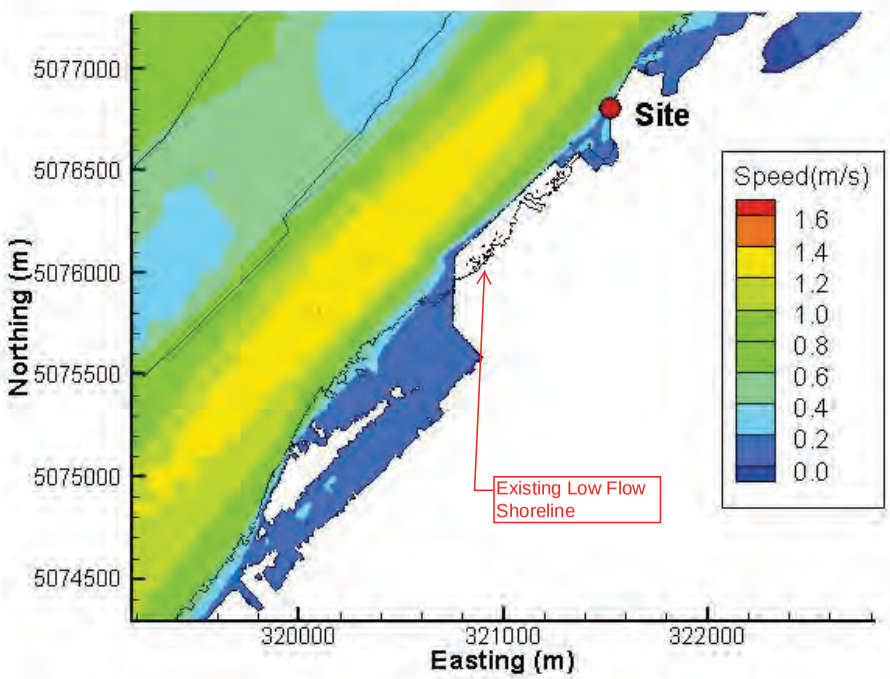


Plot 12: Phase B Preferred Alignment - High Flow



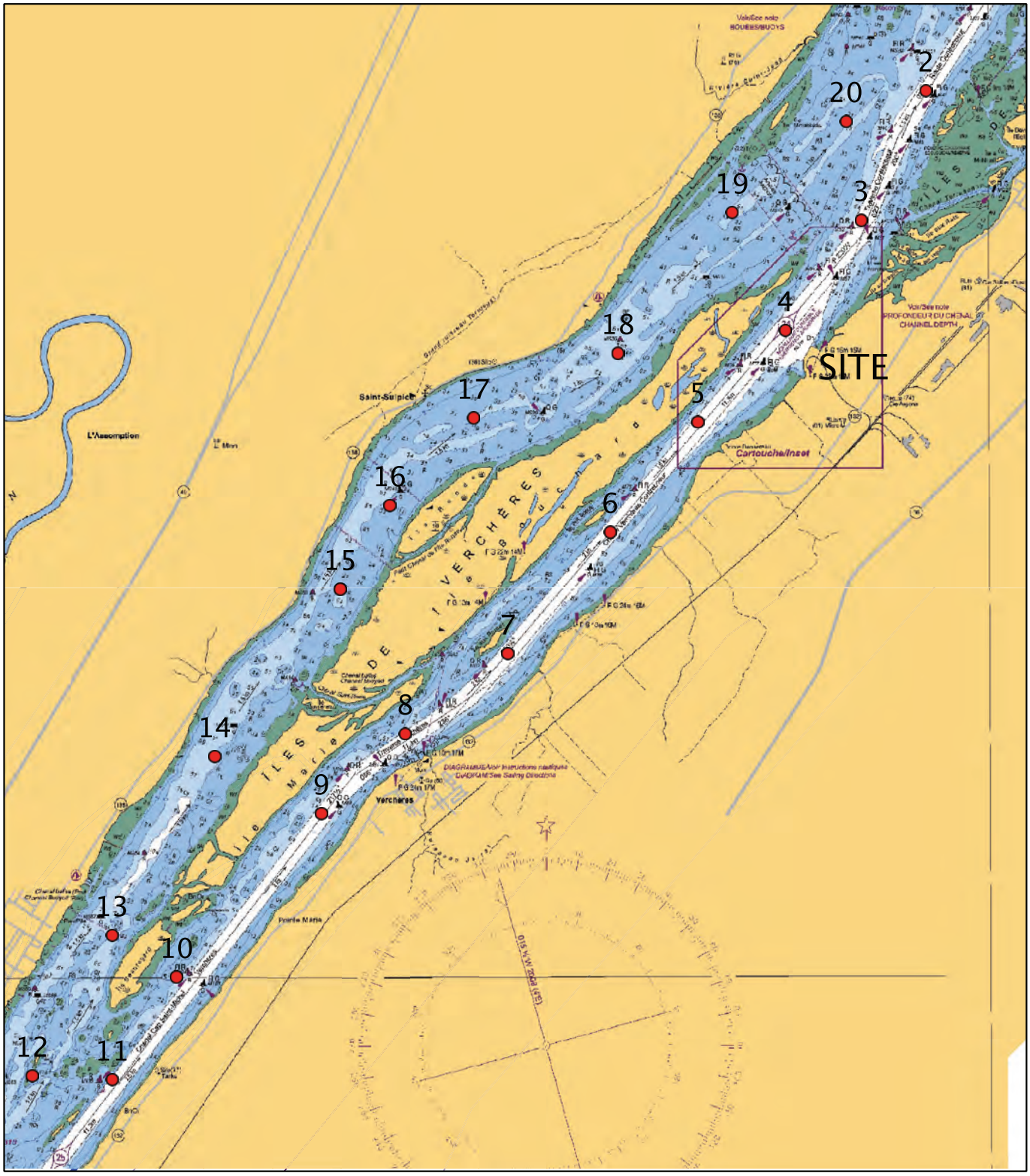






PLOT 13

Model Probe Locations



PLOT 14 - MODEL RESULTS AT LOCATIONS SHOWN ON PLOT 13

WATER LEVELS (m)

	Low Flow					Mean Flow					High Flow				
Point	**Existing**	**Buildout**	**Phase A**	**Phase B**	**Diff.**	**Existing**	**Buildout**	**Phase A**	**Phase B**	**Diff.**	**Existing**	**Buildout**	**Phase A**	**Phase B**	**Diff.**
1	3.779	3.777	3.777	3.777	-0.002	5.062	5.061	5.061	5.061	-0.001	8.472	8.472	8.472	8.472	0.000
2	3.824	3.822	3.822	3.822	-0.002	5.101	5.099	5.099	5.099	-0.002	8.506	8.506	8.506	8.506	0.000
3	3.853	3.848	3.851	3.851	-0.005	5.137	5.132	5.135	5.135	-0.005	8.548	8.543	8.548	8.548	-0.005
4	3.870	3.869	3.869	3.869	-0.001	5.157	5.156	5.156	5.156	-0.001	8.564	8.567	8.565	8.565	0.003
5	3.874	3.872	3.870	3.870	-0.002	5.159	5.159	5.156	5.156	0.001	8.578	8.577	8.576	8.575	-0.001
6	3.889	3.883	3.885	3.885	-0.006	5.180	5.175	5.178	5.178	-0.005	8.625	8.620	8.624	8.623	-0.005
7	3.927	3.920	3.923	3.923	-0.007	5.223	5.216	5.220	5.220	-0.007	8.671	8.665	8.669	8.669	-0.006
8	3.963	3.956	3.959	3.959	-0.007	5.262	5.255	5.258	5.258	-0.007	8.711	8.705	8.709	8.709	-0.006
9	3.993	3.986	3.988	3.988	-0.008	5.301	5.293	5.296	5.296	-0.008	8.763	8.757	8.761	8.760	-0.006
10	4.030	4.022	4.024	4.024	-0.008	5.345	5.336	5.339	5.339	-0.009	8.820	8.814	8.818	8.818	-0.005
11	4.069	4.060	4.062	4.062	-0.009	5.393	5.384	5.386	5.386	-0.009	8.872	8.866	8.870	8.869	-0.005
12	4.098	4.089	4.090	4.090	-0.009	5.407	5.395	5.397	5.398	-0.012	8.865	8.860	8.863	8.863	-0.005
13	4.050	4.042	4.044	4.044	-0.008	5.365	5.355	5.357	5.357	-0.010	8.819	8.814	8.818	8.817	-0.005
14	4.016	4.009	4.010	4.010	-0.007	5.319	5.311	5.312	5.312	-0.008	8.750	8.745	8.748	8.748	-0.005
15	3.973	3.967	3.968	3.968	-0.006	5.263	5.257	5.258	5.258	-0.006	8.677	8.673	8.676	8.676	-0.004
16	3.948	3.942	3.943	3.943	-0.006	5.233	5.228	5.229	5.229	-0.005	8.642	8.639	8.641	8.641	-0.003
17	3.921	3.917	3.918	3.917	-0.004	5.205	5.201	5.202	5.202	-0.005	8.614	8.612	8.614	8.613	-0.003
18	3.900	3.896	3.897	3.896	-0.004	5.178	5.175	5.176	5.176	-0.003	8.578	8.577	8.577	8.577	-0.001
19	3.862	3.859	3.859	3.859	-0.003	5.139	5.136	5.137	5.137	-0.003	8.542	8.543	8.542	8.543	0.001
20	3.831	3.828	3.828	3.828	-0.003	5.109	5.107	5.107	5.107	-0.002	8.512	8.512	8.512	8.512	0.000

CURRENT SPEEDS (m/s)

	Low Flow					Mean Flow					High Flow				
Point	**Existing**	**Buildout**	**Phase A**	**Phase B**	**Diff.**	**Existing**	**Buildout**	**Phase A**	**Phase B**	**Diff.**	**Existing**	**Buildout**	**Phase A**	**Phase B**	**Diff.**
1	0.837	0.834	0.834	0.834	-0.003	0.884	0.881	0.881	0.881	-0.003	1.040	1.040	1.039	1.039	0.000
2	0.728	0.728	0.728	0.728	0.000	0.858	0.857	0.856	0.856	-0.001	1.089	1.089	1.088	1.088	0.000
3	0.678	0.695	0.678	0.678	0.017	0.790	0.811	0.791	0.791	0.020	1.061	1.074	1.059	1.059	0.013
4	0.651	0.606	0.625	0.623	-0.045	0.786	0.734	0.760	0.762	-0.052	1.175	1.097	1.152	1.147	-0.078
5	0.756	0.671	0.756	0.756	-0.085	0.917	0.812	0.917	0.917	-0.105	1.249	1.173	1.252	1.254	-0.076
6	0.850	0.836	0.848	0.849	-0.014	0.974	0.958	0.970	0.970	-0.016	1.153	1.148	1.155	1.155	-0.006
7	0.883	0.885	0.883	0.883	0.002	1.012	1.012	1.009	1.009	0.000	1.245	1.248	1.244	1.244	0.003
8	0.796	0.797	0.795	0.795	0.001	0.931	0.932	0.929	0.929	0.001	1.222	1.226	1.222	1.222	0.004
9	0.747	0.749	0.747	0.747	0.002	0.873	0.873	0.870	0.870	0.000	1.149	1.152	1.149	1.149	0.003
10	0.720	0.716	0.714	0.714	-0.004	0.847	0.841	0.838	0.838	-0.007	1.085	1.085	1.084	1.084	0.000
11	0.963	0.966	0.964	0.965	0.002	1.028	1.031	1.029	1.029	0.003	1.204	1.205	1.204	1.204	0.001
12	0.352	0.373	0.374	0.374	0.021	0.635	0.628	0.630	0.630	-0.007	1.112	1.112	1.111	1.111	0.000
13	0.547	0.541	0.543	0.543	-0.007	0.677	0.676	0.678	0.678	-0.002	1.051	1.050	1.051	1.050	-0.001
14	0.577	0.570	0.572	0.572	-0.007	0.733	0.724	0.726	0.726	-0.010	1.084	1.080	1.082	1.082	-0.003
15	0.660	0.651	0.653	0.653	-0.009	0.804	0.793	0.796	0.796	-0.011	1.122	1.116	1.120	1.119	-0.006
16	0.591	0.585	0.587	0.587	-0.006	0.745	0.734	0.737	0.737	-0.011	1.059	1.052	1.056	1.055	-0.007
17	0.653	0.646	0.648	0.648	-0.008	0.757	0.752	0.754	0.754	-0.006	1.009	1.003	1.007	1.006	-0.006
18	0.526	0.522	0.523	0.523	-0.004	0.660	0.652	0.654	0.654	-0.008	0.931	0.911	0.927	0.925	-0.020
19	0.521	0.518	0.519	0.519	-0.003	0.614	0.611	0.613	0.613	-0.003	0.802	0.795	0.799	0.799	-0.007
20	0.563	0.558	0.561	0.561	-0.005	0.644	0.638	0.642	0.642	-0.006	0.826	0.825	0.827	0.827	-0.001

APPENDIX F

DETAILED COST BREAKDOWNS

MONTREAL PORT AUTHORITY
Contrecoeur Development Master Plan

Date: 14-Sep-10
Prepared By: MN (M&N)
Project No.: 7146

CONTRECOUER PHASE A - CONVENTIONAL

ITEM	DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT RATE	ITEM COST	AREA COST	CONTINGENCY %	CONTINGENCY $
1	CONTRECOEUR EQUIPMENT PURCHASE							
1.1	Ship-to-Shore Cranes	ea.	4	$8,800,000	$35,200,000		5	$1,760,000
1.2	Spare STS Crane Spreaders	ea.	1	$170,000	$170,000		5	$8,500
1.3	IY RMGs	ea.	3	$2,500,000	$7,500,000		10	$750,000
1.4	CY RTGs	ea.	10	$1,300,000	$13,000,000		5	$650,000
1.5	Reachstackers	ea.	1	$515,000	$515,000		5	$25,750
1.6	Top Picks	ea.	1	$505,000	$505,000		5	$25,250
1.7	MT Handlers	ea.	2	$265,000	$530,000		5	$26,500
1.8	Hostlers	ea.	35	$70,000	$2,450,000		5	$122,500
1.9	Trailers (Bombcarts)	ea.	42	$90,000	$3,780,000		5	$189,000
1.10	Fuel/Repair Trucks	ea.	2	$110,000	$220,000		5	$11,000
1.11	Pick-up Trucks	ea.	24	$40,000	$960,000		5	$48,000
					SUB-TOTAL	$64,830,000		$3,616,500
					TOTAL FOR EQUIPMENT	$64,830,000		$3,616,500
					TOTAL FOR EQUIPMENT, INCL. CONTINGENCY	*$68,446,500*		
2	PROCUREMENT & CONTRACT ADMINISTRATION							
2.1	*P & C at 1.5% of Purchase Price*	ea.	1	$972,450	$972,450		10	$97,245
					SUB-TOTAL FOR PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION	$972,450		$97,245
					TOTAL FOR EQUIPMENT	$65,800,000		$3,700,000
					TOTAL FOR EQUIPMENT , INCL. CONTINGENCY	**$69,500,000**		**(rounded)**

The cost estimate for the 30.48 m gauge ship to shore cranes includes the crane design, supply, delivery, erection and testing costs (the estimate does not include applicable taxes, duties and tarrifs). One spreader is included for each crane.

The estimate is based on Canadian (CDN) Dollars. Container handling equipment is usually purchased in US dollars or Euros and therefore its Canadian dollar cost is dependant on exchange rates at the time of purchase. The exchange rate applied to the crane estimate in this review is US$0.95 = CDN $1.00 and $0.75 Euros = $CDN 1.00

The estimate is based on typical order quantities (i.e. 3 gantry cranes per order) and mid-range equipment

MONTREAL PORT AUTHORITY
Contrecoeur Development Master Plan

Date: 14-Sep-10
Prepared By: MN (M&N)
Project No.: 7146

CONTRECOUER PHASE B - CONVENTIONAL

ITEM	DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT RATE	ITEM COST	AREA COST	CONTINGENCY %	CONTINGENCY $
1	CONTRECOEUR EQUIPMENT PURCHASE							
1.1	Ship-to-Shore Cranes	ea.	4	$8,800,000	$35,200,000		5	$1,760,000
1.2	Spare STS Crane Spreaders	ea.	1	$170,000	$170,000		5	$8,500
1.3	IY RMGs	ea.	2	$2,500,000	$5,000,000		10	$500,000
1.4	CY RTGs	ea.	14	$1,300,000	$18,200,000		5	$910,000
1.5	Reachstackers	ea.	1	$515,000	$515,000		5	$25,750
1.6	Top Picks	ea.	1	$505,000	$505,000		5	$25,250
1.7	MT Handlers	ea.	2	$265,000	$530,000		5	$26,500
1.8	Hostlers	ea.	32	$70,000	$2,240,000		5	$112,000
1.9	Trailers (Bombcarts)	ea.	38	$90,000	$3,420,000		5	$171,000
1.10	Fuel/Repair Trucks	ea.	2	$110,000	$220,000		5	$11,000
1.11	Pick-up Trucks	ea.	24	$40,000	$960,000		5	$48,000
					SUB-TOTAL	$66,960,000		$3,598,000
					TOTAL FOR EQUIPMENT	**$66,960,000**		$3,598,000
					TOTAL FOR EQUIPMENT, INCL. CONTINGENCY	*$70,558,000*		
2	PROCUREMENT & CONTRACT ADMINISTRATION							
2.1	***P&C at 1.5% of Purchase Price***	ea.	1	$1,004,400	$1,004,400		10	$100,440
					SUB-TOTAL FOR PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION	$1,004,400		$100,440
					TOTAL FOR EQUIPMENT	$68,000,000		$3,700,000
					TOTAL FOR EQUIPMENT , INCL. CONTINGENCY	**$71,700,000**		**(rounded)**

The cost estimate for the 30.48 m gauge ship to shore cranes includes the crane design, supply, delivery, erection and testing costs (the estimate does not include applicable taxes, duties and tarrifs). One spreader is included for each crane.

The estimate is based on Canadian (CDN) Dollars. Container handling equipment is usually purchased in US dollars or Euros and therefore its Canadian dollar cost is dependant on exchange rates at the time of purchase. The exchange rate applied to the crane estimate in this review is US$0.95 = CDN $1.00 and $0.75 Euros = $CDN 1.00

The estimate is based on typical order quantities (i.e. 3 gantry cranes per order) and mid-range equipment

MONTREAL PORT AUTHORITY
Contrecoeur Development Master Plan

Date: 14-Sep-10
Prepared By: MN (M&N)
Project No.: 7146

CONTRECOUER PHASE A - SEMI AUTOMATED

ITEM	DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT RATE	ITEM COST	AREA COST	CONTINGENCY %	CONTINGENCY $
1	CONTRECOEUR EQUIPMENT PURCHASE							
1.1	Ship-to-Shore Cranes	ea.	4	$8,800,000	$35,200,000		5	$1,760,000
1.2	Spare STS Crane Spreaders	ea.	1	$170,000	$170,000		5	$8,500
1.3	IY RMGs	ea.	3	$2,500,000	$7,500,000		10	$750,000
1.4	CY RMGs	ea.	12	$2,750,000	$33,000,000		10	$3,300,000
1.5	Shuttle Carriers	ea.	9	$600,000	$5,400,000		5	$270,000
1.6	Top Picks	ea.	1	$505,000	$505,000		5	$25,250
1.7	MT Handlers	ea.	0	$265,000	$0		5	$0
1.8	Hostlers	ea.	10	$70,000	$700,000		5	$35,000
1.9	Trailers (Bombcarts)	ea.	15	$90,000	$1,350,000		5	$67,500
1.10	Fuel/Repair Trucks	ea.	2	$110,000	$220,000		5	$11,000
1.11	Pick-up Trucks	ea.	16	$40,000	$640,000		5	$32,000
					SUB-TOTAL	$84,685,000		$6,259,250
					TOTAL FOR EQUIPMENT	**$84,685,000**		$6,259,250
					TOTAL FOR EQUIPMENT, INCL. CONTINGENCY	*$90,944,250*		
2	PROCUREMENT & CONTRACT ADMINISTRATION							
2.1	*P & C at 1.5% of Purchase Price*	ea.	1	$1,270,275	$1,270,275		10	$127,028
					SUB-TOTAL FOR PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION	$1,270,275		$127,028
					TOTAL FOR EQUIPMENT	$86,000,000		$6,400,000
					TOTAL FOR EQUIPMENT , INCL. CONTINGENCY	**$92,400,000**		(rounded)

The cost estimate for the 30.48 m gauge ship to shore cranes includes the crane design, supply, delivery, erection and testing costs (the estimate does not include applicable taxes, duties and tarrifs). One spreader is included for each crane.

The estimate is based on Canadian (CDN) Dollars. Container handling equipment is usually purchased in US dollars or Euros and therefore its Canadian dollar cost is dependant on exchange rates at the time of purchase. The exchange rate applied to the crane estimate in this review is US$0.95 = CDN $1.00 and $0.75 Euros = $CDN 1.00

The estimate is based on typical order quantities (i.e. 3 gantry cranes per order) and mid-range equipment

MONTREAL PORT AUTHORITY
Contrecoeur Development Master Plan

Date: 14-Sep-10
Prepared By: MN (M&N)
Project No.: 7146

CONTRECOUER PHASE B - SEMI AUTOMATED

ITEM	DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT RATE	ITEM COST	AREA COST	CONTINGENCY %	CONTINGENCY $
1	CONTRECOEUR EQUIPMENT PURCHASE							
1.1	Ship-to-Shore Cranes	ea.	4	$8,800,000	$35,200,000		5	$1,760,000
1.2	Spare STS Crane Spreaders	ea.	1	$170,000	$170,000		5	$8,500
1.3	IY RMGs	ea.	3	$2,500,000	$7,500,000		5	$375,000
1.4	CY RMGs	ea.	18	$2,750,000	$49,500,000		5	$2,475,000
1.5	Shuttle Carriers	ea.	9	$600,000	$5,400,000		5	$270,000
1.6	Top Picks	ea.	1	$505,000	$505,000		5	$25,250
1.7	Hostlers	ea.	10	$70,000	$700,000		5	$35,000
1.8	Trailers (Bombcarts)	ea.	15	$90,000	$1,350,000		5	$67,500
1.9	Fuel/Repair Trucks	ea.	2	$110,000	$220,000		5	$11,000
1.10	Pick-up Trucks	ea.	16	$40,000	$640,000		5	$32,000
					SUB-TOTAL	$101,185,000		$5,059,250
					TOTAL FOR EQUIPMENT	**$101,185,000**		$5,059,250
					TOTAL FOR EQUIPMENT, INCL. CONTINGENCY	*$106,244,250*		
2	PROCUREMENT & CONTRACT ADMINISTRATION							
2.1	***P & C at 1.5% of Purchase Price***	ea.	1	$1,517,775	$1,517,775		10	$151,778
	SUB-TOTAL FOR PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION					$1,517,775		$151,778
					TOTAL FOR EQUIPMENT	$102,700,000		$5,200,000
					TOTAL FOR EQUIPMENT , INCL. CONTINGENCY	**$107,900,000**		**(rounded)**

The cost estimate for the 30.48 m gauge ship to shore cranes includes the crane design, supply, delivery, erection and testing costs (the estimate does not include applicable taxes, duties and tarrifs). One spreader is included for each crane.

The estimate is based on Canadian (CDN) Dollars. Container handling equipment is usually purchased in US dollars or Euros and therefore its Canadian dollar cost is dependant on exchange rates at the time of purchase. The exchange rate applied to the crane estimate in this review is US$0.95 = CDN $1.00 and $0.75 Euros = $CDN 1.00

The estimate is based on typical order quantities (i.e. 3 gantry cranes per order) and mid-range equipment

MONTREAL PORT AUTHORITY
Order of Magnitude Cost Estimate for Contrecoeur Development Master Plan

Date: 17-Sep-10
Prepared By: MC
Project No.: 7146-43

DRAFT- Rev.B

1. Conventional Terminal Phase A
(1-Berth 430,000 TEU's/annum)

ITEM		DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT RATE	ITEM COST	AREA COST	CONTINGENCY %	CONTINGENCY $
1		MOBILIZATION/DEMOBILIZATION							
1.1		Mobilization/Demobilization	L.S.	1	$6,550,000	$6,550,000		20	$1,310,000
					SUB-TOTAL FOR MOBILIZATION / DEMOBILIZATION		$6,550,000		$1,310,000
2		DREDGING AND LAND RECLAMATION							
		Total Dredge Volume (Ship Basin + Tug Basin)	**cu.m.**	**620,000**					
		Total General Fill Volume Required (Upland)	**cu.m.**	**570,000**					
2.1		Dredging & Disposal							
	a	Excavator/Hydraulic Cutter Dredge and Upland Disposal (Marine + Land Based)	cu.m.	620,000	$28	$17,050,000		50	$8,525,000
	b	Upland Disposal Environmental Mitigation (Berms, Ditching, Hydroseed, etc.)	Allowance	1	$200,000	$200,000		50	$100,000
2.2		Land Reclamation & Import Material							
	a	Import Fill (Sand) for Land Reclamation to El.+8.5m ± (Subgrade Elevation)	cu.m.	570,000	$32	$18,240,000		25	$4,560,000
	b	Slope & Scour Protection (SSP Wall Toe + Wall Returns)	cu.m.	9,000	$80	$720,000		25	$180,000
					SUB-TOTAL FOR DREDGING AND LAND RECLAMATION		$36,210,000		$13,365,000
3		REMOVALS AND SITE PREPARATION							
3.1		Clear and Grub (Vegetation)	Allowance	1	$100,000	$100,000		20	$20,000
					SUB-TOTAL FOR REMOVALS AND SITE PREPARATION		$100,000		$20,000
4		WHARF STRUCTURAL							
4.1		Steel Sheet Pile Wall System (Arcelor HZ King Pile c/w AZ Sheet Pile)							
		Total Length of Wall (350m Berth + 2x50m Returns)	**m**	**450**					
		Number of Container Berths	**ea.**	**1**					
	a	Supply HZ Sheet Piling (Arcelor HZ 1180 + AZ26-700)	kg	5,240,000	$2.75	$14,410,000		25	$3,602,500
	b	Supply Tie Rods	ea.	234	$4,150	$969,123		25	$242,281
	c	Supply T-Plates and Curved Plates	ea.	234	$200	$46,705		25	$11,676
	d	Drive H Sheet Piles	ea.	234	$1,500	$350,285		25	$87,571
	e	Drive 2 Pair Sheet Piles	ea.	234	$650	$151,790		25	$37,948
	f	Supply and Install Concrete Cope Wall & Bullrail	cu.m.	1,800	$600	$1,080,000		25	$270,000
	g	Install Tie Rods	ea.	234	$500	$116,762		25	$29,190
	h	Install T-Plates and Curved Plates	ea.	234	$500	$116,762		25	$29,190
	i	Supply Anchor Pile (914mm dia.)	lin.m.	3,700	$950	$3,515,000		25	$878,750
	j	Drive Anchor Pile	ea.	234	$750	$175,143		25	$43,786
4.2		Crane Rail System (Crane Rail, Crane Beam, Support Piles and Pile Cap)							
		Length of Crane Beam	**m**	**330**					
	a	CIP Concrete Crane Beam and Pile Cap	cu.m.	3,600	$600	$2,160,000		25	$540,000
	b	CIP Concrete Seismic Tie Beam	cu.m.	7,700	$600	$4,620,000		25	$1,155,000
	c	Supply Support Piles (914mm)	lin.m.	11,300	$950	$10,735,000		25	$2,683,750
	d	Drive Support Piles	ea.	340	$900	$306,000		25	$76,500
	e	Crane Rail & Fixation	lin.m.	660	$500	$330,000		25	$82,500
	f	Crane Rail Stops	ea.	4	$18,000	$72,000		25	$18,000
	g	Stowage Pins	ea.	9	$20,000	$188,571		25	$47,143
4.3		Miscellaneous Wharf Elements							
	a	Mooring System (Bollards)	ea.	14	$10,000	$143,478		25	$35,870
	b	Crane Power Vault	ea.	5	$20,000	$100,000		25	$25,000
	c	Ship Service Pit	ea.	2	$10,000	$22,000		25	$5,500
	d	Fenders	ea.	25	$30,000	$750,000		25	$187,500
					SUB-TOTAL FOR WHARF STRUCTURAL		$40,358,619		$10,089,655
5		CIVIL & MISC. STRUCTURAL TERMINAL INFRASTRUCTURE							
5.1		Civil Utilities							
	a	Fire Protection Water Distribution System (Pipes, Valves)	lin.m.	2,000	$300	$600,000		25	$150,000
	b	Fire Hydrants	ea.	30	$4,000	$120,000		25	$30,000
	c	River Intake Pump Station for Fire Protection (Pumps & Motors, Valves)	Allowance	1	$200,000	$200,000		25	$50,000
	d	Domestic Water Distribution System (Pipes, Valves)	lin.m.	1,800	$150	$270,000		25	$67,500
	e	Sanitary Sewer Collection System (Pipes, MHs)	lin.m.	2,200	$200	$440,000		25	$110,000
	f	Sanitary Treatment Unit and River Disposal (Anaerobic/Aerobic/UV Treatment)	Allowance	1	$100,000	$100,000		25	$25,000
	g	Storm Drainage Collection System (Pipes, MHs)	lin.m.	3,800	$300	$1,140,000		25	$285,000
	h	Storm Drainage Trench Drains	lin.m.	4,700	$500	$2,350,000		25	$587,500
	i	Storm Drainage Under Drains (French Drains for Semi-Automated)	lin.m.	0	$250	$0		25	$0
	j	Storm Drainage Treatment and River Disposal	ea.	2	$100,000	$200,000		25	$50,000
	k	Utility Services (Buildings & Ship Service Pits)	ea.	5	$5,000	$26,000		25	$6,500
5.2		Civil Pavement Structures (Asphalt/Concrete, Base and Subbase Gravel)							
	a	Heavy Duty Pavement For Berth, Container Yard, Access Roads and Gate Area	sq.m.	230,000	$130	$29,900,000		25	$7,475,000
	b	Light/Medium Duty Pavement for POV/Equipment Parking Area	sq.m.	60,000	$70	$4,200,000		25	$1,050,000
	c	RTG Concrete Runways (Container Yard)	lin.m.	6,600	$500	$3,300,000		25	$825,000
	d	Misc. Concrete Slabs (RTG Repair Pad, Fueling Station, Washdown Area)	sq.m.	200	$150	$30,000		25	$7,500
5.3		Miscellaneous Civil and Structural							
	a	Fencing and Gates	lin.m.	7,000	$120	$840,000		25	$210,000
	b	Pavement Markings	Allowance	1	$100,000	$100,000		25	$25,000
	c	Reefer Tower Structures	ea.	16	$450,000	$7,200,000		25	$1,800,000
	d	Fueling Facility (Single 45,000 Gallon Diesel and Gasoline Tank)	L.S.	1	$200,000	$200,000		25	$50,000
	e	Customs portal radiation monitors (RPM)	ea.	2	$200,000	$400,000		25	$100,000
					SUB-TOTAL FOR CIVIL TERMINAL INFRASTRUCTURE		$51,616,000		$12,904,000
6		OFFSITE IMPROVEMENTS							
	a	Existing Drainage Channel Relocations	Allowance	1	$200,000	$200,000		25	$50,000
					SUB-TOTAL FOR OFFSITE IMPROVEMENTS		$200,000		$50,000
7		RAIL WORKS							
7.1		Intermodal Yard							
	a	Working Rail Track, Incl. Ballast, Subballast, Ties	lin.m.	3,660	$700	$2,562,000		20	$512,400
	b	No.8 Turnout Assembly with Switch (Relay), Incl. Ballast, Subballast, Ties, Rail	ea.	6	$100,000	$600,000		20	$120,000
	c	RMG Concrete Runways	lin.m.	1,860	$1,500	$2,790,000		25	$697,500
	d	Asphalt Pavement	sq.m.	55,000	$100	$5,500,000		25	$1,375,000
					SUB-TOTAL FOR RAIL WORKS		$11,452,000		$2,704,900
8		GATE COMPLEX							
	a	Pre-Gate OCR (Gate Arms, OCR, Cameras, Communication, Bollards, Electrical)	lane	2	$300,000	$600,000		25	$150,000
	b	In-Gate (Gate Arms, Cameras, Communication, Bollards, Electrical)	lane	3	$200,000	$600,000		25	$150,000
	c	Out-Gate OCR (Gate Arms, OCR, Cameras, Communication, Bollards, Electrical)	lane	2	$350,000	$700,000		25	$175,000
	d	Roadside Barriers	lin.m.	500	$150	$75,000		25	$18,750
	e	Canopies (Pre, In and Out Gates)	sq.m.	2,000	$650	$1,300,000		25	$325,000
					SUB-TOTAL FOR GATE COMPLEX		$3,275,000		$818,750
9		BUILDINGS							
	a	Administration building (2 floors)	sq.m.	2,500	$1,650	$4,125,000		20	$825,000
	b	Maintenance Building	sq.m.	1,875	$1,600	$3,000,000		20	$600,000
	c	Labour Check In/Lunch Building	sq.m.	1,500	$1,650	$2,475,000		20	$495,000

MONTREAL PORT AUTHORITY
Order of Magnitude Cost Estimate for Contrecoeur Development Master Plan

Date: 17-Sep-10
Prepared By: MC
Project No.: 7146-43

DRAFT- Rev.B

1. Conventional Terminal Phase A
(1-Berth 430,000 TEU's/annum)

ITEM		DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT RATE	ITEM COST	AREA COST	CONTINGENCY %	CONTINGENCY $
	d	LEED Certification (5%)	Allowance	1	$480,000	$480,000		20	$96,000
	e	Gate House	sq.m.	1	$40,000	$40,000		20	$8,000
	f	Substation Building	L.S.	1	$100,000	$100,000		20	$20,000
	g	Compressor Building	L.S.	1	$40,000	$40,000		20	$8,000
						SUB-TOTAL FOR BUILDINGS	$10,260,000		$2,052,000
10		ELECTRICAL TERMINAL INFRASTRUCTURE							
	a	Power Supply to Site	L.S.	1	$100,000	$100,000		25	$25,000
	b	Main Substation	ea.	1	$600,000	$600,000		25	$150,000
	c	Reefer Substations	ea.	1	$750,000	$750,000		25	$187,500
	d	IY Crane Substations	ea.	1	$500,000	$500,000		25	$125,000
	e	Quay Crane Substation	ea.	1	$1,400,000	$1,400,000		25	$350,000
	f	Gate Electrical	L.S.	1	$500,000	$500,000		25	$125,000
	g	High Mast Lighting Complete (Foundation, Pole, Fixture, Conduit)	ea.	30	$150,000	$4,500,000		25	$1,125,000
	h	Power and Communication Distribution	L.S.	1	$2,000,000	$2,000,000		25	$500,000
						SUB-TOTAL FOR ELECTRICAL TERMINAL INFRASTRUCTURE	$10,350,000		$2,587,500
						TOTAL FOR CAPITAL CONSTRUCTION	$170,371,619	27%	$45,901,805
						TOTAL FOR CAPITAL CONSTRUCTION, INCL. CONTINGENCY	$216,000,000		
11		PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION							
11.1		Allowance 10% of construction costs	L.S.	1	$17,000,000	$17,000,000			$0
						SUB-TOTAL FOR PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION	$17,000,000		$0
						TOTAL FOR PROJECT	$187,371,619	24%	$45,901,805
						TOTAL FOR CONSTRUCTION, INCL. CONTINGENCY	$233,000,000		

MONTREAL PORT AUTHORITY
Order of Magnitude Cost Estimate for Contrecoeur Development Master Plan

Date: 17-Sep-10
Prepared By: MC
Project No.: 7146-43

DRAFT- Rev.B

2. Conventional Terminal Phase A-2
(2-Berths 430,000 TEU's/annum. Includes 2nd Berth Extension Only)

ITEM		DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT RATE	ITEM COST	AREA COST	CONTINGENCY %	CONTINGENCY $
1		MOBILIZATION/DEMOBILIZATION							
1.1		Mobilization/Demobilization	L.S.	1	$2,360,000	$2,360,000		20	$472,000
					SUB-TOTAL FOR MOBILIZATION / DEMOBILIZATION		$2,360,000		$472,000
2		DREDGING AND LAND RECLAMATION							
		Total Dredge Volume (Ship Basin + Tug Basin)	cu.m.	310,000					
		Total General Fill Volume Required (Upland)	cu.m.	370,000					
2.1		Dredging & Disposal							
	a	Excavator/Hydraulic Cutter Dredge and Upland Disposal (Marine + Land Based)	cu.m.	310,000	$28	$8,525,000		50	$4,262,500
	b	Upland Disposal Environmental Mitigation (Berms, Ditching, Hydroseed, etc.)	Allowance	1	$100,000	$100,000		50	$50,000
2.2		Land Reclamation & Import Material							
	a	Import Fill (Sand) for Land Reclamation to El.+8.5m± (Subgrade Elevation)	cu.m.	370,000	$32	$11,840,000		25	$2,960,000
	b	Slope & Scour Protection (SSP Wall Toe + Wall Returns)	cu.m.	5,000	$80	$400,000		25	$100,000
					SUB-TOTAL FOR DREDGING AND LAND RECLAMATION		$20,865,000		$7,372,500
3		REMOVALS AND SITE PREPARATION							
3.1		Clear and Grub (Vegetation)	Allowance	1	$100,000	$100,000		20	$20,000
					SUB-TOTAL FOR REMOVALS AND SITE PREPARATION		$100,000		$20,000
4		WHARF STRUCTURAL							
4.1		Steel Sheet Pile Wall System (Arcelor HZ King Pile c/w AZ Sheet Pile)							
		Total Length of Wall (675m 2 Berths + 2x50m Returns)	m	375					
		Number of Container Berths	ea.	1					
	a	Supply HZ Sheet Piling (Arcelor HZ 1180 + AZ26-700)	kg	4,370,000	$2.75	$12,017,500		25	$3,004,375
	b	Supply Tie Rods	ea.	195	$4,150	$807,602		25	$201,901
	c	Supply T-Plates and Curved Plates	ea.	195	$200	$38,921		25	$9,730
	d	Drive H Sheet Piles	ea.	195	$1,500	$291,905		25	$72,976
	e	Drive Z Pair Sheet Piles	ea.	195	$650	$126,492		25	$31,623
	f	Supply and Install Concrete Cope Wall & Bullrail	cu.m.	1,500	$600	$900,000		25	$225,000
	g	Install Tie Rods	ea.	195	$500	$97,302		25	$24,325
	h	Install T-Plates and Curved Plates	ea.	195	$500	$97,302		25	$24,325
	i	Supply Anchor Pile (914mm dia.)	lin.m.	3,100	$950	$2,945,000		25	$736,250
	j	Drive Anchor Pile	ea.	195	$750	$145,952		25	$36,488
4.2		Crane Rail System (Crane Rail, Crane Beam, Support Piles and Pile Cap)							
		Length of Crane Beam	m	315					
	a	CIP Concrete Crane Beam and Pile Cap	cu.m.	3,500	$600	$2,100,000		25	$525,000
	b	CIP Concrete Seismic Tie Beam	cu.m.	7,400	$600	$4,440,000		25	$1,110,000
	c	Supply Support Piles (914mm)	lin.m.	10,800	$950	$10,260,000		25	$2,565,000
	d	Drive Support Piles	ea.	330	$900	$297,000			
	e	Crane Rail & Fixation	lin.m.	630	$500	$315,000		25	$78,750
	f	Crane Rail Stops	ea.	4	$18,000	$72,000		25	$18,000
	g	Stowage Pins	ea.	9	$20,000	$180,000		25	$45,000
4.3		Miscellaneous Wharf Elements							
	a	Mooring System (Bollards)	ea.	14	$10,000	$136,957		25	$34,239
	b	Crane Power Vault	ea.	5	$20,000	$100,000		25	$25,000
	c	Ship Service Pit	ea.	2	$10,000	$21,000		25	$5,250
	d	Fenders	ea.	25	$30,000	$750,000		25	$187,500
					SUB-TOTAL FOR WHARF STRUCTURAL		$36,139,931		$8,960,733
5		CIVIL & STRUCTURAL TERMINAL INFRASTRUCTURE							
5.1		Civil Utilities - Not Applicable							
5.2		Civil Pavement Structures (Asphalt/Concrete, Base and Subbase Gravel)							
	a	Heavy Duty Pavement For Berth Area	sq.m.	13,000	$130	$1,690,000		25	$422,500
	b	Fencing and Gates	lin.m.	350	$120	$42,000		25	$10,500
	c	Pavement Markings	Allowance	1	$10,000	$10,000		25	$2,500
					SUB-TOTAL FOR CIVIL TERMINAL INFRASTRUCTURE		$1,742,000		$435,500
6		OFFSITE IMPROVEMENTS							
		Not Applicable							
					SUB-TOTAL FOR OFFSITE IMPROVEMENTS		$0		$0
7		RAIL WORKS							
		Not Applicable							
					SUB-TOTAL FOR RAIL WORKS		$0		$0
8		GATE COMPLEX							
		Not Applicable							
					SUB-TOTAL FOR GATE COMPLEX		$0		$0
9		BUILDINGS							
		Not Applicable							
					SUB-TOTAL FOR BUILDINGS		$0		$0
10		ELECTRICAL TERMINAL INFRASTRUCTURE							
	a	Main Substation	ea.	1	$100,000	$100,000		25	$25,000
	b	Quay Crane Substation	ea.	1	$150,000	$150,000		25	$37,500
					SUB-TOTAL FOR ELECTRICAL TERMINAL INFRASTRUCTURE		$250,000		$62,500
						TOTAL FOR CAPITAL CONSTRUCTION	$61,456,931	28%	$17,323,233
						TOTAL FOR CAPITAL CONSTRUCTION, INCL. CONTINGENCY		$79,000,000	
11		PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION							
11.1		Allowance 10% of construction costs	L.S.	1	$6,100,000	$6,100,000			$0
					SUB-TOTAL FOR PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION		$6,100,000		$0
						TOTAL FOR PROJECT	$67,556,931	26%	$17,323,233
						TOTAL FOR CONSTRUCTION, INCL. CONTINGENCY		$85,000,000	

MONTREAL PORT AUTHORITY
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Date: 17-Sep-10
Prepared By: MC
Project No.: 7146-43

DRAFT- Rev.B

3. Conventinal Terminal Phase B
(2-Berths 1,050,000 TEU's/annum)

ITEM		DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT RATE	ITEM COST	AREA COST	CONTINGENCY %	CONTINGENCY $
1		MOBILIZATION/DEMOBILIZATION							
1.1		Mobilization/Demobilization	L.S.	1	$2,010,000	$2,010,000		20	$402,000
					SUB-TOTAL FOR MOBILIZATION / DEMOBILIZATION		$2,010,000		$402,000
2		DREDGING AND LAND RECLAMATION							
		Not Applicable. 2nd Berth Extension + Fill Included in Phase A-2.							
					SUB-TOTAL FOR DREDGING AND LAND RECLAMATION		$0		$0
3		REMOVALS AND SITE PREPARATION							
		Not Applicable.							
					SUB-TOTAL FOR REMOVALS AND SITE PREPARATION		$0		$0
4		WHARF STRUCTURAL							
		Not Appplicable. 2nd Berth Extension Included In Phase A-2							
					SUB-TOTAL FOR WHARF STRUCTURAL		$0		$0
5		CIVIL & STRUCTURAL TERMINAL INFRASTRUCTURE							
5.1		Civil Utilities							
	a	Fire Protection Water Distribution System (Pipes, Valves)	lin.m.	1,150	$300	$345,000		25	$86,250
	b	Fire Hydrants	ea.	12	$4,000	$48,000		25	$12,000
	c	Domestic Water Distribution System (Pipes, Valves)	lin.m.	350	$150	$52,500		25	$13,125
	d	Storm Drainage Collection System (Pipes, MHs)	lin.m.	800	$300	$240,000		25	$60,000
	e	Storm Drainage Trench Drains	lin.m.	2,800	$500	$1,400,000		25	$350,000
	f	Utility Services (Ship Service Pits)	ea.	3	$5,000	$15,000		25	$3,750
5.2		Civil Pavement Structures (Asphalt/Concrete, Base and Subbase Gravel)							
	a	Heavy Duty Pavement For Berth, Container Yard, Access Roads and Gate Area	sq.m.	170,000	$130	$22,100,000		25	$5,525,000
	b	Light/Medium Duty Pavement for POV/Equipment Parking Area	sq.m.	2,000	$70	$140,000		25	$35,000
	c	RTG Concrete Runways (Container Yard)	lin.m.	7,800	$500	$3,900,000		25	$975,000
5.3		Miscellaneous Civil and Structural							
	a	Fencing and Gates	lin.m.	450	$120	$54,000		25	$13,500
	b	Pavement Markings	Allowance	1	$100,000	$100,000		25	$25,000
	c	Reefer Tower Structures	ea.	20	$450,000	$9,000,000		25	$2,250,000
	d	Customs portal radiation monitors (RPM)	ea.	2	$200,000	$400,000		25	$100,000
					SUB-TOTAL FOR CIVIL TERMINAL INFRASTRUCTURE		$37,794,500		$9,448,625
6		OFFSITE IMPROVEMENTS							
	a	Tug Basin (Mooring Piles and Access Gangway)	Allowance	1	$400,000	$400,000		25	$100,000
					SUB-TOTAL FOR OFFSITE IMPROVEMENTS		$400,000		$100,000
7		RAIL WORKS							
7.1		Intermodal Yard							
	a	Working Rail Track, Incl. Ballast, Subballast, Ties	lin.m.	3,660	$700	$2,562,000		20	$512,400
	b	No.8 Turnout Assembly with Switch (Relay), Incl. Ballast, Subballast, Ties, Rail	ea.	4	$100,000	$400,000		20	$80,000
	c	Asphalt Pavement	sq.m.	20,000	$100	$2,000,000		25	$500,000
					SUB-TOTAL FOR RAIL WORKS		$4,962,000		$1,092,400
8		GATE COMPLEX							
	a	In-Gate (Gate Arms, Cameras, Communication, Bollards, Electrical)	lane	3	$200,000	$600,000		25	$150,000
	b	Out-Gate OCR (Gate Arms, OCR, Cameras, Communication, Bollards, Electrical)	lane	1	$350,000	$350,000		25	$87,500
	c	Canopies (Pre, In and Out Gates)	sq.m.	800	$650	$520,000		25	$130,000
					SUB-TOTAL FOR GATE COMPLEX		$1,470,000		$367,500
9		BUILDINGS							
	a	Maintenance Building	sq.m.	625	$1,600	$1,000,000		20	$200,000
	b	LEED Certification (5%)	Allowance	1	$50,000	$50,000		20	$10,000
					SUB-TOTAL FOR BUILDINGS		$1,050,000		$210,000
10		ELECTRICAL TERMINAL INFRASTRUCTURE							
	a	Main Substation	L.S.	1	$100,000	$100,000		25	$25,000
	b	Reefer Substations	ea.	1	$750,000	$750,000		25	$187,500
	c	IY Crane Substations (@ Rail)	ea.	1	$200,000	$200,000		25	$50,000
	d	Quay Crane Substation	ea.	1	$450,000	$450,000		25	$112,500
	e	Gate Electrical	L.S.	1	$50,000	$50,000		25	$12,500
	f	High Mast Lighting Complete (Foundation, Pole, Fixture, Conduit)	ea.	12	$150,000	$1,800,000		25	$450,000
	g	Power and Communication Distribution	L.S.	1	$1,200,000	$1,200,000		25	$300,000
					SUB-TOTAL FOR ELECTRICAL TERMINAL INFRASTRUCTURE		$4,550,000		$1,137,500
						TOTAL FOR CAPITAL CONSTRUCTION	$52,236,500	24%	$12,758,025
						TOTAL FOR CAPITAL CONSTRUCTION, INCL. CONTINGENCY		$65,000,000	
11		PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION							
11.1		Allowance 10% of construction costs	L.S.	1	$5,200,000	$5,200,000			$0
					SUB-TOTAL FOR PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION		$5,200,000		$0
						TOTAL FOR PROJECT	$57,436,500	22%	$12,758,025
						TOTAL FOR CONSTRUCTION, INCL. CONTINGENCY		$70,000,000	

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Date: 17-Sep-10
Prepared By: MC
Project No.: 7146-43

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4 CONVENTIONAL TERMINAL - ENTRY COSTS
(Assumes Costs to the end of Phase B)

ITEM		DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT RATE	ITEM COST	AREA COST	CONTINGENCY %	CONTINGENCY $
1		ENTRY COSTS							
1.1		Mobilization/Demobilization	L.S.	1	$2,080,000	$2,080,000		20	$416,000
1.2		Hwy 132 Overpass Structure (2-Lane Hwy.132 over New Rail)	sq.m.	4,500	$4,000	$18,000,000		20	$3,600,000
1.3		Storage Tracks							
	a	Storage, Runaround and Interchange Rail Track	lin.m.	20,000	$700	$14,000,000		20	$2,800,000
	b	No.8 Turnout Assembly with Switch (Relay), Incl. Ballast, Subballast, Ties, Rail	ea.	20	$100,000	$2,000,000		20	$400,000
	c	Gravel Surfacing Access Roads	L.S.	1	$50,000	$50,000		20	$10,000
1.4		Environmental Habitat Compensation (5% of Capital Construction Cost, end of Ph 2)	Allowance	1	$18,000,000	$18,000,000		0	$0
						SUB-TOTAL FOR ENTRY COSTS	$54,130,000		$7,226,000
						TOTAL FOR CAPITAL CONSTRUCTION	**$54,130,000**	**13%**	**$7,226,000**
						TOTAL FOR CAPITAL CONSTRUCTION, INCL. CONTINGENCY		**$61,400,000**	
2		PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION							
2.1		Allowance 10% of Construction Costs	L.S.	1	$5,410,000	$5,410,000			
						SUB-TOTAL FOR PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION	$5,410,000		$0
						TOTAL FOR PROJECT	**$59,540,000**	**12%**	**$7,226,000**
						TOTAL FOR CONSTRUCTION, INCL. CONTINGENCY		**$67,000,000**	

MONTREAL PORT AUTHORITY
Order of Magnitude Cost Estimate for Contrecoeur Development Master Plan

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Prepared By: MC
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5. Semi Automated Terminal Phase A
(1-Berth, 470,000 TEU's/annum)

ITEM		DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT RATE	ITEM COST	AREA COST	CONTINGENCY %	CONTINGENCY $
1		MOBILIZATION/DEMOBILIZATION							
1.1		Mobilization/Demobilization	L.S.	1	$6,340,000	$6,340,000		20	$1,268,000
					SUB-TOTAL FOR MOBILIZATION / DEMOBILIZATION		$6,340,000		$1,268,000
2		DREDGING AND LAND RECLAMATION							
		Total Dredge Volume (Ship Basin + Tug Basin)	**cu.m.**	**620,000**					
		Total General Fill Volume Required (Upland)	**cu.m.**	**670,000**					
2.1		Dredging & Disposal							
	a	Excavator/Hydraulic Cutter Dredge and Upland Disposal (Marine + Land Based)	cu.m.	620,000	$28	$17,050,000		50	$8,525,000
	b	Upland Disposal Environmental Mitigation (Berms, Ditching, Hydroseed, etc.)	Allowance	1	$200,000	$200,000		50	$100,000
		Land Reclamation & Import Material							
	a	Import Fill (Sand) for Land Reclamation to El.+8.5m± (Subgrade Elevation)	cu.m.	570,000	$32	$18,240,000		25	$4,560,000
	d	Slope & Scour Protection (SSP Wall Toe + Wall Returns)	cu.m.	9,000	$80	$720,000		25	$180,000
					SUB-TOTAL FOR DREDGING AND LAND RECLAMATION		$36,210,000		$13,365,000
3		REMOVALS AND SITE PREPARATION							
3.1		Clear and Grub	Allowance	1	$100,000	$100,000		20	$20,000
					SUB-TOTAL FOR REMOVALS AND SITE PREPARATION		$100,000		$20,000
4		WHARF STRUCTURAL							
4.1		Steel Sheet Pile Wall System (Arcelor HZ King Pile c/w AZ Sheet Pile)							
		Total Length of Wall	**m**	**450**					
		Number of Container Berths	**ea.**	**1**					
	a	Supply HZ Sheet Piling (Arcelor HZ 1180 + AZ26-700)	kg	5,240,000	$2.75	$14,410,000		25	$3,602,500
	b	Supply Tie Rods	ea.	234	$4,150	$969,123		25	$242,281
	c	Supply T-Plates and Curved Plates	ea.	234	$200	$46,705		25	$11,676
	d	Drive H Sheet Piles	ea.	234	$1,500	$350,285		25	$87,571
	e	Drive Z Pair Sheet Piles	ea.	234	$650	$151,790		25	$37,948
	f	Supply and Install Concrete Cope Wall & Bullrail	cu.m.	1,800	$600	$1,080,000		25	$270,000
	g	Install Tie Rods	ea.	234	$500	$116,762		25	$29,190
	h	Install T-Plates and Curved Plates	ea.	234	$500	$116,762		25	$29,190
	i	Supply Anchor Pile (914mm dia.)	lin.m.	3,700	$950	$3,515,000		25	$878,750
	j	Drive Anchor Pile	ea.	234	$750	$175,143		25	$43,786
4.2		Crane Rail System (Crane Rail, Crane Beam, Support Piles and Pile Cap)							
		Length of Crane Beam	**m**	**330**					
	a	CIP Concrete Crane Beam and Pile Cap	cu.m.	3,600	$600	$2,160,000		25	$540,000
	b	CIP Concrete Seismic Tie Beam	cu.m.	7,700	$600	$4,620,000		25	$1,155,000
	c	Supply Support Piles (914mm)	lin.m.	11,300	$950	$10,735,000		25	$2,683,750
	d	Drive Support Piles	ea.	340	$750	$255,000			
	e	Crane Rail & Fixation	lin.m.	660	$500	$330,000		25	$82,500
	f	Crane Rail Stops	ea.	4	$18,000	$72,000		25	$18,000
	g	Stowage Pins	ea.	9	$20,000	$188,571		25	$47,143
4.3		Miscellaneous Wharf Elements							
	a	Mooring System (Bollards)	ea.	14	$10,000	$143,478		25	$35,870
	b	Crane Power Vault	ea.	5	$20,000	$100,000		25	$25,000
	c	Ship Service Pit	ea.	2	$10,000	$22,000		25	$5,500
	d	Fenders	ea.	25	$30,000	$750,000		25	$187,500
					SUB-TOTAL FOR WHARF STRUCTURAL		$40,307,619		$10,013,155
5		CIVIL & STRUCTURAL TERMINAL INFRASTRUCTURE							
5.1		Civil Utilities							
	a	Fire Protection Water Distribution System (Pipes, Valves)	lin.m.	2,000	$300	$600,000		25	$150,000
	b	Fire Hydrants	ea.	25	$4,000	$100,000		25	$25,000
	c	River Intake Pump Station for Fire Protection (Pumps & Motors, Valves)	Allowance	1	$200,000	$200,000		25	$50,000
	d	Domestic Water Distribution System (Pipes, Valves)	lin.m.	1,800	$150	$270,000		25	$67,500
	e	Sanitary Sewer Collection System (Pipes, MHs)	lin.m.	2,200	$200	$440,000		25	$110,000
	f	Sanitary Treatment Unit and River Disposal (Anaerobic/Aerobic/UV Treatment)	Allowance	1	$100,000	$100,000		25	$25,000
	g	Storm Drainage Collection Syatem (Pipes, MHs)	lin.m.	4,200	$300	$1,260,000		25	$315,000
	h	Storm Drainage Trench Drains	lin.m.	330	$500	$165,000		25	$41,250
	i	Storm Drainage Under Drains (French Drains for Semi-Automated)	lin.m.	6,750	$250	$1,687,500		25	$421,875
	j	Storm Drainage Treatment and River Disposal	ea.	2	$100,000	$200,000		25	$50,000
	k	Utility Services (Buildings & Ship Service Pits)	ea.	5	$5,000	$26,000		25	$6,500
5.2		Civil Pavement Structures (Asphalt/Concrete, Base and Subbase Gravel)							
	a	Heavy Duty Pavement For Container Yard, Access Roads and Gate Area	sq.m.	200,000	$100	$20,000,000		25	$5,000,000
	c	Light/Medium Duty Pavement for POV/Equipment Parking Area	sq.m.	60,000	$70	$4,200,000		25	$1,050,000
	d	RMG Concrete Runways (Container Yard)	lin.m.	4,080	$1,500	$6,120,000		25	$1,530,000
	e	Misc. Concrete Slabs (RTG Repair Pad, Fueling Station, Washdown Area)	sq.m.	200	$150	$30,000		25	$7,500
	f	Misc. Concrete Strips for Container Castings (for Semi-Automated only)	cu.m.	8,000	$600	$4,800,000		25	$1,200,000
5.3		Miscellaneous Civil and Structural							
	a	Fencing and Gates	lin.m.	6,000	$120	$720,000		25	$180,000
	b	Pavement Markings	Allowance	1	$100,000	$100,000		25	$25,000
	c	Reefer Tower Structures	ea.	8	$450,000	$3,600,000		25	$900,000
	d	Fueling Facility (Single 45,000 Gallon Diesel and Gasoline Tank)	L.S.	1	$200,000	$200,000		25	$50,000
	e	Customs portal radiation monitors (RPM)	ea.	2	$200,000	$400,000		25	$100,000
					SUB-TOTAL FOR CIVIL TERMINAL INFRASTRUCTURE		$45,218,500		$11,304,625
6		OFFSITE IMPROVEMENTS							
	a	Existing Drainage Channel Relocations	Allowance	1	$100,000	$100,000		25	$25,000
					SUB-TOTAL FOR OFFSITE IMPROVEMENTS		$100,000		$25,000
7		RAIL WORKS							
7.1		Intermodal Yard							
	a	Working Rail Track, Incl. Ballast, Subballast, Ties	lin.m.	3,972	$700	$2,780,400		20	$556,080
	b	No.8 Turnout Assembly with Switch (Relay), Incl. Ballast, Subballast, Ties, Rail	ea.	6	$100,000	$600,000		20	$120,000
	c	RMG Concrete Runways	lin.m.	1,860	$1,500	$2,790,000		25	$697,500
	d	Asphalt Pavement	sq.m.	55,000	$100	$5,500,000		25	$1,375,000
					SUB-TOTAL FOR RAIL WORKS		$11,670,400		$2,748,580
8		GATE COMPLEX							
	a	Pre-Gate OCR (Gate Arms, OCR, Cameras, Communication, Bollards, Electrical)	lane	2	$300,000	$600,000		25	$150,000
	b	In-Gate (Gate Arms, Cameras, Communication, Bollards, Electrical)	lane	3	$200,000	$600,000		25	$150,000
	c	Out-Gate OCR (Gate Arms, OCR, Cameras, Communication, Bollards, Electrical)	lane	2	$350,000	$700,000		25	$175,000
	d	Roadside Barriers	lin.m.	500	$150	$75,000		25	$18,750
	e	Canopies (Pre, In and Out Gates)	sq.m.	2,000	$650	$1,300,000		25	$325,000
					SUB-TOTAL FOR GATE COMPLEX		$3,275,000		$818,750
9		BUILDINGS							
	a	Administration building (2 floors)	sq.m.	3,000	$1,650	$4,950,000		20	$990,000
	b	Maintenance Building	sq.m.	1,500	$1,600	$2,400,000		20	$480,000

MONTREAL PORT AUTHORITY
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Project No.: 7146-43

DRAFT- Rev.B

5. Semi Automated Terminal Phase A
(1-Berth, 470,000 TEU's/annum)

ITEM		DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT RATE	ITEM COST	AREA COST	CONTINGENCY %	CONTINGENCY $
	c	Labour Check In/Lunch Building	sq.m.	1,000	$1,650	$1,650,000		20	$330,000
	d	LEED Certification (5%)	Allowance	1	$450,000	$450,000		20	$90,000
	e	Gate House	sq.m.	1	$40,000	$40,000		20	$8,000
	f	Substation Building	L.S.	1	$100,000	$100,000		20	$20,000
	g	Compressor Building	L.S.	1	$40,000	$40,000		20	$8,000
						SUB-TOTAL FOR BUILDINGS	$9,630,000		$1,926,000
10		ELECTRICAL TERMINAL INFRASTRUCTURE							
	a	Power Supply to Site	L.S.	1	$100,000	$100,000		25	$25,000
	b	Main Substation	ea.	1	$1,000,000	$1,000,000		25	$250,000
	c	Reefer Substations	ea.	2	$400,000	$800,000		25	$200,000
	d	ASC Crane Substations	ea.	2	$400,000	$800,000		25	$200,000
	e	IY Crane Substations	ea.	1	$750,000	$750,000		25	$187,500
	f	Quay Crane Substation	L.S.	1	$1,200,000	$1,200,000		25	$300,000
	g	Gate Electrical	L.S.	1	$500,000	$500,000		25	$125,000
	h	High Mast Lighting Complete (Foundation, Pole, Fixture, Conduit)	ea.	25	$150,000	$3,750,000		25	$937,500
	i	Power and Communication Distribution	L.S.	1	$3,000,000	$3,000,000		25	$750,000
						SUB-TOTAL FOR ELECTRICAL TERMINAL INFRASTRUCTURE	$11,900,000		$2,975,000
						TOTAL FOR CAPITAL CONSTRUCTION	$164,751,519	27%	$44,464,110
						TOTAL FOR CAPITAL CONSTRUCTION, INCL. CONTINGENCY		$209,000,000	
11		PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION							
11.1		Allowance 10% of construction costs	L.S.	1	$16,500,000	$16,500,000			$0
						SUB-TOTAL FOR PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION	$16,500,000		$0
						TOTAL FOR PROJECT	$181,251,519	25%	$44,464,110
						TOTAL FOR CONSTRUCTION, INCL. CONTINGENCY		$226,000,000	

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6. Semi Automated Terminal Phase A-2
(2-Berth, 470,000 TEU's/annum)

ITEM		DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT RATE	ITEM COST	AREA COST	CONTINGENCY %	CONTINGENCY $
1		MOBILIZATION/DEMOBILIZATION							
1.1		Mobilization/Demobilization	L.S.	1	$2,360,000	$2,360,000		20	$472,000
					SUB-TOTAL FOR MOBILIZATION / DEMOBILIZATION		$2,360,000		$472,000
2		DREDGING AND LAND RECLAMATION							
		Total Dredge Volume (Ship Basin + Tug Basin)	**cu.m.**	**310,000**					
		Total General Fill Volume Required (Upland)	**cu.m.**	**370,000**					
2.1		Dredging & Disposal							
	a	Excavator/Hydraulic Cutter Dredge and Upland Disposal (Marine + Land Based)	cu.m.	310,000	$28	$8,525,000		50	$4,262,500
	b	Upland Disposal Environmental Mitigation (Berms, Ditching, Hydroseed, etc.)	Allowance	1	$100,000	$100,000		50	$50,000
		Land Reclamation & Import Material							
	a	Import Fill (Sand) for Land Reclamation to El.+8.5m± (Subgrade Elevation)	cu.m.	370,000	$32	$11,840,000		25	$2,960,000
	d	Slope & Scour Protection (SSP Wall Toe + Wall Returns)	cu.m.	5,000	$80	$400,000		25	$100,000
					SUB-TOTAL FOR DREDGING AND LAND RECLAMATION		$20,865,000		$7,372,500
3		REMOVALS AND SITE PREPARATION							
3.1		Clear and Grub	Allowance	1	$100,000	$100,000		20	$20,000
					SUB-TOTAL FOR REMOVALS AND SITE PREPARATION		$100,000		$20,000
4		WHARF STRUCTURAL							
4.1		Steel Sheet Pile Wall System (Arcelor HZ King Pile c/w AZ Sheet Pile)							
		Total Length of Wall	**m**	**375**					
		Number of Container Berths	**ea.**	**1**					
	a	Supply HZ Sheet Piling (Arcelor HZ 1180 + AZ26-700)	kg	4,370,000	$2.75	$12,017,500		25	$3,004,375
	b	Supply Tie Rods	ea.	195	$4,150	$807,602		25	$201,901
	c	Supply T-Plates and Curved Plates	ea.	195	$200	$38,921		25	$9,730
	d	Drive H Sheet Piles	ea.	195	$1,500	$291,905		25	$72,976
	e	Drive Z Pair Sheet Piles	ea.	195	$650	$126,492		25	$31,623
	f	Supply and Install Concrete Cope Wall & Bullrail	cu.m.	1,500	$600	$900,000		25	$225,000
	g	Install Tie Rods	ea.	195	$500	$97,302		25	$24,325
	h	Install T-Plates and Curved Plates	ea.	195	$500	$97,302		25	$24,325
	i	Supply Anchor Pile (914mm dia.)	lin.m.	3,100	$950	$2,945,000		25	$736,250
	j	Drive Anchor Pile	ea.	195	$750	$145,952		25	$36,488
4.2		Crane Rail System (Crane Rail, Crane Beam, Support Piles and Pile Cap)							
		Length of Crane Beam	**m**	**315**					
	a	CIP Concrete Crane Beam and Pile Cap	cu.m.	3,500	$600	$2,100,000		25	$525,000
	b	CIP Concrete Seismic Tie Beam	cu.m.	7,400	$600	$4,440,000		25	$1,110,000
	c	Supply Support Piles (914mm)	lin.m.	10,800	$950	$10,260,000		25	$2,565,000
	d	Drive Support Piles	ea.	330	$900	$297,000			
	e	Crane Rail & Fixation	lin.m.	630	$500	$315,000		25	$78,750
	f	Crane Rail Stops	ea.	2	$18,000	$36,000		25	$9,000
	g	Stowage Pins	ea.	9	$20,000	$180,000		25	$45,000
4.3		Miscellaneous Wharf Elements							
	a	Mooring System (Bollards)	ea.	14	$10,000	$138,957		25	$34,239
	b	Crane Power Vault	ea.	5	$20,000	$100,000		25	$25,000
	c	Ship Service Pit	ea.	2	$10,000	$21,000		25	$5,250
	d	Fenders	ea.	25	$30,000	$750,000		25	$187,500
					SUB-TOTAL FOR WHARF STRUCTURAL		$36,103,931		$8,951,733
5		CIVIL & STRUCTURAL TERMINAL INFRASTRUCTURE							
5.1		Civil Utilities - Not Applicable							
5.2		Civil Pavement Structures (Asphalt/Concrete, Base and Subbase Gravel)						25	$0
	a	Heavy Duty Pavement For Berth Area	sq.m.	13,000	$130	$1,690,000		25	$422,500
	b	Fencing and Gates	lin.m.	350	$120	$42,000		25	$10,500
	c	Pavement Markings	Allowance	1	$10,000	$10,000		25	$2,500
					SUB-TOTAL FOR CIVIL TERMINAL INFRASTRUCTURE		$1,742,000		$435,500
6		OFFSITE IMPROVEMENTS							
		Not Applicable							
					SUB-TOTAL FOR OFFSITE IMPROVEMENTS		$0		$0
7		RAIL WORKS							
		Not Applicable							
					SUB-TOTAL FOR RAIL WORKS		$0		$0
8		GATE COMPLEX							
		Not Applicable							
					SUB-TOTAL FOR GATE COMPLEX		$0		$0
9		BUILDINGS							
		Not Applicable							
					SUB-TOTAL FOR BUILDINGS		$0		$0
10		ELECTRICAL TERMINAL INFRASTRUCTURE							
	a	Main Substation	ea.	1	$100,000	$100,000		25	$25,000
	b	Quay Crane Substation	L.S.	1	$150,000	$150,000		25	$37,500
					SUB-TOTAL FOR ELECTRICAL TERMINAL INFRASTRUCTURE		$250,000		$62,500
						TOTAL FOR CAPITAL CONSTRUCTION	$61,420,931	28%	$17,314,233
						TOTAL FOR CAPITAL CONSTRUCTION, INCL. CONTINGENCY		$79,000,000	
11		PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION							
11.1		Allowance 10% of construction costs	L.S.	1	$6,100,000	$6,100,000			$0
					SUB-TOTAL FOR PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION		$6,100,000		$0
						TOTAL FOR PROJECT	$67,520,931	26%	$17,314,233
						TOTAL FOR CONSTRUCTION, INCL. CONTINGENCY		$85,000,000	

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7. Semi Automated Terminal Phase B
(2-Berths 1,140,000 TEU's/annum. Includes Costs In Addition to Phase A)

ITEM		DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT RATE	ITEM COST	AREA COST	CONTINGENCY %	CONTINGENCY $
1		MOBILIZATION/DEMOBILIZATION							
1.1		Mobilization/Demobilization	L.S.	1	$2,030,000	$2,030,000		20	$406,000
					SUB-TOTAL FOR MOBILIZATION / DEMOBILIZATION		$2,030,000		$406,000
2		DREDGING AND LAND RECLAMATION							
		Not Applicable. 2nd Berth Extension + Fill Included in Phase A-2							
					SUB-TOTAL FOR DREDGING AND LAND RECLAMATION		$0		$0
3		REMOVALS AND SITE PREPARATION							
		Not Applicable.							
					SUB-TOTAL FOR REMOVALS AND SITE PREPARATION		$0		$0
4		WHARF STRUCTURAL							
		Not Appplicable. 2nd Berth Extension Included in Phase A-2							
					SUB-TOTAL FOR WHARF STRUCTURAL		$0		$0
5		CIVIL & STRUCTURAL TERMINAL INFRASTRUCTURE							
5.1		Civil Utilities							
	a	Fire Protection Water Distribution System (Pipes, Valves)	lin.m.	1,150	$300	$345,000		25	$86,250
	b	Fire Hydrants	ea.	5	$4,000	$20,000		25	$5,000
	c	Domestic Water Distribution System (Pipes, Valves)	lin.m.	350	$150	$52,500		25	$13,125
	d	Storm Drainage Trench Drains	lin.m.	325	$500	$162,500		25	$40,625
	e	Storm Drainage Under Drains (French Drains for Semi-Automated)	lin.m.	3,500	$250	$875,000		25	$218,750
	f	Utility Services (Buildings & Ship Service Pits)	ea.	3	$5,000	$15,000		25	$3,750
5.2		Civil Pavement Structures (Asphalt/Concrete, Base and Subbase Gravel)							
	a	Heavy Duty Pavement For Container Yard, Access Roads and Gate Area	sq.m.	142,000	$100	$14,200,000		25	$3,550,000
	b	Light/Medium Duty Pavement for POV/Equipment Parking Area	sq.m.	2,000	$70	$140,000		25	$35,000
	c	RMG Concrete Runways (Container Yard)	lin.m.	6,120	$1,500	$9,180,000		25	$2,295,000
	d	Misc. Concrete Slabs (RTG Repair Pad, Fueling Station, Washdown Area)	sq.m.	200	$150	$30,000		25	$7,500
	e	Misc. Concrete Strips for Container Castings (for Semi-Automated only)	cu.m.	12,000	$600	$7,200,000		25	$1,800,000
5.3		Miscellaneous Civil and Structural							
	a	Fencing and Gates	lin.m.	450	$120	$54,000		25	$13,500
	b	Pavement Markings	Allowance	1	$100,000	$100,000		25	$25,000
	c	Reefer Tower Structures	ea.	12	$450,000	$5,400,000		25	$1,350,000
	d	Customs portal radiation monitors (RPM)	ea.	2	$200,000	$400,000		25	$100,000
					SUB-TOTAL FOR CIVIL TERMINAL INFRASTRUCTURE		$38,174,000		$9,543,500
6		OFFSITE IMPROVEMENTS							
	a	Tug Basin (Mooring Piles and Access Gangway)	Allowance	1	$400,000	$400,000		25	$100,000
					SUB-TOTAL FOR OFFSITE IMPROVEMENTS		$400,000		$100,000
7		RAIL WORKS							
7.1		Intermodal Yard							
	a	Working Rail Track, Incl. Ballast, Subballast, Ties	lin.m.	3,972	$700	$2,780,400		20	$556,080
	b	No.8 Turnout Assembly with Switch (Relay), Incl. Ballast, Subballast, Ties, Rail	ea.	2	$100,000	$200,000		20	$40,000
	c	Asphalt Pavement	sq.m.	20,000	$100	$2,000,000		25	$500,000
					SUB-TOTAL FOR RAIL WORKS		$4,980,400		$1,096,080
8		GATE COMPLEX							
	b	In-Gate (Gate Arms, Cameras, Communication, Bollards, Electrical)	lane	3	$200,000	$600,000		25	$150,000
	c	Out-Gate OCR (Gate Arams, OCR, Cameras, Communication, Bollards, Electrical)	lane	1	$350,000	$350,000		25	$87,500
	e	Canopies (Pre, In and Out Gates)	sq.m.	800	$650	$520,000		25	$130,000
					SUB-TOTAL FOR GATE COMPLEX		$1,470,000		$367,500
9		BUILDINGS							
	a	Maintenance Building	sq.m.	500	$1,600	$800,000		20	$160,000
	b	LEED Certification (5%)	Allowance	1	$40,000	$40,000		20	$8,000
					SUB-TOTAL FOR BUILDINGS		$840,000		$168,000
10		ELECTRICAL TERMINAL INFRASTRUCTURE							
	a	Main Substation	ea.	1	$100,000	$100,000		25	$25,000
	b	Reefer Substations	ea.	1	$400,000	$400,000		25	$100,000
	c	ASC Crane Substations	ea.	1	$400,000	$400,000		25	$100,000
	d	IY Crane Substations	ea.	1	$100,000	$100,000		25	$25,000
	e	Quay Crane Substation	L.S.	1	$450,000	$450,000		25	$112,500
	f	Gate Electrical	L.S.	1	$100,000	$100,000		25	$25,000
	g	High Mast Lighting Relocations (Foundation, Pole, Fixture, Conduit)	ea.	4	$100,000	$400,000		25	$100,000
	h	Power and Communication Distribution	L.S.	1	$3,000,000	$3,000,000		25	$750,000
					SUB-TOTAL FOR ELECTRICAL TERMINAL INFRASTRUCTURE		$4,950,000		$1,237,500
						TOTAL FOR CAPITAL CONSTRUCTION	$52,844,400	24%	$12,918,580
						TOTAL FOR CAPITAL CONSTRUCTION, INCL. CONTINGENCY		$66,000,000	
11		PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION							
11.1		Allowance 10% of construction costs	L.S.	1	$5,300,000	$5,300,000			$0
					SUB-TOTAL FOR PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION		$5,300,000		$0
						TOTAL FOR PROJECT	$58,144,400	22%	$12,918,580
						TOTAL FOR CONSTRUCTION, INCL. CONTINGENCY		$71,000,000	

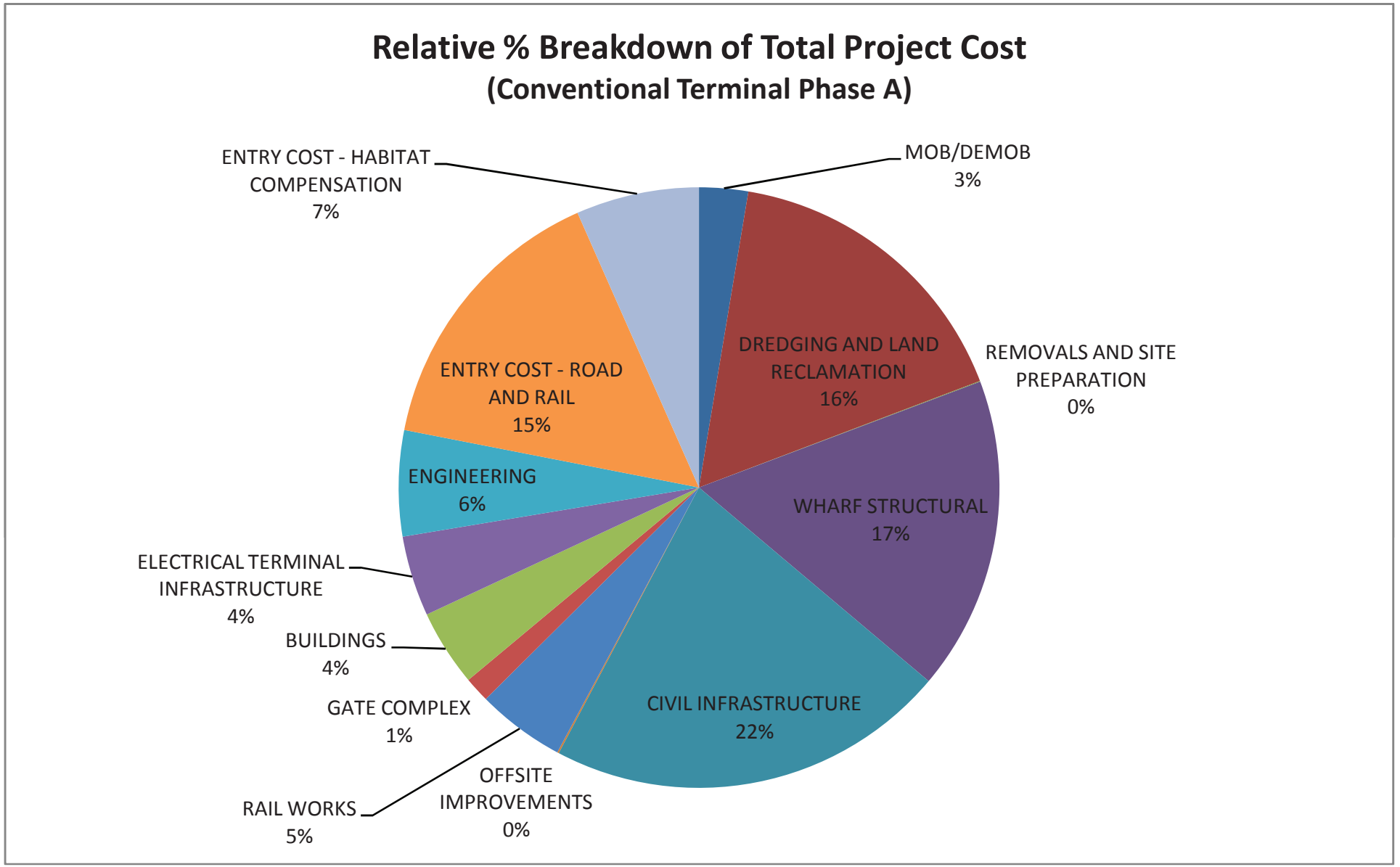
MONTREAL PORT AUTHORITY
Order of Magnitude Cost Estimate for Contrecoeur Development Master Plan

Date: 17-Sep-10
Prepared By: MC
Project No.: 7146-43

DRAFT- Rev.B

8. SEMI-AUTOMATED TERMINAL - ENTRY COSTS
(Assumes Costs to the End of Phase B)

ITEM	DESCRIPTION	UNITS	ESTIMATED QUANTITY	UNIT RATE	ITEM COST	AREA COST	CONTINGENCY %	CONTINGENCY $
1	ENTRANCE COSTS							
1.1	Mobilization/Demobilization	L.S.	1	$2,110,000	$2,110,000		20	$422,000
1.2	Hwy 132 Overpass Structure (2-Lane Hwy.132 over New Rail)	sq.m.	4,500	$4,000	$18,000,000		20	$3,600,000
1.3	Storage Tracks							
	a Storage, Runaround and Interchange Rail Track	lin.m.	21,300	$700	$14,910,000		20	$2,982,000
	b No.8 Turnout Assembly with Switch (Relay), Incl. Ballast, Subballast, Ties, Rail	ea.	20	$100,000	$2,000,000		20	$400,000
	c Gravel Surfacing Access Roads	Allowance	1	$50,000	$50,000		20	$10,000
1.4	Environmental Habitat Compensation (5% of Capital Construction Cost, Ph.1)	L.S.	1	$17,700,000	$17,700,000		0	$0
					SUB-TOTAL FOR ENTRY COSTS	$54,770,000		$7,414,000
					TOTAL FOR CAPITAL CONSTRUCTION	$54,770,000	14%	$7,414,000
					TOTAL FOR CAPITAL CONSTRUCTION, INCL. CONTINGENCY		$62,200,000	
2	PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION							
2.1	Allowance 10% of Construction Costs	L.S.	1	$5,480,000	$5,480,000			
					SUB-TOTAL FOR PERMITTING, ENGINEERING, CONTRACT ADMINISTRATION	$5,480,000		$0
					TOTAL FOR PROJECT	$60,250,000	12%	$7,414,000
					TOTAL FOR CONSTRUCTION, INCL. CONTINGENCY		$68,000,000	


Relative % Breakdown of Total Project Cost
(Conventional Terminal Phase A)
ENTRY COST - HABITAT COMPENSATION 7%
MOB/DEMOB 3%
DREDGING AND LAND RECLAMATION 16%
REMOVALS AND SITE PREPARATION 0%
ENTRY COST - ROAD AND RAIL 15%
ENGINEERING 6%
WHARF STRUCTURAL 17%
ELECTRICAL TERMINAL INFRASTRUCTURE 4%
BUILDINGS 4%
GATE COMPLEX 1%
CIVIL INFRASTRUCTURE 22%
OFFSITE IMPROVEMENTS 0%
RAIL WORKS 5%

APPENDIX G

SCHEDULES

CONTRECOEUR DEVELOPMENT MASTER PLAN
PRELIMINARY PHASE A, A2 AND B DESIGN AND CONSTRUCTION SCHEDULE (DRAFT)

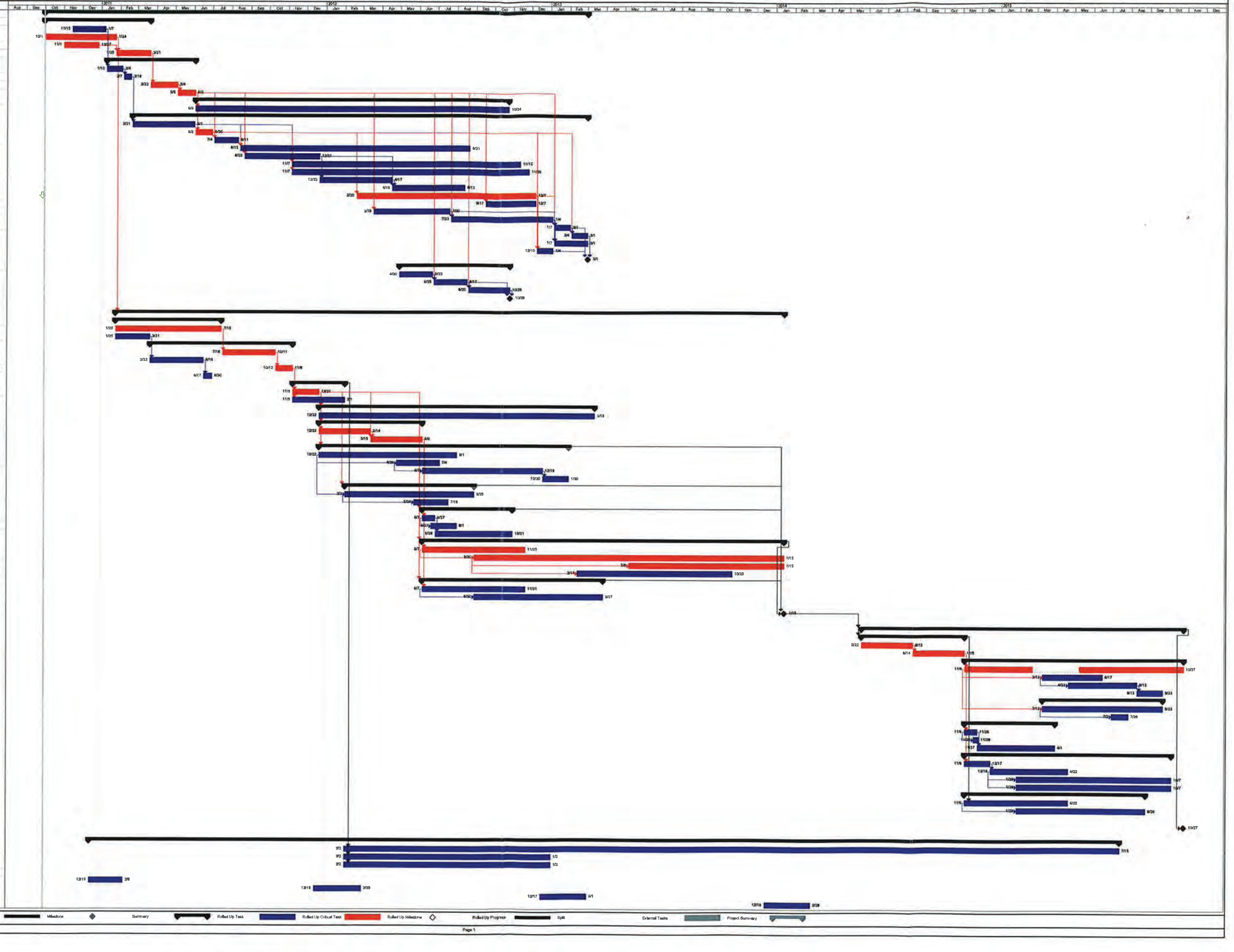
ID	Task Name	Duration	Start	Finish
1	**PHASE A3 MARINE WORKS**	**622 days**	**Fri 12/1/10**	**Fri 3/1/13**
2	**Construction Documents**	**320 days**	**Fri 12/1/10**	**Mon 3/21/11**
3	Prepare File Supply Specification	2 mons	Mon 11/15/10	Fri 1/7/11
4	Prepare SSP Wharf Plans & Specifications	4 mons	Fri 10/1/10	Mon 12/6/11
5	Prepare Dredging Plans & Specifications	2 mons	Mon 11/1/10	Mon 12/27/10
6	Prepare Construction Documents	2 mons	Tue 1/25/11	Mon 3/21/11
7	**Tendering**	**101 days**	**Mon 1/10/11**	**Thu 6/2/11**
8	Tender SSP & Pipe File Supply	1 mon	Mon 1/10/11	Fri 2/4/11
9	Award SSP & Pipe File Supply	0.5 mons	Mon 2/7/11	Fri 2/18/11
10	Tender Marine Works	1.5 mons	Tue 3/22/11	Wed 5/4/11
11	Award Marine Works	1 mon	Thu 5/5/11	Thu 6/2/11
12	**Ship to Shore Crane Procurement**	**360 days**	**Fri 6/3/11**	**Wed 10/24/12**
53	Order, Fabricate, Transport & Commission Cranes	16 mons	Fri 6/3/11	Wed 10/24/12
14	**Wharf Material Supply & Construction**	**523 days**	**Mon 2/21/11**	**Fri 3/1/13**
15	Supply SSP & Pipe Piles	3.5 mons	Mon 2/21/11	Wed 6/1/11
16	Shoreline Preparation & Mobilization	1 mon	Fri 6/3/11	Thu 6/30/11
17	Supply and Place Initial Shoreline Fill	28 days	Mon 7/4/11	Thu 8/11/11
18	Pitch and Drive SSP	53 wks	Mon 6/15/11	Tue 6/21/12
19	Pitch and Drive Anchor Wall Piles	56 days	Mon 9/12/11	Wed 12/21/11
20	Install Tie Rods	53 wks	Mon 11/7/11	Mon 11/12/12
21	Backfill Wharf	55 wks	Mon 11/7/11	Mon 11/26/12
22	Pitch and Drive Backside Crane Rail Piles	84 days	Thu 12/22/11	Tue 4/17/12
23	Pitch and Drive Frontside Crane Rail Piles	84 days	Wed 4/18/12	Mon 8/13/12
24	Cast Cope Beam	42 wks	Mon 2/20/12	Fri 12/7/12
25	Cast Cold Iron Pits, Cable Pits, Etc.	3 mons	Mon 8/27/12	Fri 12/7/12
26	Cast Backside Crane Rail	18 wks	Mon 3/19/12	Fri 7/20/12
27	Cast Frontside Crane Rail & Seismic Tie	24 wks	Mon 7/23/12	Fri 1/4/13
28	Backfill to Grade	1 mon	Mon 1/7/13	Fri 2/1/13
29	Install Wharf Utilities	1 mon	Mon 2/4/13	Fri 3/1/13
30	Install Crane Rails	2 mons	Mon 1/7/13	Fri 3/1/13
31	Install Fenders, Bollards, Slope, Ladders, Etc.	1 mon	Mon 12/10/12	Fri 1/4/13
32	Substantial Completion Wharf	0 days	Fri 3/1/13	Fri 3/1/13
33	**Ship Basin Dredging and Disposal**	**188 days**	**Mon 4/30/12**	**Fri 10/26/12**
34	Prepare Upland Disposal Area	2 mons	Mon 4/30/12	Fri 6/22/12
35	Mobilize Dredge	2 mons	Mon 6/25/12	Fri 8/17/12
36	Dredge Ship Basin	10 wks	Mon 8/20/12	Fri 10/26/12
37	Substantial Completion Dredging	0 days	Fri 10/26/12	Fri 10/26/12
38				
39	**PHASE A SITE BACKLANDS SITE IMPROVEMENTS**	**778 days**	**Tue 1/25/11**	**Wed 1/15/14**
40	Construction Documents	130 days	Tue 1/25/11	Fri 7/15/11
41	Prepare SSP Site Work Plans & Specifications	6 mons	Tue 1/25/11	Fri 7/15/11
42	Prepare Buildings Plans & Specifications	2 mons	Tue 1/25/11	Mon 3/21/11
43	**Tendering**	**160 days**	**Tue 3/22/11**	**Tue 11/8/11**
44	Tender Site Work	60 days	Mon 7/18/11	Tue 10/11/11
45	Tender Building	60 days	Tue 3/22/11	Thu 6/16/11
46	Award Site Work	1 mon	Wed 10/12/11	Tue 11/8/11
47	Award Building	0.5 mons	Fri 6/17/11	Thu 6/30/11
48	**Notice to Proceed**	**62 days**	**Wed 11/9/11**	**Wed 2/1/12**
80	Mobilization - Site Work	30 days	Wed 11/9/11	Wed 12/21/11
50	Submittals	60 days	Wed 11/9/11	Wed 2/1/12
51	**Major Equipment Procurement**	**330 days**	**Thu 12/22/11**	**Wed 3/13/13**
52	RTG	16 mons	Thu 12/22/11	Wed 3/13/13
53	**Removals and Site Preparation**	**130 days**	**Thu 12/22/11**	**Wed 6/6/12**
54	Clear & Grub	60 days	Thu 12/22/11	Wed 3/14/12
55	Rough Grading/Import Fill	60 days	Thu 3/15/12	Wed 6/6/12
56	**Civil & Misc Struc Terminal Infrastructure**	**210 days**	**Thu 12/22/11**	**Wed 10/10/12**
57	Civil Utilities	8 mons	Thu 12/22/11	Wed 8/1/12
58	RTG Concrete Runways	80 days	Thu 4/26/12	Wed 8/15/12
59	Paving & Pavement Markings	3 mons	Thu 8/1/12	Wed 8/29/12
60	Misc Site Work (fencing, gates)	30 days	Thu 8/30/12	Wed 10/10/12
61	**Intermodal Yard**	**150 days**	**Thu 4/26/12**	**Wed 11/21/12**
62	Railwork	150 days	Thu 4/26/12	Wed 11/21/12
63	Paving & Pavement Marking	3 mons	Thu 8/16/12	Wed 11/7/12
64	**Gate Complex**	**105 days**	**Thu 8/1/12**	**Wed 10/31/12**
65	Grading & Drainage	15 days	Thu 8/1/12	Wed 8/22/12
66	Paving & Pavement Marking	30 days	Thu 8/2/12	Wed 9/12/12
67	Utilities (Incl OCR, Comm)	90 days	Thu 8/26/12	Wed 10/31/12
68	**Buildings**	**420 days**	**Thu 6/7/12**	**Wed 1/15/14**
69	Foundation	120 days	Thu 6/7/12	Wed 11/21/12
70	Building Structures	360 days	Thu 8/30/12	Wed 1/15/14
71	Interior Construction	180 days	Thu 3/9/13	Wed 1/15/14
72	Building Utility Systems	180 days	Thu 2/14/13	Wed 10/23/13
73	**Electrical Terminal Infrastructure**	**315 days**	**Thu 6/7/12**	**Wed 3/27/13**
74	Primary Infrastructure	120 days	Thu 6/7/12	Wed 11/21/12
75	Distribution	150 days	Thu 8/30/12	Wed 3/27/13
76				
77	Construction Substantial Completion - Phase A	0 days	Wed 1/15/14	Wed 1/15/14
78				
79	PHASE B SITE BACKLANDS SITE IMPROVEMENT	374 days	Thu 5/22/14	Tue 10/27/15
80	Removals and Site Preparation	130 days	Thu 5/22/14	Wed 11/5/14
81	Clear & Grub	60 days	Thu 5/22/14	Wed 8/13/14
82	Rough Grading/Import Fill	60 days	Thu 8/14/14	Wed 11/5/14
83	**Civil & Misc Struc Terminal Infrastructure**	**264 days**	**Thu 11/6/14**	**Tue 10/27/15**
84	Civil Utilities	9.75 mons	Thu 11/6/14	Tue 10/27/15
85	RTG Concrete Runways	80 days	Thu 3/12/15	Wed 7/1/15
86	Paving & Pavement Markings	60 days	Thu 4/23/15	Wed 7/15/15
87	Misc Site Work (fencing, gates)	30 days	Thu 7/16/15	Wed 8/26/15
88	**Intermodal Yard**	**140 days**	**Thu 3/12/15**	**Wed 9/23/15**
89	Railwork	140 days	Thu 3/12/15	Wed 9/23/15
90	Paving & Pavement Marking	3 mons	Thu 7/2/15	Wed 9/23/15
91	**Gate Complex**	**105 days**	**Thu 11/6/14**	**Wed 4/1/15**
92	Grading & Drainage	15 days	Thu 11/6/14	Wed 11/26/14
93	Paving & Pavement Marking	30 days	Thu 11/27/14	Wed 1/21/15
94	Utilities (Incl OCR, Comm)	90 days	Thu 11/27/14	Wed 4/1/15
95	**Buildings**	**240 days**	**Thu 11/6/14**	**Wed 10/7/15**
96	Foundation	30 days	Thu 11/6/14	Wed 12/17/14
97	Building Structures	90 days	Thu 12/18/14	Wed 4/22/15
98	Interior Construction	180 days	Thu 1/29/15	Wed 10/7/15
99	Building Utility Systems	180 days	Thu 1/29/15	Wed 10/7/15
100	**Electrical Terminal Infrastructure**	**210 days**	**Thu 11/6/14**	**Wed 8/26/15**
101	Primary Infrastructure	120 days	Thu 11/6/14	Wed 4/22/15
102	Distribution	150 days	Thu 5/28/15	Wed 8/26/15
103				
104	Construction Substantial Completion Phase B	0 days	Tue 10/27/15	Tue 10/27/15
105				
106	**OFFSITE ENTRY IMPROVEMENTS**	**1189 days**	**Wed 12/15/10**	**Wed 7/15/15**
107	Service/Storage Tracks	800 days	Thu 2/2/12	Wed 7/15/15
108	Hwy 132 Overpass	12 mons	Thu 2/2/12	Wed 1/2/13
109	Environmental habitat compensation	12 mons	Thu 2/2/12	Wed 1/2/13
110				
111	Ice Winter Excavation -2010-2011	55 days	Wed 12/15/10	Tue 3/1/11
112	Ice Winter Excavation -2011-2012	75 edays	Thu 12/15/11	Fri 3/2/12
113	Ice Winter Excavation -2012-2013	78 edays	Sat 12/15/12	Sun 3/3/13
114	Ice Winter Excavation -2013-2014	78 edays	Sun 12/15/13	Mon 3/3/14

Project: 7146_Conventional Terminal2
Date: Thu 8/29/10

Task | Critical Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Critical Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary

CONTRECOEUR DEVELOPMENT MASTER PLAN
PRELIMINARY PHASE A, A2 AND B DESIGN AND CONSTRUCTION SCHEDULE (DRAFT)

ID	Task Name	Duration	Start	Finish	Predecessors
1	**PHASE A3 MARINE WORKS**	**623 days**	**Fri 10/1/10**	**Fri 2/1/13**	
2	Construction Documents	**130 days**	**Fri 10/1/10**	**Mon 3/21/11**	
3	Prepare Pile Supply Specification	2 mons	Mon 11/15/10	Fri 1/7/11	
4	Prepare SSP Wharf Plans & Specifications	4 mons	Fri 10/1/10	Mon 1/24/11	
5	Prepare Dredging Plans & Specifications	2 mons	Mon 11/1/10	Mon 12/27/10	
6	Prepare Construction Documents	3 mons	Tue 1/25/11	Mon 3/21/11	4,5
7	**Tendering**	**101 days**	**Mon 1/10/11**	**Thu 6/2/11**	
8	Tender SSP & Pipe Pile Supply	1 mon	Mon 1/10/11	Fri 2/4/11	3
9	Award SSP & Pipe Pile Supply	0.5 mons	Mon 2/7/11	Fri 2/18/11	8
10	Tender Marine Works	1.5 mons	Tue 3/22/11	Wed 5/4/11	6
11	Award Marine Works	1 mon	Thu 5/5/11	Thu 5/2/11	10
12	**Ship to Shore Crane Procurement**	**360 days**	**Fri 6/3/11**	**Wed 10/24/12**	
13	Order Fabricate, Transport & Commission Cranes	16 mons	Fri 6/3/11	Wed 10/24/12	11
14	**Wharf Material Supply & Construction**	**623 days**	**Mon 2/21/11**	**Fri 2/1/13**	
15	Supply SSP & Pipe Piles	3.5 mons	Mon 2/21/11	Wed 6/1/11	9
16	Shoreline Preparation & Mobilization	1 mon	Fri 6/3/11	Thu 6/30/11	11
17	Supply and Place Initial Shoreline Fill	25 days	Mon 7/4/11	Thu 8/11/11	11,16
18	Pitch and Drive SSP	53 wks	Mon 8/15/11	Tue 8/21/12	15,16FS+5 days
19	Pitch and Drive Anchor Wall Piles	66 days	Mon 8/22/11	Wed 12/21/11	11,18
20	Install Tie Rods	53 wks	Mon 11/7/11	Mon 11/12/12	15,18FS+10 days
21	Backfill Wharf	55 wks	Mon 11/7/11	Mon 11/26/12	15,18FS+20 days
22	Pitch and Drive Backside Crane Rail Piles	84 days	Thu 12/22/11	Tue 4/17/12	19
23	Pitch and Drive Frontside Crane Rail Piles	84 days	Wed 4/18/12	Mon 8/13/12	18,22
24	Cast Cope Beam	42 wks	Mon 2/20/12	Fri 12/7/12	18
25	Cast Cold Iron Pile, Cable Pits, Etc	3 mons	Mon 9/17/12	Fri 12/7/12	11
26	Cast Backside Crane Rail	18 wks	Mon 3/19/12	Fri 7/20/12	11
27	Cast Frontside Crane Rail & Seismic Tie	24 wks	Mon 7/23/12	Fri 1/4/13	11,26
28	Backfill to Grade	1 mon	Mon 1/7/13	Fri 2/1/13	11,24,26,27
29	Install Wharf Utilities	1 mon	Mon 2/4/13	Fri 3/1/13	16,28
30	Install Crane Rails	2 mons	Mon 1/7/13	Fri 3/1/13	16,28,27
31	Install Fenders, Bollards, Stops, Ladders, Etc.	1 mon	Mon 12/10/12	Fri 1/4/13	16,24
32	Substantial Completion Wharf	0 days	Fri 3/1/13	Fri 3/1/13	28,29,30,31
33	**Ship Basin Dredging and Disposal**	**130 days**	**Mon 4/30/12**	**Fri 10/26/12**	
34	Prepare Upland Disposal Area	2 mons	Mon 4/30/12	Fri 6/22/12	
35	Mobilize Dredge	2 mons	Mon 6/25/12	Fri 8/17/12	11,34
36	Dredge Ship Basin	10 wks	Mon 8/20/12	Fri 10/26/12	11,35
37	Substantial Completion Dredging	0 days	Fri 10/26/12	Fri 10/26/12	35,36
38					
39	**PHASE A BACKLAND SITE IMPROVEMENTS**	**778 days**	**Tue 1/25/11**	**Wed 1/15/14**	4
40	Construction Documents	**130 days**	**Tue 1/25/11**	**Fri 7/15/11**	
41	Prepare Site Work Plans & Specifications	6 mons	Tue 1/25/11	Fri 7/15/11	
42	Prepare Buildings Plans & Specifications	3 mons	Tue 1/25/11	Mon 3/21/11	
43	**Tendering**	**152 days**	**Tue 3/22/11**	**Tue 11/8/11**	
44	Tender Site Work	60 days	Mon 7/18/11	Tue 10/11/11	41
45	Tender Building	60 days	Tue 3/22/11	Thu 6/16/11	42
46	Award Site Work	1 mon	Wed 10/12/11	Tue 11/8/11	44
47	Award Building	0.5 mons	Fri 6/17/11	Thu 6/30/11	45
48	**Notice to Proceed**	**68 days**	**Wed 11/9/11**	**Wed 3/1/12**	
49	Mobilization - Site Work	30 days	Wed 11/9/11	Wed 12/21/11	46
50	Submittals	60 days	Wed 11/9/11	Wed 2/1/12	46
51	**Major Equipment Procurement**	**330 days**	**Thu 12/22/11**	**Wed 3/13/13**	**48**
52	RMG	15 mons	Thu 12/22/11	Wed 3/13/13	
53	**Removals and Site Preparation**	**130 days**	**Thu 12/22/11**	**Wed 6/6/12**	**48**
54	Clear & Grub	60 days	Thu 12/22/11	Wed 3/14/12	48
55	Rough Grading/Import Fill	60 days	Thu 3/15/12	Wed 6/6/12	48,54
56	**Civil & Misc Struc Terminal Infrastructure**	**280 days**	**Thu 12/22/11**	**Wed 1/30/13**	**48**
57	Civil Utilities	6 mons	Thu 12/22/11	Wed 6/1/12	
58	RMG Concrete Runways	50 days	Thu 4/26/12	Wed 7/4/12	57SS+30 days
59	Paving & Pavement Markings	140 days	Thu 8/7/12	Wed 12/19/12	58SS+30 days
60	Misc Site Work (fencing, gates)	30 days	Thu 12/20/12	Wed 1/30/13	59
61	**Intermodal Yard**	**150 days**	**Thu 2/2/12**	**Wed 8/29/12**	**48**
62	Railwork	150 days	Thu 2/2/12	Wed 8/29/12	57SS+30 days
63	Paving & Pavement Marking	40 days	Thu 5/24/12	Wed 7/18/12	62SS+30 days
64	**Gate Complex**	**105 days**	**Thu 6/7/12**	**Wed 10/31/12**	**48**
65	Grading & Drainage	15 days	Thu 6/7/12	Wed 6/27/12	55
66	Paving & Pavement Marking	30 days	Thu 6/21/12	Wed 8/1/12	65SS+10 days
67	Utilities (Incl OCR, Comm)	90 days	Thu 6/28/12	Wed 10/31/12	65
68	**Buildings**	**420 days**	**Thu 6/7/12**	**Wed 1/15/14**	**48**
69	Foundation	120 days	Thu 6/7/12	Wed 11/21/12	55
70	Building Structures	360 days	Thu 8/30/12	Wed 1/15/14	69SS+60 days
71	Interior Construction	180 days	Thu 5/9/13	Wed 1/15/14	70SS+15D days
72	Building Utility Systems	180 days	Thu 2/14/13	Wed 10/23/13	70SS+120 days
73	**Electrical Terminal Infrastructure**	**210 days**	**Thu 6/7/12**	**Wed 3/27/13**	**48**
74	Primary infrastructure	120 days	Thu 6/7/12	Wed 11/21/12	55
75	Distribution	150 days	Thu 8/30/12	Wed 3/27/13	74SS+60 days
76					
77	Construction Substantial Completion - Phase A	0 days	Wed 1/15/14	Wed 1/15/14	73,68,64,61,56
78					
79	**PHASE B BACKLANDS SITE IMPROVEMENTS**	**374 days**	**Thu 5/22/14**	**Tue 10/27/15**	**77FS+60 days**
80	**Removals and Site Preparation**	**120 days**	**Thu 5/22/14**	**Wed 11/5/14**	**77FS+60 days**
81	Clear & Grub	60 days	Thu 5/22/14	Wed 8/13/14	
82	Rough Grading/Import Fill	60 days	Thu 8/14/14	Wed 11/5/14	81
83	Civil & Misc Struc Terminal Infrastructure	254 days	Thu 11/6/14	Tue 10/27/15	
84	Civil Utilities	10 mons	Thu 11/6/14	Tue 10/27/15	82
85	RMG Concrete Runways	70 days	Thu 3/12/15	Wed 6/17/15	84SS+60 days
86	Paving & Pavement Markings	80 days	Thu 4/23/15	Wed 8/12/15	85SS+30 days
87	Misc Site Work (fencing, gates)	30 days	Thu 8/13/15	Wed 9/23/15	86
88	**Intermodal Yard**	**140 days**	**Thu 3/12/15**	**Wed 9/23/15**	
89	Railwork	140 days	Thu 3/12/15	Wed 9/23/15	84SS+60 days
90	Paving & Pavement Marking	1 mon	Thu 7/2/15	Wed 7/29/15	89SS+60 days
91	**Gate Complex**	**105 days**	**Thu 11/6/14**	**Wed 4/1/15**	
92	Grading & Drainage	15 days	Thu 11/6/14	Wed 11/26/14	82
93	Paving & Pavement Marking	7 days	Thu 11/20/14	Fri 11/28/14	92SS+10 days
94	Utilities (Incl OCR, Comm)	90 days	Thu 11/27/14	Wed 4/1/15	92
95	**Buildings**	**340 days**	**Thu 11/6/14**	**Wed 10/7/15**	
96	Foundation	30 days	Thu 11/6/14	Wed 12/17/14	82
97	Building Structures	60 days	Thu 12/18/14	Wed 4/22/15	96
98	Interior Construction	180 days	Thu 1/29/15	Wed 10/7/15	97SS+30 days
99	Building Utility Systems	180 days	Thu 1/29/15	Wed 10/7/15	97SS+30 days
100	**Electrical Terminal Infrastructure**	**210 days**	**Thu 11/6/14**	**Wed 8/26/15**	
101	Primary infrastructure	120 days	Thu 11/6/14	Wed 4/22/15	80
102	Distribution	150 days	Thu 1/29/15	Wed 8/26/15	101SS+60 days
103					
104	Construction Substantial Completion - Phase B	0 days	Tue 10/27/15	Tue 10/27/15	79
105					
106	**OFFSITE ENTRY IMPROVEMENTS**	**1189 days**	**Wed 12/15/10**	**Wed 7/15/15**	
107	Storage Track	900 days	Thu 2/2/12	Wed 7/15/15	48
108	Hwy 132 Overpass	12 mons	Thu 2/2/13	Wed 1/2/13	48
109	Environmental habitat compensation	12 mons	Thu 2/2/12	Wed 1/2/13	48
110					
111	No Winter Excavation -2010-2011	55 edays	Wed 12/15/10	Tue 2/5/11	
112	No Winter Excavation - 2011-2012	55 days	Thu 12/15/11	Wed 2/29/12	
113	No Winter Excavation - 2012-2013	55 days	Mon 12/15/12	Fri 2/1/13	
114	No Winter Excavation - 2013-2014	55 days	Mon 12/16/13	Fri 2/28/14	



Project: 7145_Kent Automated Termin
Date: Thu 8/30/15

Task | Critical Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Critical Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary





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Étude sectorielle No. 29

Port of Montreal Container Forecasts





Port of Montreal Container Forecasts

February 2017

Prepared for the **Port of Montreal** by:

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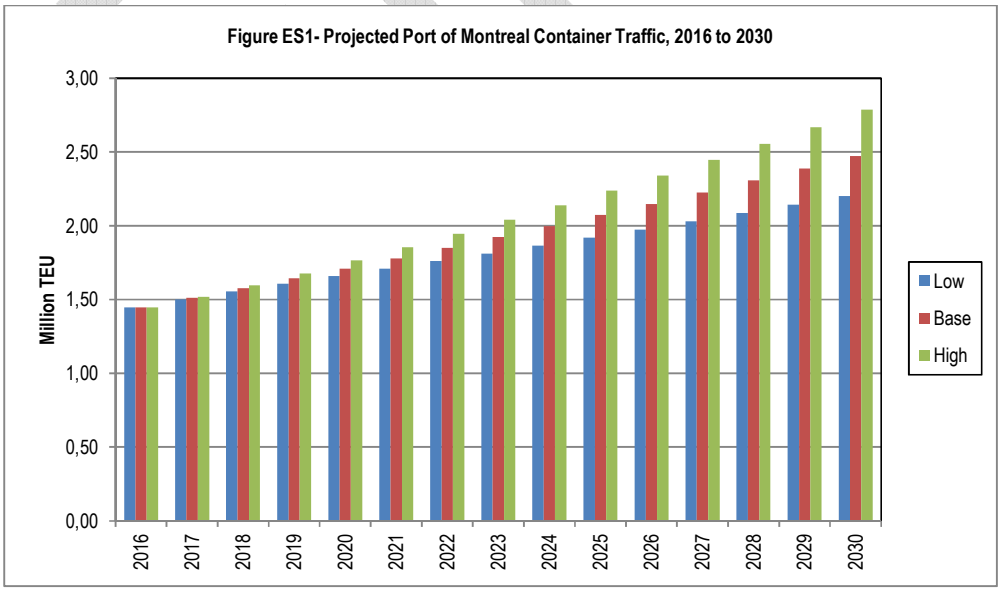
1. EXECUTIVE SUMMARY

The Montreal Port Authority (MPA) wishes to obtain independent container traffic forecasts to the year 2030, as part of its continuing assessment of future demand to support future planning and investment decisions.

The following synopsis outlines Montreal's competitive position:

- North America has a number of well-established gateway ports on all coasts. As well as serving local hinterlands, many ports compete to meet discretionary hinterlands, such as the US Midwest.
- Any port able to serve the US Midwest will be a competitive option to Montreal. However, the port remains very competitive and largely unrivalled for its own localised regions.
- Melford Bay and Sydney International Terminal continue to maintain plans to bring their projects to fruition. However, this developments have been under consideration for a long time already without actually being able to confirm specific construction and operating dates.
- Recent investment at many ports on the East Coast of North America has been concentrated on deepening water to allow larger ships to call. Major terminal capacity development has been relatively limited. New York/New Jersey and Savannah need to increase container capacity.
- Ship 'cascading' will continue for deep sea trades impacting the East Coast of North America. Bigger ships passing through the Panama Canal is already underway and the trend for larger ships sailing from Asia via the Suez Canal will continue as cargo potential at Mid-East and Mediterranean hubs grows.
- The demise of Hanjin Shipping will have some minor impact on the make-up of shipping alliances, but will not slow the process of new major alliance partnerships forming by 2017. Montreal it is largely immune to these changing strategies because there are no other competing local ports on the same schedules. This unique position is unlikely to change due to the ongoing alliance reorganisation and Montreal will remain on shipping line schedules as a dedicated trade lane.

A summary of the total container volumes for Montreal under each growth scenario to 2030 is shown in more detail in Figure ES1.



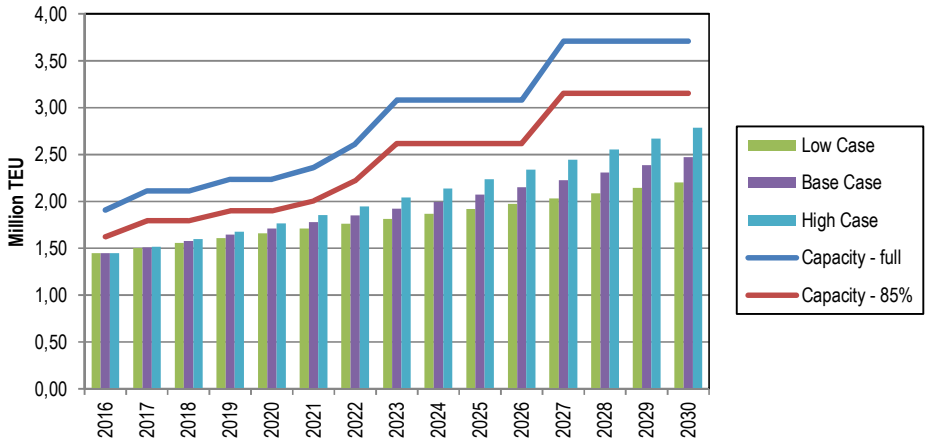
The following summary relates to the Port of Montreal forecasts to 2030:

- Base Case volume growth to 2030 of almost 4% per annum is expected – this increasing demand reflects the port's strong position in serving Quebec/Ontario and noted potential for attracting more US Midwest traffic. A balanced mix of inbound/outbound activity is expected to continue.
- The Low Case/High Case annual growth range is between 3.1 per cent and 4.8 per cent.
- The Base Case growth option will necessitate the introduction of additional capacity at the port in the early years of the next decade in order to allow optimum operational efficiency to be maintained.
- Increasing container volumes over the forecast period means that by 2030, the Base Case option will see rising demand reach an estimated 2.47 million TEU, with the Low Case/High Case range being 2.20-2.79 million TEU, respectively.

These projections are shown in Figure ES2 which takes the Low Case, Base Case and High Case demand projections for the port and compares each to two different capacity scenarios for the period to 2030:

1. Where 100 per cent of capacity is available.
2. Where 85 per cent of capacity is used (on the basis that after 85 per cent terminals become congested and the operation is then working at less than optimal efficiency).

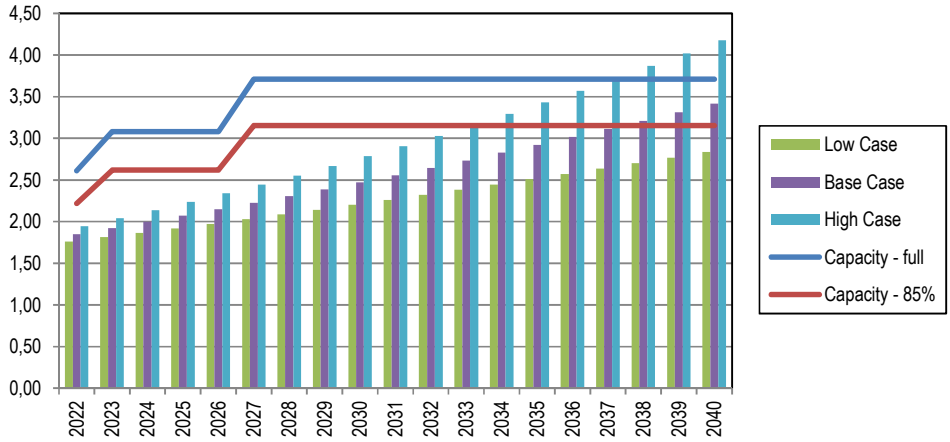
Figure ES2: Projected Container Supply-Demand Balance for Montreal, 2016-2030



The need for additional capacity, while ensuring the optimum level of operating efficiency is maintained, is clearly evident moving forward over the longer term, even allowing for the subsequent development of Contrecoeur.

Looking further ahead, Figure ES3 notes that without further capacity additions, Montreal will be enduring substantial congestion well before 2040, even under the Low Case growth option. Consequently, additional container capacity will need to be in place by this time.

Figure ES3: Projected Container Supply-Demand Balance for Montreal, 2022-2040



A summary Strengths, Weaknesses, Opportunities and Threats analysis is outlined in Table ES1.

Table ES1

Summary Strengths, Weaknesses, Opportunities & Threats Analysis for Port of Montreal

Strengths	Weaknesses	Opportunities	Threats
Established port, close to hinterland demand	US Midwest traffic has been reliant upon limited number of key shipping lines	Developing more terminal capacity - short-term at VIAU, longer-term at Contrecoeur	Need to balance volumes at terminals - longer-term MGT will be congested, Termont will have capacity
Key shipping lines are aggressively building localised hinterland volumes	Up-river location represents longer sailing time for shipping	Development of logistics parks/distribution warehousing to support demand	Montreal needs to maintain good links with key hub ports - i.e. Freeport (Bah), Mediterranean ports
Good growth continuing in key areas, including Asia	Cannot handle largest ships calling to East Coast North America	CETA will help support potential upside	Ability of main US East Coast ports to serve US Midwest region
Port volumes are widespread across various international areas - no longer too reliant upon North Europe		Future demand growth anticipated for Asia, Mid East and Latin America	Based on 85% capacity for optimum performance, it is essential that additional capacity is developed in the early years of the next decade
Montreal is a very well-balanced port between inbound/outbound demand		Vessel upsizing expected - Montreal well-placed to satisfy bigger units	Not all shipping lines pursue US Midwest cargo via Montreal
Montreal benefits from very high ship utilisation per call -a unique full discharge/full load port		Provincial government maritime strategy supportive of port competitiveness and growth	
Changing liner alliance membership will have minimal impact on Montreal – it remains a specialist, niche port with full discharge/load per call.		Introduction of Contrecoeur 2020-2025 will not contribute to coast-wide over-capacity	

Source: Ocean Shipping Consultants

2. INTRODUCTION & METHODOLOGY

2.1 Introduction

The Montreal Port Authority (MPA) wishes to obtain independent container traffic forecasts to the year 2030, as part of its continuing assessment of future demand to support future planning and investment decisions.

The following outlines key components of the proposed Scope of Work and builds on OSC's previous Navigational Study work for MPA in 2013/2014, plus high-level container forecasts provided in 2014:

- **Proposed Methodology** – the forecasts take into account growth scenarios for both hinterland and overseas markets. OSC has examined key international growth regions for Montreal to complement hinterland region volumes within Canada and the US.

  It is important to note that trade lane specific forecasts (such as Transpacific) are not provided because Montreal does not directly serve all of the routings in the same way as other ports – it has a strong reliance upon transshipment in key locations (i.e. Mediterranean), so the origin/destination of container cargo is the primary area of interest.

- **Data** - MPA has provided supporting data on overseas markets serviced for the 2012-2015 period, together with relevant information with respect to strategic investment decisions relating to its terminal development programmes.

- **Assumptions** - The forecasts clearly define assumptions behind low, base and high case growth scenarios. Both macro-economic (markets) and operational (trade route/services level) contexts to be considered. Macro-economic outlook should focus on the first five-year period, 2017-2022.

- **Other Developments** - In addition, there are other pertinent factors of note, including the following, each of which will be considered on a qualitative and/or quantitative basis:

  - The potential impact on Canadian tariffs of CETA.
  - Overall trade impacts that the UK "Brexit" decision might evoke for trade with Canada.
  - Development of logistics parks and distribution warehousing close to or at Montreal's container terminals, including Contrecoeur, to support the supply-chain networks of Beneficial Cargo Owners (BCOs) and 3PL service providers.
  - Liner shipping developments – i.e. MSC launching a new Mediterranean service in Q2 2015 and Hapag Lloyd upsizing the sizes of ships deployed.

The growth in containerised world trade, and expansion of the Panama Canal in mid-2016 are part of the global ship size revolution that continues to see ocean carriers expand their fleets with ever larger vessels. The impact on ports is that they must ensure that terminals are ready and able to accommodate this trend.

Ports that are not able to handle the increased volumes and larger ships arriving are likely to lose shipping services to those facilities that are better equipped and more capable. This can deprive regions of the benefits of low cost access to world trade and also negatively impact the cargo volumes handled at certain ports. The ability to secure traffic by indirect methods, as Montreal continues to do with transhipment in the Mediterranean or feeder services to the Caribbean are good examples of diversification to meet trade dynamics.

Montreal is in a unique geographic and competitive position. While it is located some distance along the St Lawrence River, the port's terminals are much closer to key local hinterland regions, while also being competitive for discretionary regions in the US Midwest. At the same time, shipping lines calling to the port undertake a full

discharge/load of all containers for the vessel, a highly unusual process in modern container shipping, but one that helps necessitate the port call.

In terms of the existing key container ports regarded as being competitors to Montreal for container traffic, these are shown in Figure 1.1, although for serving the US Midwest region then facilities on the western seaboard, such as Los Angeles, Long Beach, Seattle-Tacoma, Vancouver and Prince Rupert are also potential competitors.

If constructed, there could be some competitive threat posed by the "mega-hub" facilities proposed for the North Atlantic area, such as Melford Bay and Sydney International Terminal, which are apparently keen to develop a transhipment hub concept on the East Coast of Canada. These facilities are included in the assessment in Section 3.



Figure 1: Port of Montreal Location and Current Competing East Coast Regional Ports

2.2 Methodology

The approach taken in this Study is to relate the development of GDP directly to container port demand in the import/export market, and to use this as a basic driver of demand growth. This allows factors such as increased penetration of the container system into new commodity groups and the imbalance of container port demand (i.e. the requirement to handle empty containers) to be adequately captured. In summary, the approach is as follows:

- ***Step 1*** – the relationship between regional GDP and the port range hinterland's GDP is identified. The degree to which this co-efficient has changed over time is defined is detailed, with this generally reflecting a declining intensity. As economic development is noted, the trend is that trade as a percentage of the economy begins to stabilise to a mature level. This process is anticipated to continue over the forecast period.

- ***Step 2*** – the development of demand in each of the markets that is served by Montreal is defined. These comprise the immediate markets of Quebec and the Maritimes and eastern Ontario. The balance of Ontario and transit volumes to the US Midwest and the north-eastern parts of the US. These are projected on the basis of economic development in each market, with three cases developed.

- ***Step 3*** – the market shares of Montreal in each of these markets is considered. These are based upon comparative transport costs and other key qualitative factors, such as infrastructure investment and developments at Montreal terminals. At the same time, the international markets that the port serves are also noted, including, for example, the ongoing shift in share of international traffic from the established region of North Europe to the emerging area of Asia. This data and analysis provides the key driving force for demand development.

- ***Step 4*** – generates a review of total container demand for the port by aggregating the volumes from each component market. Qualitative factors, such as CETA, "Brexit," BCO/3PL feedback and liner strategies are also considered. These projections are developed on the basis of total unconstrained demand for Montreal's terminals, with the shares of import-export, empties and truck/rail components all derived from the total projected container traffic available.

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3. MACRO-ECONOMIC DEVELOPMENT & TRENDS

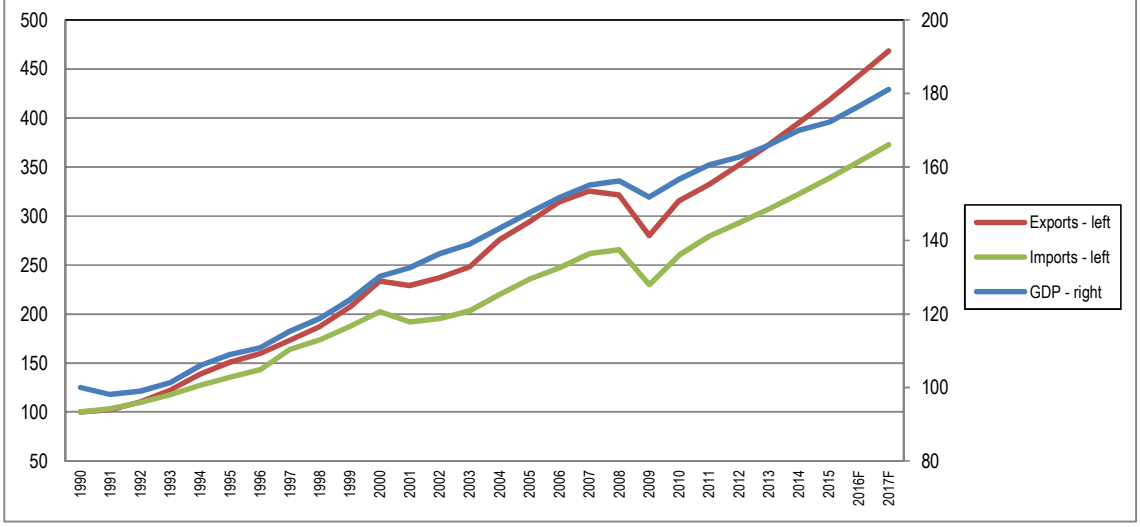
3.1 Introduction to Macro-Economic Development

Container trade volumes (and port demand) are directly related to the overall volumes of traded goods, especially in the manufactured sector. This is particularly the case for cargoes imported into North America and directly to Canadian customers and consumers. In the North American economies of Canada and the US there is a close relation between the year-on-year development of GDP and the annual development of trade volumes.

For Canadian container ports, the close relationship between GDP and trade volumes in the Canadian economy is underlined in Figure 2. The long-term development of trade is seen to be highly susceptible to macro-economic uncertainties. This was noted to some extent in 2000-2001 and in a far more reaching manner in the 2007-2009 Global Financial Crisis directly. The speed of recovery from such downturns is also apparent and can be noted in the general upturn from 2010 onwards, with 2012 levels surpassing the pre-recessionary position, reflected by container volume and trends over the same period of time.

Based on OECD forecast data and historic development to date, a continuation of recent trends is anticipated, providing ongoing growth of both imports and exports during 2016 and into 2017. Indeed, between 1990 and 2015, OECD trade data confirms Canadian trade exports rose by an average of 5.9% per annum, with imports increasing over the same period by 5.0% per annum. This level of growth is expected to continue short term.

Figure 2 - Canada GDP and Trade Development since 1990
(indexed development 1990=100)



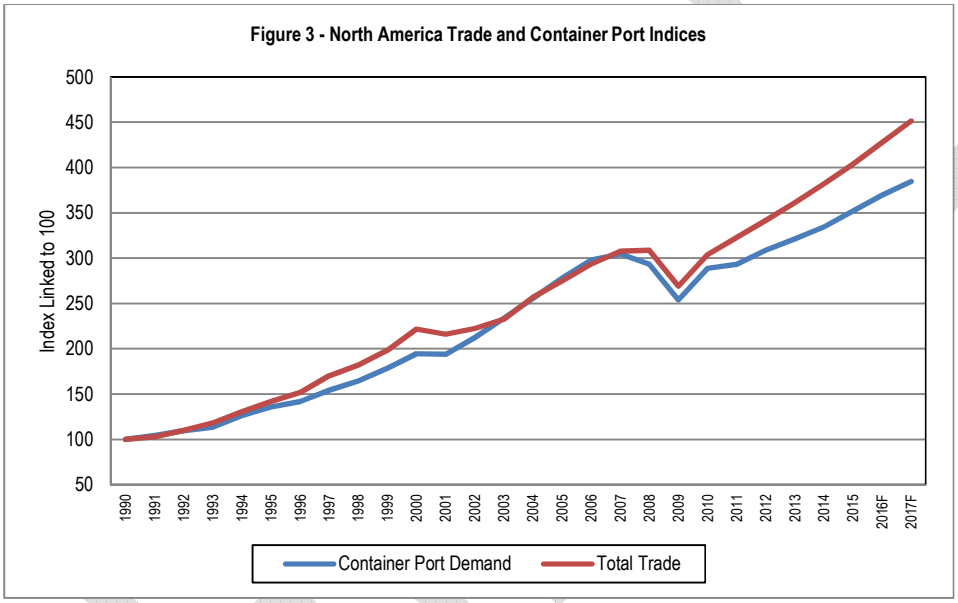
The relationship between the expansion of the North America economies and the level of trade is fundamental to the analysis of recent developments and future prospects. There are, obviously, limits to the ultimate expansion of container trade volumes, but it is unlikely that demand saturation will affect the North American markets over the timeframe of this study.

A close relationship exists between the development of GDP, total trade volumes and container port demand. In most regions and throughout the period under review, the variables have moved broadly in tandem and, indeed, the link was seen to be sustained during the recent contraction and subsequent recovery.

Given the timescale of the current analysis, it is also necessary to remark upon the penetration of containerisation into general cargo trade. Although by the late 1970s the role of containers was already firmly established on the major long-haul trades (Transatlantic and Transpacific), the overall penetration of containerisation remained limited on other secondary trades. At the outset of the study period, container trade volumes were being further boosted by the conversion of conventional liner trade to containers. This resulted in an additional layer of demand growth over and above that indicated by the progress of total trade. There is some limited scope for further conversion for import cargoes, but a further shift of some commodities (such as grains, forest products etc.) into empty units will help with export demand.

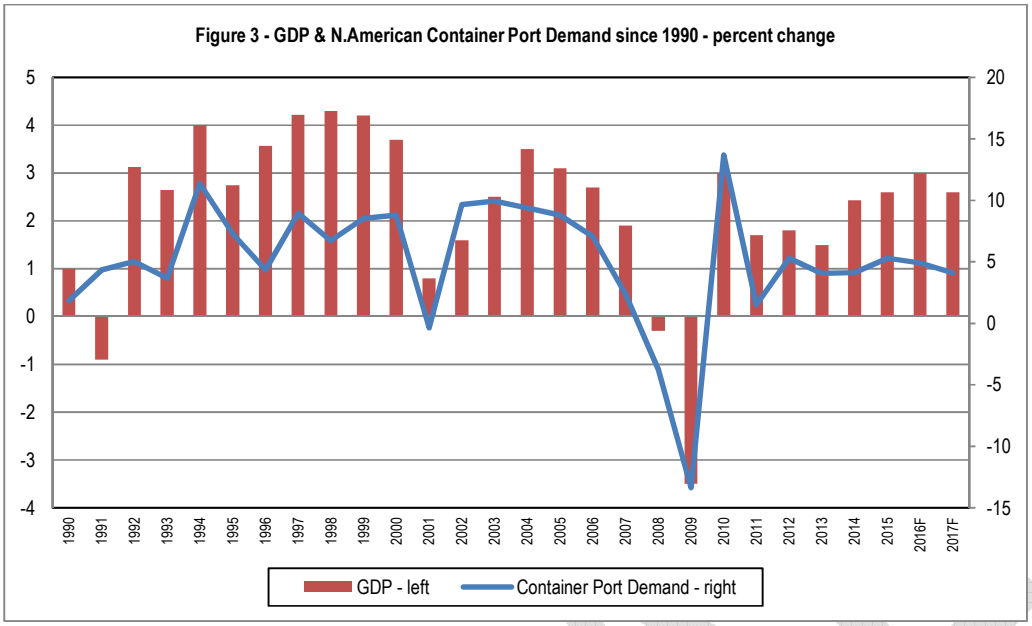
The indexed development of North American trade volumes and container port demand since 1990 is detailed in Figure 3. There is seen to have been a very close relationship between these two variables over the period and this has remained highly robust even during periods of economic downturn, such as 2008-2009. Moving forward, over the short-term, at least, the trend is expected to continue.

Figure 3 - North America Trade and Container Port Indices



In addition to direct, trade-related factors, container port demand has traditionally been boosted by the continuing containerisation of general cargoes in developing markets and of backhaul cargoes in developed markets (including Canada), as well as by transshipment demand (although transshipment is of marginal importance in North American markets). These factors help to explain why the relationship between output growth and container port demand is not clear-cut.

However, as Figure 4 indicates, the correlation has been evident historically and is expected to continue moving forward. The same notable trends, such as the Global Financial Crisis and subsequent rebound are evident and the short-term indications for 2016 and 2017 expect the trend to continue.



For the purposes of the medium term development of forecasts, the direct relationship between GDP and container port volumes is of central importance. Throughout the period the connection between economic expansion and the level of containerised imports and exports is firmly grounded, although it is apparent that there has been some decline in the intensity of this relation for the reasons detailed.

The ratio between North American container port demand and GDP development on an annual basis for the period since 1985 has been calculated. These relationships are of central importance in understanding the development of the overall port market and it is necessary to identify trends for the period. These may be summarised as follows:

- 1985-1990 1 : 1.98
- 1990-1995 1 : 2.73
- 1995-2000 1 : 1.96
- 2000-2005 1 : 3.04
- 2005-2015 1 : 3.52
- 2005-2015 1 : 2.88 (if the impact of the Global Financial Crisis is excluded)

The trend had been one of decreasing intensity in the earlier years of the assessment period, although recent events have impacted this position. The period between 2000 and 2005 recorded a very intense relation on account of strong economic expansion and the acceleration of the 'China Effect' with very strong demand growth. More recently the Global Financial Crisis of 2008-2009 negatively impacted GDP growth.

The economic relationship between GDP growth and trade growth is very useful in forecasting the development of the containerised sector. However, this underlying relationship is not a sufficient explanation of the growth in container port demand. There are numerous other factors at work, and the limitations of economic data (which are often revised) and container handling statistics further complicate the picture.

Therefore, some other factors affecting the development of container port demand, and issues relating to the measurement and comparison of output growth and container port demand growth include:

- In addition to imports and exports, container throughput also includes empty containers, which do not represent cargo actually being traded. The proportion of empty containers within a port's throughput can vary significantly.

- Transhipment trebles the number of port moves per container (and hence the TEU count), but again it does not represent additional cargo. This is not a major aspect of regional North American demand, however and so of minimal interest to Montreal and competing (existing) regional ports.

- The increasing penetration of containerisation is a significant factor in some global markets, although less so in developed markets, where the containerisation of general cargoes is more or less at saturation level. However, an imbalance of loaded inbound and outbound containers (notably, between North America and Asia) means that shippers continually search for more cargo to containerise on return legs of voyages. This has led to the increasing use of containers in cargo sectors that were not historically regarded as suitable for containerisation – for example iron and steel scrap and waste paper. There are also 'neo-bulks' such as forest products that are increasingly containerised. This continues to be an important driver for some ports, especially on the West Coast of North America and biomass-based bulk commodities represent an important driver of demand moving forward too.

- Containerisation itself generates trade, by making it easy to transport goods cheaply over considerable distances.

- Container throughput is quantified in volume terms and output is measured in value terms, so the two measures are not directly comparable. In recent years, the volume of containerised cargo has increased more rapidly than its real value, due to factors such as the fall in price of electronic goods.

- There are also significant economic relationships which modify the underlying link between economic growth and trade growth. These include fluctuations in the relative propensities to consume or save, to import or purchase domestically, to export or sell domestically, all mediated by relative movements in prices, incomes, exchange rates, tastes, confidence and other factors.

- In addition to the limitations of available economic data, there are lags in the economy between causes and their effects, so that it is not always clear which periods should be compared when different aspects of economic development (such as output and trade) are contrasted.

- OSC generally uses the container handling statistics published by ports themselves. Whilst every effort is made to employ comparable statistics, on inspection it is found that the methods of calculation can differ between ports and distort the data. Furthermore, ports may not distinguish clearly between different elements of throughput. Not all ports record transhipment (and few distinguish between hub-and-spoke and relay).

Despite the numerous factors – which need to be built into, or allowed for in the interpretation of, forecasts – the generation of trade through economic growth provides the most rational foundation for predicting the future direction and scale of import/export container handling demand.

For the purposes of the short and medium term development of forecasts for the Port of Montreal, the direct relationship between GDP and container port volumes remains of central importance. Throughout the assessment period the connection between economic expansion and the level of containerised imports and exports is firmly grounded.

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3.2 Development of GDP

Given the noted strong link between GDP and container demand outlined in Section 2.1, the starting point for the container demand projections must be a summary of the development trends for the economies under review. These projections have been fully updated and are based upon the position in Q3 2016, using available information, with specific sources noted.

In terms of national GDP outlooks, the position for Canada is summarised in Table 1. The outlook is for sustained economic development over 2016, with the average growth of 2.5% per annum an improvement on the weaker position noted in 2015 of 1.3%. Moving forward, each of the regular sources of this data are expecting to see average annual growth of just over 2% maintained until 2020, after which the 2% average is maintained (though will be updated nearer the time).

Of course, this is a national figure covers a wide range of regional developments and these are further considered below.

Table 1
Canada - GDP Forecasts
Real % change

Year	BMO Prov. Econ. Outlook	Scotia Global Forecast	TD Prov. Econ. Update	RBC Prov. Outlook	CIBC Prov. Forecast	IMF	Average
2014	2.4%	2.2%	2.3%	2.5%	2.4%	2.4%	**2.4%**
2015	1.2%	1.1%	1.2%	1.2%	1.8%	1.0%	**1.3%**
2016	2.1%	1.8%	2.0%	2.5%	4.9%	1.7%	**2.5%**
2017		2.3%	1.9%			2.4%	**2.2%**
2018						2.3%	**2.3%**
2019						2.1%	**2.1%**
2020						2.0%	**2.0%**
2021-2030							**2.0%**

Source: Collated by Ocean Shipping Consultants from published bank data

The situation for the US is detailed in Table 2. The US economy gathered pace in 2014 and 2015, with annual growth of 2.5% and 2.6%, respectively, and this is expected to continue for the period through to 2018, with a further expansion of 3.0% (2016), 2.6% (2017) and 2.7% (2018).

However, by 2020 the IMF is projecting that the US economy will be seeing the same level of growth as Canada, with 2.0% projected from 2020 onwards. This means that a (somewhat small) slowing of the current economic development is anticipated for the US in due course.

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Table 2
USA - GDP Forecasts
Real % change

Year	BMO Prov. Econ. Outlook	Scotia Global Forecast	TD Prov. Econ. Update	RBC Prov. Outlook	CIBC Prov. Forecast	IMF	Average
2014	2.4%	1.9%	2.7%	3.0%	2.4%	2.4%	**2.5%**
2015	2.5%	2.4%	2.5%	2.2%	3.7%	2.6%	**2.6%**
2016	2.6%	2.5%	2.6%	2.9%	4.4%	2.8%	**3.0%**
2017	2.3%	2.7%	2.4%			2.8%	**2.6%**
2018						2.7%	**2.7%**
2019						2.2%	**2.2%**
2020						2.0%	**2.0%**
2021-2030							**2.0%**

Source: Collated by Ocean Shipping Consultants from published bank data

With respect to regional economic outlooks, Montreal is a gateway for a combination of local Canadian hinterlands (and the key US Midwest region).

As a result, it is also worthwhile to consider the anticipated economic growth, albeit at a somewhat higher level. Hence, province-specific GDP forecasts are prepared by several financial institutions and the results of the most recent estimations are summarised in Table 3.

For completeness all major Canadian provinces are shown in order to compare the short-term growth projections for Montreal's key hinterlands with other parts of the country.

It is necessary to consider how the regional economy will expand over the forecast period. Indeed, this will be one of the primary determinants of container port demand in the Montreal markets.

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Table 3
Canada: Short Term GDP Forecasts by Province

Real % change

		2013	2014	2015	2016 F	2017 F
BMO						
	British Columbia	1.9%	3.2%	2.6%	2.5%	2.4%
	Alberta	3.8%	4.8%	-2.8%	-2.5%	2.1%
	Saskatchewan	5.0%	1.9%	-0.5%	0.0%	1.8%
	Manitoba	2.2%	2.3%	2.2%	1.8%	2.1%
	Western Canada (calculated)	3.1%	3.7%	-0.2%	0.0%	2.2%
	Ontario	1.3%	2.7%	2.5%	2.2%	2.3%
	Quebec	1.0%	1.5%	1.6%	1.7%	1.8%
	Canada	2.0%	2.5%	1.2%	1.2%	2.1%
RBC						
	British Columbia	1.9%	3.2%	2.9%	3.1%	2.9%
	Alberta	3.8%	4.8%	-1.3%	0.9%	2.7%
	Saskatchewan	5.0%	1.9%	-0.6%	2.5%	1.8%
	Manitoba	2.2%	2.3%	1.8%	2.4%	2.6%
	Western Canada (calculated)	3.1%	3.7%	0.6%	2.0%	2.7%
	Ontario	1.3%	2.7%	2.6%	2.8%	2.5%
	Quebec	1.0%	1.5%	1.3%	1.9%	1.7%
	Canada	2.0%	2.5%	1.2%	2.2%	2.7%
TD						
	British Columbia	1.9%	3.2%	2.5%	2.4%	2.1%
	Alberta	3.8%	4.8%	-1.4%	1.2%	1.6%
	Saskatchewan	5.0%	1.9%	-0.8%	1.7%	1.9%
	Manitoba	2.2%	2.3%	2.3%	2.2%	2.1%
	Western Canada (calculated)	3.1%	3.7%	0.4%	1.8%	1.9%
	Ontario	1.3%	2.7%	2.6%	2.3%	2.2%
	Quebec	1.0%	1.5%	1.7%	2.1%	2.0%
	Canada	2.0%	2.5%	1.2%	2.0%	1.9%
ScotiaBank						
	British Columbia	1.9%	3.2%	2.3%	2.3%	2.4%
	Alberta	3.8%	4.8%	-1.6%	-0.2%	2.2%
	Saskatchewan	5.0%	1.9%	-0.2%	1.0%	2.2%
	Manitoba	2.2%	2.3%	2.2%	2.2%	2.3%
	Western Canada (calculated)	3.1%	3.7%	0.3%	1.0%	2.3%
	Ontario	1.3%	2.7%	2.2%	2.3%	2.4%
	Quebec	1.0%	1.5%	1.6%	1.9%	2.0%
	Canada	2.0%	2.5%	1.2%	1.6%	2.3%

Source: Banks, collated by OSC

There is now renewed confidence in the outlook for the world economy, but the position remains fragile, with structural weaknesses with regard to trade and government deficits. Given these uncertainties, it is unclear at what rate the world economy will continue to recover and whether the current recovery is sustainable.

Therefore, three macroeconomic growth forecasts have been developed to cope with the range of possible outcomes. The interdependencies within the world economy and international trade mean that it is necessary to consider the global and regional economic scenarios that are likely to underpin economic growth, trade and hence port demand both within the region and in the broader relay context. Three cases have been developed:

- ***The Base Case*** – this represents a consensus view of the position through to 2016, with a continued recovery towards trend growth. From the current perspective, this remains the likely outcome.
- ***The High Case*** – this assumes a more rapid upturn, with some more positive developments in 2016 and then a return to a somewhat higher rate of economic expansion.
- ***The Low Case*** – anticipates some further uncertainties at the macro-economic level in 2016 and 2017, with the chance of some chance of renewed stagnation. Beyond 2016 a more restrained pace of subsequent expansion as the cost of the downturn is worked through the economy.

Developments at this macro-economic level are critical in determining the position for the regional economies. Significant risks for the world economy remain and play directly through into the region.

Table 4
Core Macro-Economic Forecasts to 2030
Real % change

	2016	2017	2018	2019	2020	2021-2030
High Case						
Quebec/Ontario	2.63%	2.43%	2.42%	2.30%	2.30%	2.30%
Canada	2.87%	2.53%	2.68%	2.46%	2.31%	2.30%
USA	3.42%	2.93%	3.08%	2.55%	2.30%	2.30%
Base Case						
Quebec/Ontario	2.29%	2.11%	2.10%	2.00%	2.00%	2.00%
Canada	2.49%	2.20%	2.33%	2.14%	2.01%	2.00%
USA	2.97%	2.55%	2.68%	2.22%	2.00%	2.00%
Low Case						
Quebec/Ontario	1.94%	1.80%	1.79%	1.70%	1.70%	1.70%
Canada	2.12%	1.76%	1.86%	1.71%	1.61%	1.60%
USA	2.53%	2.04%	2.14%	1.78%	1.60%	1.60%

Source: Various, incl. Ocean Shipping Consultants

The core macro-economic GDP forecasts shown in Table 4 are used in the projections of container demand to 2030 under the Base Case, High Case and Low Case scenarios.

The North American forecasts utilise Canadian/USA GDP growth rates, with Quebec/Ontario GDP growth used for local Montreal market projections, with the following essential conditions subsequently applied:

Base Case:

- Economic fall-out of the Global Financial Crisis has finally settled and the scope for economic uncertainty over 2016 and 2017 is limited;
- Credit availability continues to improve through 2016 and 2017;

- Return to long-term growth of US economy, accompanied by free-trade policies and no negative impact to trade from 2016 US presidential elections, including no significant change to NAFTA;
- Euro Zone pressures continue to restrain growth, but uncertainties are contained;
- Economic growth and positive timing of CETA (EU trade deal);
- More flexible economic management within Euro Zone;
- Economic and currency stability in East Asia and key emerging areas, such as India;
- Renewed attempts to deregulate and restructure key Asian economies linked to Montreal through cargo origin/destination;
- Political stability, economic expansion and continuing structural reforms in China;
- Oil price stable at relatively high levels;
- Stable trade framework and continued foreign direct investment in emerging and developing economies.

High Case:

- Economic fall-out now contained and more rapid expansion from 2016 and 2017;
- Credit availability improves sharply during 2016 and 2017 and approaches pre-crisis levels;
- Earlier return to long-term growth of US economy, stimulating earlier expansion in trade and eased credit conditions, positive impact from 2016 US presidential elections, no change to NAFTA;
- Economic growth and quicker timing of CETA (EU trade deal);
- Euro Zone pressures are successfully managed;
- Key Asian economies providing cargo connected to Montreal recovers more strongly than in the Base Case;
- Return to economic and currency stability in East Asia and key emerging areas like India, but at an accelerated rate;
- Political stability, economic expansion and accelerated structural reforms in China;
- Oil price stable at relatively high levels;
- Stable trade framework and continued foreign direct investment in emerging and developing economies.

Low Case:

- Renewed uncertainty and periods of short term contraction in established economies;
- More uncertainty in the US, negative trade and protectionist impact from 2016 US presidential elections leading directly to slower world growth and weaker NAFTA trade;
- Slower growth in the EU economies – especially in the south;
- Renewed inflexibility of economic management and irreconcilable policy objectives within Euro Zone;
- Further delay in anticipated introduction of CETA (EU trade deal);
- More prolonged stagnation of other key Asian economies linked to Montreal cargo, with inadequate structural adjustment;
- Economic uncertainty in China and lower growth;
- Uncertain and volatile development of oil prices;
- More uncertain trade and foreign investment climate in emerging and developing economies, like India.

It remains unclear which development will actually occur, but this process captures the range of possibilities that can be reasonably anticipated. Under the Base Case the current recovery accelerates in both the US and Canada and continues over the forecast period. The development of these underlying economic factors will be the primary determinant of demand development for import volumes.

The High and the Low Cases represent a range of possible developments around the Base Case which, with changes in the assumed container port demand multiplier, will determine the overall development of demand at the continental and regional level.

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4. COMPETITIVE TERMINAL TRENDS & LINER DEVELOPMENTS

4.1 Terminal Trends

Introduction & Montreal Competitive Region

Ports fall into different categories as far as their natural market is concerned. In particular, the location and cargo-handling facilities of each port dictate which type of traffic it can compete for, and therefore defines its role in the market.

Gateway ports handling origin/destination cargo must also have sufficient water depth and equipment for the largest ships in service or to be introduced into the geographic region, although as compared to hub ports it is the proximity to centres of population and industry that is most significant. Of course, this overview is very generic and each different region will have to contend with slight nuances and specific issues pertinent to the area itself, but in overall terms the outline is fundamentally correct and applicable.

Moreover, it is important to distinguish between those factors within the control of a port or terminal operator and those over which there is no influence, as the following general points note:

- Control – number of cranes, berthing space, ship placement at the quay, type and amount of yard equipment used, operating performance, water depth alongside terminal, training of staff, application of IT used.
- No control – geographic location of terminal, time of vessel arrival, cargo stowage on the ship, workforce unionisation/rules.

There are a number of different key gateway import-export ports and regions in North America, as Figure 5 shows, with the following representing the main areas of port activity for container traffic:

- Southern California ports of Long Beach and Los Angeles.
- Port of Vancouver and the Pacific Northwest region (including Prince Rupert, to the north, which collectively comprises the Pacific Gateway area).
- The North East of North America, with ports in Canada and the US, including Montreal and New York/New Jersey.
- The US Southeast region, ostensibly Charleston and Savannah.
- Some volumes via the US Gulf, mainly Houston.

An indication of the size of the gateway volume activity is shown.

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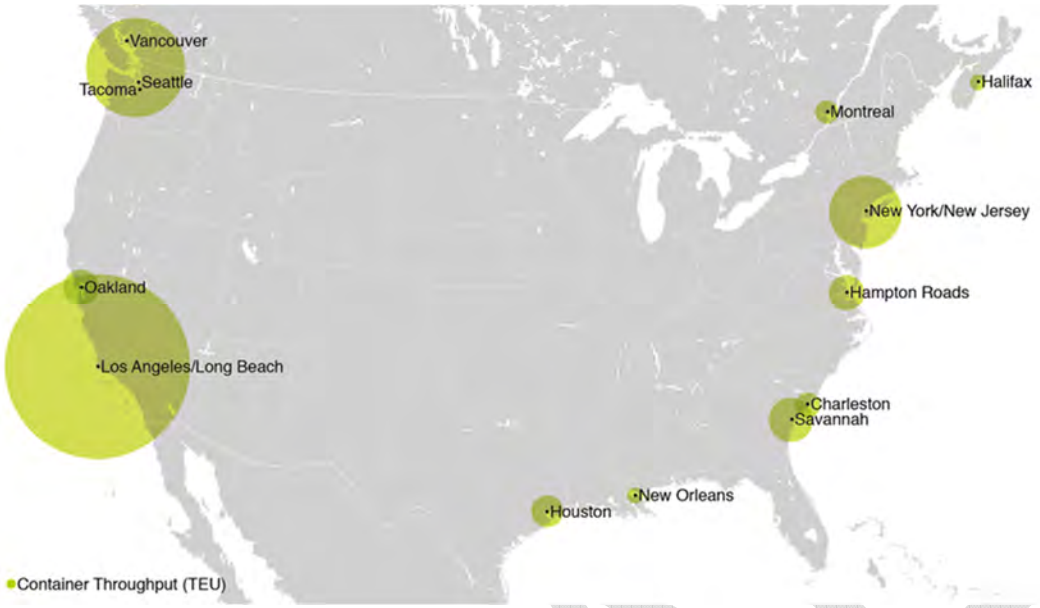


Figure 5: Key Container Gateways in North America, 2016

In terms of more localised competition to Montreal on the East Coast of North America, these are shown in Figure 6 and comprise:

- New York/New Jersey, Virginia (Norfolk) and Baltimore – large ports with geographic access that potentially allows them to compete for US Midwest markets and US North East areas. Very good intermodal rail access and deep water at each port intensifies the level of competition beyond the immediate hinterland of each port.
- Halifax – in view of potential to serve a number of key local/Canadian markets, such as Montreal, Toronto, New England in the US and the US Midwest.
- Boston and Philadelphia – smaller, peripheral container facilities but geographic location means that access is possible to serve US North East regions. They also have significant immediate hinterlands.
- Charleston and Savannah – located much further away but a degree of potential overlap because of the ability, and desire, to serve US Midwest markets. Savannah, in particular, continues to expand its total container volumes strongly (and is known to be actively marketing to attract more US Midwest cargo through intermodal rail services). Any ports located further south do not have overlapping markets in the US being targeted.
- The proposed facilities at Melford Bay and Sydney should continue to be monitored. To date, neither project has commenced construction but the development companies involved with each plan remain determined, even without tangible and confirmed interest from any shipping lines in signing contracts to guarantee annual volume commitments. Nevertheless, it is prudent to continue to track the progress of both examples.

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Figure 6: Summary of Competitive Port Region for Montreal

Competitive Port Analysis for Montreal – Current Position

Before assessing the future confirmed changes to the competitive position on the East Coast of North America, it is important to put the current situation into context.

Table 5 provides a summary overview of the infrastructure for each of the main container terminals at the major port facilities, including Montreal. The development of the new VIAU terminal at Montreal certainly increases the overall competitiveness of the port, especially in terms of amount of quay available to berth ships, albeit that Montreal and Philadelphia remain the only ports on the eastern seaboard currently not utilising any Super Post Panamax cranes and Virginia has the highest number in total.

Aside from the VIAU development, there has been very little additional container capacity added at ports and terminals on the eastern seaboard of North America in the past few years, with more investment and effort generally taking place with respect to supporting infrastructure, like the Bayonne Bridge and ExpressRail at New York/New Jersey, and dredging/water depths on the seaboard to accommodate larger ships entering service.

The current (2016) position with respect to water depths in access channels and at berths for key East Coast North America ports is outlined in Table 6.

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Table 5
Comparison of Berth & Crane Facilities at ECNA Container Ports - mid 2016

Port	Terminal	Operator	Berth Length (m)	Total Cranes Per Port	Number of Cranes		
					Panamax	Post Panamax	Super Post Panamax
Montreal	Bickerdike	Empire Stevedoring	357		2		
	Racine	MGT	2381		5		
	Maisonneuve	Termont	827	17	1	3	
	VIAU	Termont	550			2	
	Cast	MGT	740		4		
Halifax	Fairview Cove	Ceres Corp	700	12	2		3
	Halterm	Halterm	1045		3		4
Boston	Conley Contr. Term.	Massport	1850	6		6	
NY/NJ	APM Terminals	APM Terminals	1829			11	4
	Maher Terminals	Maher Terminals	2204		12	11	
	Global Terminal	Global Terminal	549	64	2	6	
	NYCT	NYCT	918		3	6	
	PNCT	Ports America	1481			9	
Baltimore	Seagirt	Ports America	953			7	4
	Dundalk Contr. Term.	Ports America	1736	24	9		
	North Locust Point	Ceres Global	366		1		
	South Locust Point	Maryland Port Admin.	974		3		
Philadelphia	Packer Ave Marine Term.	Greenwich Terminals LLC	1158	7	2	3	
	Tioga Marine	Delaware River Stevedores	1164		2		
Virginia	Virginia Int'l Gateway	Virginia International Term.	1230	22			8
	Norfolk International Term.	Virginia International Term.	1290				14
Wilmington	Port of Wilmington (NC)	NCSPA	2062	9	5	4	
Charleston	Colombus Street	SCSPA	1181		1	2	
	Wando Welch Term.	SCSPA	1159	21			12
	North Charleston	SCSPA	762			6	
Savannah	Garden City	Georgia Ports Authority	2955	23		11	12

Note: Ports in Florida excluded as no competitive overlap in hinterlands served.

Source: Ocean Shipping Consultants

Table 6
Current Water Depths at ECNA Container Ports - Mid 2016

Port	Terminal	Operator	Water Depth Range (m)		
			At Berth	Access Channels	Tidal Range
Montreal	Bickerdike	Empire Stevedoring	8.8		
	Racine	MGT	11.0		
	Maisonneuve	Termont	10.7	11.3	N/A
	VIAU	Termont	10.7		
	Cast	MGT	11.0		
Halifax	Fairview Cove	Ceres Corp	16.8	18.1-21.3	1.37-1.98
	Halterm	Halterm	11.9-16.2		
Boston	Conley Contr. Term.	Massport	13.7	18.2	2.73
NY/NJ	APM Terminals	APM Terminals	13.7-15.2		
	Maher Terminals	Maher Terminals	13.7-15.2		
	Global Terminal	Global Terminal	13.1	13.5-16.2*	1.43
	NYCT	NYCT	13.7		
	PNCT	Ports America	12.2-15.2		
Baltimore	Seagirt	Ports America	13.7-15.2		
	Dundalk Contr. Term.	Ports America	10.4-13.7	15.2	1.10
	North Locust Point	Ceres Global	11.0		
	South Locust Point	Maryland Port Admin.	10.4		
Philadelphia	Packer Ave Marine Term.	Greenwich Terminals LLC	12.2	12.2	1.70
	Tioga Marine	Delaware River Stevedores	11.0		
Virginia	Virginia Int'l Gateway	Virginia International Term.	15.0	15.0	1.16
	Norfolk International Term.	Virginia International Term.	15.0		
Wilmington	Port of Wilmington (NC)	Port of Wilmington	12.9	12.9	1.17
Charleston	Colombus Street	South Carolina State Ports Authority	12.3		
	Wando Welch Term.	South Carolina State Ports Authority	13.7	13.7-14.3	1.52-1.82
	North Charleston	South Carolina State Ports Authority	13.7		
Savannah	Garden City	Georgia Ports Authority	12.8-14.6	12.8-13.4	2.13

Notes:

* = 13.5m based on depth of Ambrose Channel.

Ports in Florida excluded as no competitive overlap in hinterlands served.

Source: Ocean Shipping Consultants

Competitive Port Analysis for Montreal – Future Position, 2020+

The position at East Coast North America ports has recently been primarily focused towards investment in the ability to receive larger container ships rather than adding landside capacity. This trend has primarily been driven by the completed expansion of the Panama Canal and greater use of the Suez Canal route from Asia.

As Table 7 shows, almost all ports are either in the process of, or planning to commence, different deepening projects that are all geared towards improving the size of container vessel that can be accommodated. As mentioned, the expansion of the Panama Canal has been a key driver, as part of the continued strong demand for All-Water container services via the Suez and Panama canals.

Hence, competing ports have been under pressure to offer deeper water in access channels and at berths, further impacted by the cascading of container vessels onto trade lanes like the All Water, Transatlantic and Latin America routes.

Table 7

Water Depth Projects at ECNA Container Ports - 2016 & 2020-2025

Port	Terminal	Water Depth Range in Channels (m)		
		2016	2020-2025	Key Changes
Montreal	Bickerdike Racine Maisonneuve Cast	11.3	Under consideration	Under consideration
Halifax	Fairview Cove Halterm	18.1-21.3	18.1-21.3	No changes
Boston	Conley Contr. Term.	18.2	18.2	No changes
NY/NJ	APM Terminals Maher Terminals Global Terminal NYCT PNCT	15.2-16.2	15.2-16.2	"50ft deepening project" completed Sept 1 2016 according to US Army Corps of Engineers
Baltimore	Seagirt Dundalk Contr. Term. North Locust Point South Locust Point	15.2	15.2	No depth changes but width for safety issues - due for completion from 2018
Philadelphia	Packer Ave Marine Term. Tioga Marine	12.2	13.7	By end of 2017, depth of 13.7 to be provided
Virginia	Virginia Int'l Gateway Norfolk International Term.	15.2-15.8	15.2-15.8	Southern Elizabeth River channel only - 10.7/12.2 deepening to 12.2/13.7 from 2018 (earliest) – benefits Portsmouth Terminal, others already at 15m+
Wilmington	Port of Wilmington (NC)	12.9	12.9	No changes
Charleston	Colombus Street Wando Welch Term. North Charleston	13.7-14.3	13.7-14.3	Feasibility study to be completed by 2015. No work to start before 2020
Savannah	Garden City	12.8-13.4	14.3-14.9	"Savannah Harbour" project - 14.3-14.9 estimated to be available by 2019

Ports in Florida excluded as no competitive overlap in hinterlands served.

Source: Ocean Shipping Consultants

In terms of notable landside development and investment at regional East Coast North America ports, the following summary applies:

- **Halifax** – short term Halterm is adding equipment (notably RTGs) and minor reconfiguration of yard space to increase capacity and improve the current level of around 450,000 TEU per annum to (potentially) 1.0 million TEU per annum with limited investment. Longer term, the terminal operator claims there is scope to utilise 36 to create 2 berths and an intermodal yard.

The port authority is also undertaking a masterplan study which includes relocating one container terminal to Dartmouth, which will remove truck traffic from the local downtown area. The recommendations from the masterplan are not expected until at least Q2 2017 and it will need to consider the exact location in Dartmouth that is available, the dredging requirements of the site and how much rail capacity is possible (assuming that CN is part of the process – the possibility of CP Railroad also offering services has not been commented upon).

According to local sources in Halifax the more likely facility to be relocated is expected to be the Fairview Cove operation because ship-size access is already restricted, whereas the South End facility can receive bigger vessels. Also, there is more infrastructure to be moved from the South End facility in addition to the Halterm terminal, including Halifax Ocean Terminals at Piers 20-35, numerous transit sheds and a grain elevator.

- **Boston** – investment focused on new equipment and improving local inland access, but minimal capacity improvements in overall terms. With existing capacity available and the port's continued lower container volumes, the position is not expected to alter much moving forward.

- **New York/New Jersey** – creating a fourth berth and increasing NYCT capacity to 950,000 TEU per annum, Maher Terminals has increased its straddle carrier fleet, APM Terminals purchased four new cranes with an outreach of 22 containers, while overall terminal size increased from 107.6 ha to 155.4 ha and PNCT has recently increased capacity to 1.2 million TEU per annum.

  However, after these intermediate plans, larger-scale investment is unclear, although it must be assumed that further development will occur because in April 2016 an RfP for a long-term masterplan study was issued. By Q4 2016 there was no confirmation about who had been selected to undertake the exercise but it is reasonable to assume the process will commence in early 2017 and the port's future container capacity requirements will be included.

- **Philadelphia** – the new "Southport" project is adding 48.6 ha and 750,000 TEU of capacity and providing an extra 762m of quay, although the port authority continues to struggle to attract a developing international stevedore partner, with all international terminal operators known to have considered the merits of the project. In January 2016, the Philadelphia Regional Port Authority (PRPA) announced it would select from shortlisted companies its preferred partner – it should be noted that none of the confirmed bidders are a noted terminal operating company. Nevertheless, PRPA appears committed to developing the facility and, at present, containers remain a component part of the project.

  In the shorter term, a new Capital Investment program (CIP) announced in November 2016 will see a total of US$300 million invested between 2017 and 2020, with US$200 million scheduled for the Packer Avenue Marine Terminal delivering four new Post Panamax cranes and relocation of warehousing. As a result, capacity will rise from around 400,000 TEU per annum to up to 900,000 TEU and the potential to further increase to 1.2 million TEU annually.

  This investment and longer-term plans for additional capacity are despite current container traffic at the port currently being less than 430,000 TEU annually.

- **Baltimore** – investment continues to focus on improving intermodal rail connectivity to/from the port, with the specific aim of allowing better double-stack access through the Howard Street Tunnel. This remains a long-term initiative, even if there have been few tangible developments to date. However, the Maryland Department of Transportation (MDOT), the port authority and CSX Transportation (CSXT) remain committed to the project. Indeed, the longstanding issue has been the considerable costs involved, with previous estimates of the construction work on the tunnel and nine bridges was put at between US$1 billion and US$3 billion.

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However, MDOT has now confirmed that it is able to complete the reported seven-year process for US$425 million, with the State of Maryland and CSXT contributing US$270 million, if the remaining US$155 million were provided from federal funds. Unfortunately, in Q3 2016 the US government declined this application for funding (again, the second time in two years), although MDOT has said it will try again to gain this needed financial support, albeit that it is not provided any timescales for the process. With Maryland remaining a Democratic state in the 2016 US presidential election (and also returning a Democratic senator), gaining Republican support for funding could prove challenging.

The ability to allow doublestack containers through the Howard Street Tunnel would indeed improve the competitiveness of Baltimore to better serve areas such as the US Midwest. However, this project has seen little traction to date, despite the issue being extremely well-known and requiring attention and the demand for federal funds remaining high, unless MDOT and CSXT fully-fund the entire process there is no reason to believe it will move forward. Nevertheless, the project remains a matter that all ports on the East Coast of North America will continue to monitor

- **Virginia** – the former APM Terminals site is now a joint-venture partnership of Virginia Ports Authority (VPA) and VIG Inc. (owned by Alinda Capital Partners and Universities Superannuation Scheme (USS)) and a new leased signed in November 2016 now runs to 2065. The original annual capacity of 1.3 million TEU has since been increased to 2m TEU (according to VPA) and ultimately there is scope to further expand the operation to 4m TEU per annum. Phase 2 has been confirmed and work is expected to commence in late 2016 or early 2017, despite current volumes totalling just 600,000 TEU per annum. Phase 2 will include expand the size of the facility from 125.4 ha to 147.1 ha and extend the quay from 985m to 1,220m. It is reasonable to expect the total 2m TEU of additional capacity to be developed in phases as there is clearly sufficient capacity available.

  Over the longer-term, VPA will eventually develop the five million TEU per annum Craney Island site. Current timescales indicate further slippage in the timescales with Phase One being operational from 2028 instead of 2022 (which itself was a delay on previous start dates). While it is reasonable to assume that Craney Island will probably, one day, be developed, a degree of caution should be exercised regarding the date that it will occur.

- **Charleston** – currently developing a 10.1 ha refrigerated container yard at the Wando Welch facility, together with a further 10.1 ha being added to the yard for dry container storage. The major investment is the new container terminal at the site of a former naval base that is, according to the port authority adding "50% more capacity" when it becomes operational by 2020 with a 117-acre first phase.

- **Jasper County** – the new Greenfield terminal, which is projected to open in 2025 and represents a joint-development between the states of Georgia and South Carolina. The 1,500-acre site is estimated to be costing around US$4.5 billion and regarded as the long-term solution to capacity in the South Atlantic region when both Savannah and Charleston are projected to run out of capacity in around 15 years (according to the Joint Project Office). The ultimate capacity of Jasper Country is currently put at around 7 million TEU per annum, but for the timescales of this assessment, capacity of around 2.5 million TEU per annum by 2030 is reasonable, assuming the facility does commence operations in 2025.

Taking into account these noted development plans at competing regional ports, Figure 7 summarises capacity additions at each facility, with the following key conclusions:

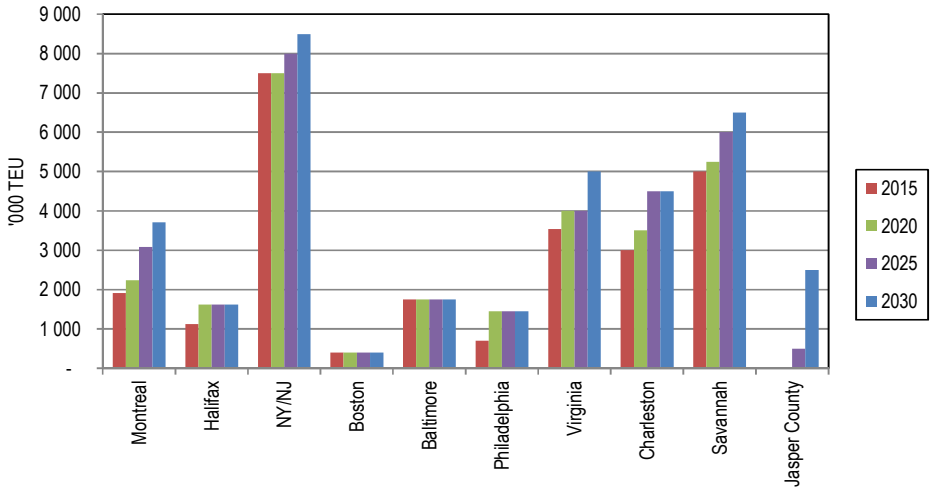
- Montreal is planning on developing additional capacity to keep pace with future growth and this is noticeable compared to the likes of Boston, Baltimore, Philadelphia and (after 2025) for Charleston, none of which have any confirmed or noted plans to expand.

- New York/New Jersey actually has little in the way of confirmed plans, although it has been assumed that some extra space will have to be found, in view of the port remaining a "must-call" on many shipping line schedules.

- Virginia's increase is primarily due to VIG phase 2 recently confirmed. Craney Island has to be considered with some degree of scepticism before 2030 because of continued slippage in the start dates.

- Savannah is expected to reach its maximum and confirmed build-out of 6.5 million TEU per annum, with the Jasper County facility deemed to be the much longer-term solution for capacity in the Atlantic South area.

Figure 8 - Development of ECNA Port Capacity, 2015-2030



The proposed capacity additions are further highlighted in Table 8, which takes the estimated utilisation in 2015 too. The higher New York/New Jersey utilisation is perhaps the major point to note because future planning for additional capacity is less certain than at other facilities on the east coast of North America.

The capacity development totals are based on known plans, where possible, with some estimates included. There is little additional investment at ports such as Boston, Baltimore and Philadelphia, especially after 2020.

While these ports are somewhat similar to Montreal in terms of seeking to attract cargo from the larger facilities like New York/New Jersey and Virginia, especially exploiting any delays in major infrastructure projects, such as the Bayonne Bridge raising, they do lack Montreal's advantage of having a larger local market that will always attract ships to call. The likes of Boston and Philadelphia, in particular, have much smaller local hinterlands to serve and a much more significant overlap with much larger and better equipped (including deeper water) terminals.

Table 8

Summary of ECNA Port Development Plans to 2030 and Port Utilisation - End of 2015

Port	TEU Volumes - 2015	Estimated Utilisation - 2015	Estimated Capacity Development			
			2015	2020	2025	2030
Montreal	1,446,075	76%	1,910,000	2,240,000	3,080,000	3,710,000
Halifax	418,359	37%	1,125,000	1,625,000	1,625,000	1,625,000
NY/NJ	6,372,000	85%	7,500,000	7,500,000	8,000,000	8,500,000
Boston	237,166	59%	400,000	400,000	400,000	400,000
Baltimore	840,314	48%	1,750,000	1,750,000	1,750,000	1,750,000
Philadelphia	427,630	61%	700,000	1,450,000	1,450,000	1,450,000
Virginia	2,745,290	78%	3,540,000	4,000,000	4,500,000	5,500,000
Charleston	1,973,202	66%	3,000,000	3,500,000	4,500,000	4,500,000
Savannah	3,737,400	75%	5,000,000	5,250,000	6,000,000	6,500,000
Jasper County					500,000	2,500,000

Source: Ocean Shipping Consultants

As part of the competitiveness assessment of regional ports on the East Coast of North America, a simplistic supply-demand outlook for each facility is produced using historic annual growth that occurred between 2000 and 2015 (Table 9).

While past performance is no guarantee of future development, applying the same average annual growth to the 2015 total for each port and running it through to 2020 can offer an indication of potential volumes that might need to be handled by each port if competitive market dynamics remain largely consistent with the historic position.

Table 9

Annual Volume Growth at ECNA Container Ports, 2000-2015 in TEU

Port	2000	2007	2015	CAGR
Montreal	1,014,148	1,363,021	1,446,075	2.4%
Halifax	548,404	490,071	418,359	-1.8%
NY/NJ	3,006,493	5,299,105	6,372,000	5.1%
Boston	138,904	220,139	237,166	3.6%
Baltimore	498,016	610,466	840,314	3.5%
Philadelphia	198,680	253,492	427,630	5.2%
Virginia	1,347,517	2,128,366	2,549,270	4.3%
Charleston	1,629,070	1,754,376	1,973,202	1.3%
Savannah	948,699	2,604,312	3,737,400	9.6%

Source: Ocean Shipping Consultants

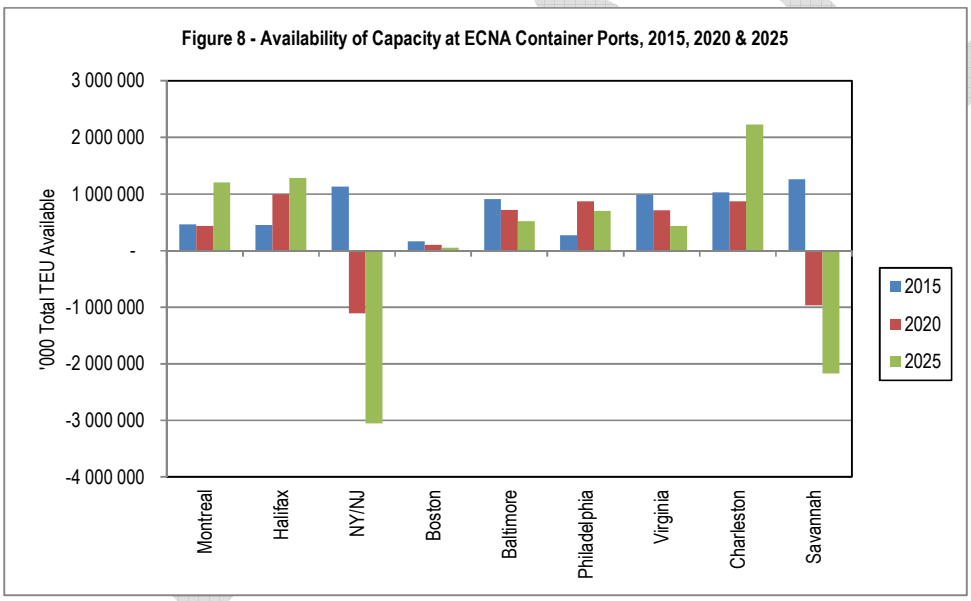
The strongest growth occurred at Savannah, with annual increases of 9.6 per cent per annum generated, followed by 5.2 per cent for Philadelphia (albeit from a much lower starting point in 2000) and 5.1 per cent recorded by New York/New Jersey. If the same average annual growth continues between 2015 and 2020, as occurred between 2000 and 2015 for all ports listed a high-level supply-demand analysis can be concluded. (The

Montreal figure used is not the projections from Section 4, but instead historic growth rates have been applied to ensure consistency with the comparative assessment to all other ports included).

In terms of actual TEU capacity available at each port in both 2015 and 2020, Figure 8 provides a summary position of the supply-demand balance, further emphasising which ports could be in a position to compete for traffic during the remainder of the current decade if historic growth rates continue in the near future.

Without additional capacity expansion plans, both Savannah and New York/New Jersey will not be able to maintain current growth levels, thereby impacting on their overall competitiveness, albeit that Savannah does have noted plans to generate up to 6.5 million TEU capacity (even if the exact timescales are unconfirmed).

The aim of this simplistic analysis is to highlight where the future congestion issues could occur, if the relative competitive positions remain similar. It indicates that the key dates of interest to Montreal for the development of Contrecoeur are 2020-2025 (which is included in the capacity for Montreal in Figure 8). There is a clear window of opportunity for this development because it could be delivered without contributing to any significant overcapacity at container ports on the East Coast of North America.



The specific numbers supporting Figure 8 are provided in Table 10, for better clarity, along with the following accompanying notes:

- Savannah and Charleston are expected to have the first phase of Jasper County available and this new terminal will alleviate the higher utilisation at Savannah.
- The development of VIG Phase 2 means it is almost certain that Craney Island is brought forward. Instead, further efficiencies at this former APM Terminals' facility would be fully utilised first.
- It has been assumed that New York/New Jersey will develop additional capacity, although a lack of defined expansion plans at present will certainly hamper the port's competitiveness moving forward. If this occurs, it is reasonable to expect the large local markets to be served first, but more distant discretionary areas would be served by other ports. In this case, it is regarded as an opportunity for Montreal, which will already be serving its own local market but with larger ships calling and aggressive

shipping line customers like MSC there could be greater US Midwest traffic moving through the port's terminals.

- There exists a critical time window to add capacity on the entire East Coast of North America, which is between 2020 and 2025. This is when Contrecoeur should be targeting operations commencing to maintain Montreal's competitiveness. It is important to note that Contrecoeur will not create coast-wide overcapacity if it is delivered in this period of time.

Table 10

Potential Supply-Demand Balance at ECNA Container Ports, 2015, 2020 & 2025 - Based on Historic Growth Levels

Port	Capacity - TEU	Volumes - TEU	Estimated Utilisation %	Capacity - TEU	Volumes - TEU	Estimated Utilisation %	Capacity - TEU	Volumes - TEU	Estimated Utilisation %
	2015	2015	2015	2020	2020	2020	2025	2025	2025
Montreal	1,910,000	1,446,075	76%	2,100,000	1,666,582	79%	3,080,000	1,875,814	61%
Halifax	1,125,000	418,359	37%	1,125,000	375,430	33%	1,625,000	343,040	21%
NY/NJ	7,500,000	6,372,000	85%	7,500,000	8,605,220	115%	8,000,000	11,053,518	138%
Boston	400,000	237,166	59%	400,000	293,757	73%	400,000	351,102	88%
Baltimore	1,750,000	840,314	48%	1,750,000	1,035,907	59%	1,750,000	1,233,257	70%
Philadelphia	700,000	427,630	61%	1,450,000	581,077	40%	1,450,000	750,248	52%
Virginia	3,540,000	2,549,270	72%	4,000,000	3,289,792	82%	4,500,000	4,068,762	90%
Charleston	3,000,000	1,973,202	66%	3,000,000	2,130,415	71%	4,500,000	2,270,953	50%
Savannah	5,000,000	3,737,400	75%	5,500,000	6,467,643	118%	6,000,000	8,170,585	136%

Source: Ocean Shipping Consultants

It is prudent to include a summary synopsis of the proposed large-scale hub ports on the East Coast of Canada that have been under consideration for some time. The following outlines the noted competitive position of these two projects:

- **Melford International Terminal** – although it has been under consideration since 2008, the 315-acre facility currently has no carrier commitment. The project is now a joint-venture partnership between SSA Marine, Melford International Terminal and Cyrus Capital Partners LLP. It is being modelled similar to Prince Rupert, targeting ultra-large container ships and moving containers onto the Canadian railroad network (with only limited truck activity) to serve more distant discretionary markets.

  A phase one plan of 500,000 TEU per annum capacity subsequently growing to 2.0 million TEU is anticipated. However, the same challenge still applies as it has since 2008, namely securing a shipping line commitment to call with guaranteed traffic. This requirement will definitely be needed before construction commences, although all developments should continue to be monitored by the Montreal Port Authority.

- **Sydney International Terminal** – this 500-acre site is seeking to develop a container transhipment facility, targeting the largest ships calling to the East Coast of North America. The two berths planned could eventually offer up to 1.5 million TEU per annum and while all necessary construction and environmental permits are noted to be in-place by the developer, phase one building will not commence until a concessionaire is in place. To date, this has not occurred.

Containers moving directly to rail transportation is the preferred option for imports from Asia via the Suez Canal, with access to the Chicago market cited as being two days quicker than if containers access New York/new Jersey.

The fact that neither of these two terminals has secured a shipping line commitment continues to stop construction commencing. With good rail access there is no doubt that it is possible to reach the highly-competitive Chicago and US Midwest markets quickly. However, there are other factors that need to be noted too:

- Neither facility can offer shipping lines any substantial supporting localised traffic demand. So, there is not already a reason to call (such as in New York/New Jersey or Montreal which have a large local consuming market attracting ships).
- Neither port can confirm when it will start construction, let alone when phase one operations will commence and ships will call.
- Transhipment is not a used concept in North America. While the Jones Act will preclude the activity in the US, there is some scope for it to be undertaken in Canada (within the terms of the Coastal Shipping Act). However, even then there will be a requirement for a certain criteria to be met – i.e. ships starting upon arrival, flexible and competitive tariffs, ability of larger ships to berth and then smaller feeder units to make onward connections and full support of unionised workforce to understand and adapt working practices.
- The Port of Halifax can already meet some of the necessary requirements and if transhipment is to be pursued, this existing facility has deep water and large cranes at its Halterm terminal already – it does not need a C$400 million investment to pursue transhipment.
- The economics of transhipment and accessing markets such as the US Midwest need to be sufficiently competitive to justify the large construction costs. Transhipment rates are generally lower than import-export containers so any hub port will need to handle high volumes of cargo to offset the double-handling and extra sailing costs. This must be determined to justify the project.

4.2 Liner Developments

Vessel Size Developments & 'Cascading'

The container shipping market is continuing to pass through a period of rapid change. This is almost entirely due to this ship size revolution that is underway. Essentially this trend may be summarised as follows:

- Shipping lines are striving for improved scale economies and introducing larger vessels.
- There has been a mismatch between supply and demand, due to the introduction of much larger vessels and weaker than anticipated demand growth following from global economic conditions. This has resulted in severe and prolonged over-capacity.

- The Asia-Europe container trade cannot absorb all of the largest vessels that have been added to the market. The result has been a period of 'cascading' of large vessels onto other trades – usually ahead of underlying demand and port capabilities. The trend of 'cascading' is expected to continue and is occurring in the trades served by Halifax.

- The search to fill the largest vessels has seen increased use of transhipment. Indeed, this is vital to the economics of utilising the bigger ships.

It is also apparent that this process is still underway, with the shares of the largest vessels set to increase further and serious evaluation is underway concerning the addition of even larger vessels.

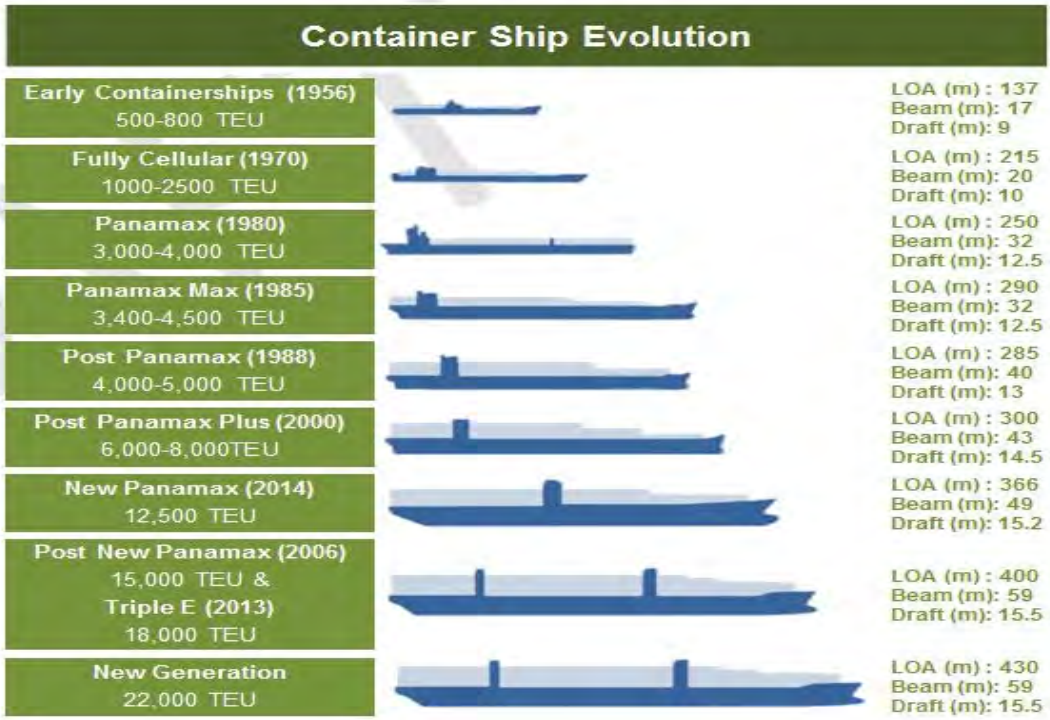
The shipping lines' attempts to manage these developments will significantly change the structure of various port markets. The process of consolidation and increased use of transhipment are set to radically change the market.

Transhipment is a key aspect of the global container market place but this has not been a feature of business at North American ports, although for the US this is entirely due to the Jones Act limitations which means cargo moving between US ports must be undertaken by US flagged and owned ships using a US crew. This process increases costs and is reliant upon sufficient vessels being available.

However, there remains interest for the concept to be considered for Canadian ports on the East Coast of North America, albeit that no project has come to fruition yet. Furthermore, as soon as one major operator advances to the next size echelon, the competitive nature of the shipping industry is forcing other operators to follow accordingly. The net effect is a rise in both average vessel size and the size of the largest vessels deployed – this trend has continued for some time.

These developments are of importance to the North American container port market in overall terms and influence the sizes and types of vessels deployed, port-calling strategies adopted and future planned developments. Figure 9 outlines the development of container ship size evolution, based on key vessel-size classifications. The requirements of the larger ships should be noted in terms of vessel length (meaning longer quays are needed to berth them) and berth depth (meaning deeper water needed at ports and terminals). Vessel width is also a relevant factor because terminals have to invest in cranes with a wider outreach.

Figure 9: Development of Container Vessel Dimensions



Source: Ocean Shipping Consultants

Container vessel sizes have increased from 2,000 TEU in 1990 to 21,100 TEU in 2017. Figure 10 provides a summary overview of this position.

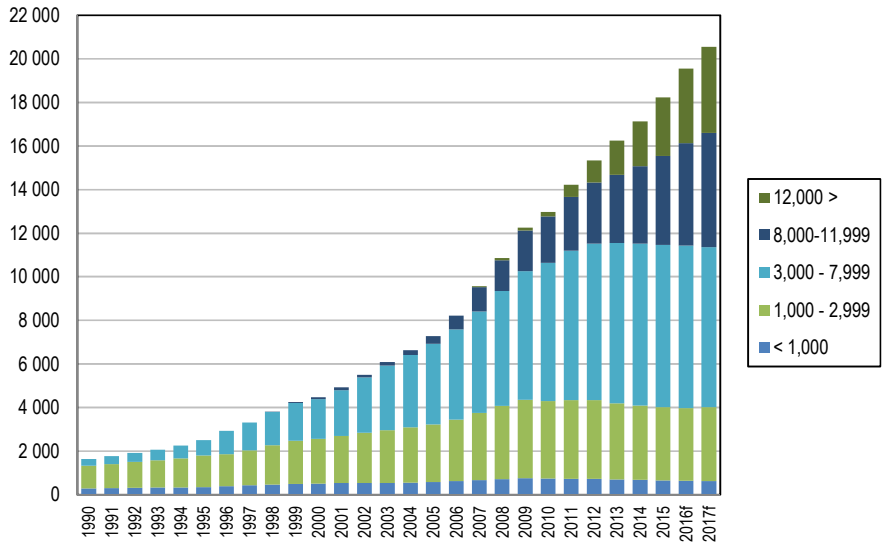
This development has been driven by the shipping lines seeking to achieve economies of scale. The shift to larger vessels has been the most significant feature for deepsea containerization in recent years. The search for scale economies is at the heart of this drive.

This process has also seen a considerable increase in the capacity of the container fleet as all major operators have introduced much larger vessels. This has resulted in a miss-match between supply and demand and has resulted in a very weak shipping market.

The largest vessels that are on-order have a length (LOA) of 400m, a beam of 59m and a design draught of around 15.5m – although full draught by weight will seldom be used. Larger vessels are also under consideration with designs for vessels of 22,000TEU and even 24,000TEU proposed.

The very largest vessels are typically deployed on trades between East Asia and Europe; however, the oversupply of these largest classes of vessels is now resulting in pressure to re-deploy these vessels on other trades.

Figure 10 - World Container Fleet Development 1990-2017 ('000TEU)



In terms of the current fleet, Table 11 outlines that at the start of 2016 the number of active container ships totalled 5,124, with a collective nominal capacity of 19.7 million TEU.

While the largest container vessel had increased from 14,000 TEU in 2006 to 21,100 TEU in 2017 (planned), the vessel dimensions (400m by 59m) remain largely unchanged.Vessel sizes have continued to increase with new orders from the market leaders to retain market share at the cost to margins.

Maersk Line first introduced the E-class vessels in 2006 with Emma Maersk being the first container ship in the series of eight units owned by the A. P. Moller-Maersk Group. It was the largest container ship ever built at the time with a loading capacity of 14,770 TEU, although a 15,011 TEU load was recorded (mostly empties).

Table 11
Active container vessel fleet in Q1 2016, (TEU, %)

Vessel size (TEU)	Number of vessels	(%)	TEU Slots	(%)
0-1,000 TEU	936	18.27%	577,999	2.93%
1,000-2,000 TEU	1246	24.32%	1,751,179	8.87%
2,000-3,000 TEU	652	12.72%	1,648,979	8.35%
3,000-4,000 TEU	265	5.17%	920,184	4.66%
4,000-5,000 TEU	632	12.33%	2,801,441	14.18%

5,000-6,000 TEU	339	6.62%	1,847,870	9.36%
6,000-7,000 TEU	239	4.66%	1,570,260	7.95%
7,000-8,000 TEU	36	0.70%	264,181	1.34%
8,000-9,000 TEU	299	5.84%	2,535,192	12.84%
9,000-10,000 TEU	158	3.08%	1,489,913	7.54%
10,000-11,000 TEU	61	1.19%	626,738	3.17%
11,000-12,000 TEU	22	0.43%	248,774	1.26%
12,000-13,000 TEU	13	0.25%	162,212	0.82%
13,000-14,000 TEU	128	2.50%	1,710,466	8.66%
14,000-15,000 TEU	41	0.80%	581,040	2.94%
15,000-16,000 TEU	8	0.16%	124,400	0.63%
16,000-17,000 TEU	8	0.16%	131,326	0.66%
17,000-18,000 TEU	6	0.12%	106,743	0.54%
18,000-19,000 TEU	24	0.47%	440,164	2.23%
19,000-20,000 TEU	11	0.21%	210,844	1.07%
	5,124	**100.00%**	**19,749,905**	**100.00%**

Source: Ocean Shipping Consultants

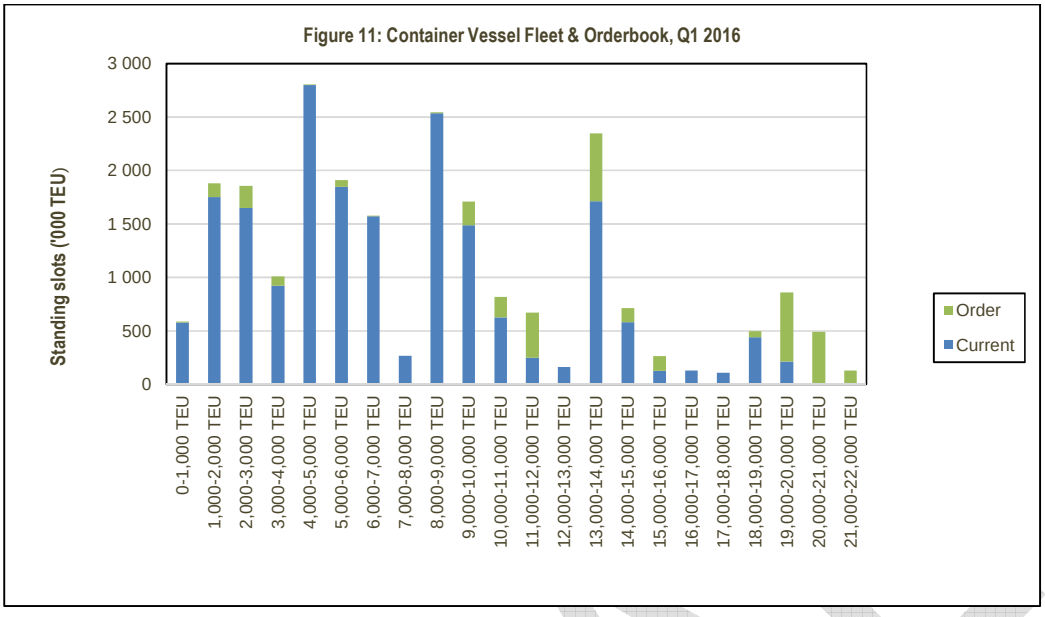
In February 2011, Maersk Line awarded Daewoo Shipbuilding a US$3.8 billion contract to build twenty even larger vessels known as the Triple E class (each being 400m long and 59 m wide - 3m longer and 4m wider than E-class ships, the Triple E ships are able to carry 2,500 more containers). With a draft of 14.5m, this tonnage is too deep to call at any port in the Americas or transit the Panama Canal, but will pass through the Suez Canal when sailing between Europe and Asia. Particularly notable is the fact that the draft is claimed to be less than the E class Maersk.

In March 2015, CMA CGM signed an order with Hanjin Heavy Industries for three 20,600-TEU vessels. The ships are to be delivered in the third quarter of 2017 and are estimated to have cost CMA approximately US$145 million per vessel. The newly ordered ships are going to be 400m long with a beam of 59m, and will be constructed at Hanjin's Filipino shipyard in Subic.

CMA CGM's order continued the trend of major liners increasing vessel sizes. CMA's decision came just days after OOCL placed an order with Samsung Heavy Industries for six 21,200-TEU vessels, while MOL of Japan had placed an order early in the previous month for six 20,150-TEU ships, also with Samsung Heavy Industries

Figure 11 puts the vessel fleet and orderbook into better perspective, which also highlights where the current ordering size trends are prevalent.

FINAL



The order book for the next five years confirms a total of 418 vessels are due, adding 3.6 million TEU of extra capacity, with 15 per cent of these ships larger than 20,000 TEU. The first of these units will be delivered in 2017, with the following key conclusions:

- The "giants" of 16,000 TEU-18,000TEU that were largest in class as recent 2013 are now no longer on order.
- The planned 18-22,000 TEU vessels are for delivery to Asia–Europe routes only.
- The 9-14,000 TEU vessels will most likely be predominantly deployed on the Transpacific routes, although larger ships will also be cascaded from Asia-Europe routes.
- Ship cascading will also impact the East Coast of North America across the Transatlantic but also for All-Water services via the Panama and Suez canals, with larger vessels expected moving forward (as outlined in the analysis below).
- It is reasonable to expect cascading to impact the Montreal trades too. With increasing volumes through the port in the future and additional capacity being added (at Contrecoeur), shipping lines will want to maximise the benefits of lower operating costs by using bigger vessels to carry more containers. This cascade will also enable ocean carriers to deploy larger ships currently in service elsewhere in serving Montreal.
- Demand for vessel ordering in the sub-4000 TEU category will continue as these are optimal sizes for the intra-Asia trades, while feeder ships are also increasing in size in major regions where the activity is prevalent.

Table 12 offers further insight into the confirmed orderbook in Q1 2016.

Table 12
Container vessel fleet on order in Q1 2016, (TEU, %)

Vessel size (TEU)	Number of vessels	(%)	Standing slots	(%)
0-1,000 TEU	8	1.91%	7,278	0.20%
1,000-2,000 TEU	84	20.10%	128,833	3.61%
2,000-3,000 TEU	80	19.14%	205,266	5.74%
3,000-4,000 TEU	23	5.50%	87,472	2.45%
4,000-5,000 TEU	1	0.24%	4,957	0.14%
5,000-6,000 TEU	12	2.87%	63,600	1.78%
6,000-7,000 TEU	1	0.24%	6,865	0.19%
7,000-8,000 TEU	1	0.24%	8,800	0.25%
8,000-9,000 TEU	0	9%	0	0%
9,000-10,000 TEU	23	5.50%	217,961	6.10%
10,000-11,000 TEU	18	4.31%	189,200	5.30%
11,000-12,000 TEU	37	8.85%	422,460	11.82%
12,000-13,000 TEU	46	11.00%	638,050	17.86%
13,000-14,000 TEU	0	9%	0	0%
14,000-15,000 TEU	9	2.15%	132,500	3.71%
15,000-16,000 TEU	9	2.15%	137,700	3.85%
16,000-17,000 TEU	3	0.72%	57,000	1.60%
17,000-18,000 TEU	33	7.89%	647,040	18.11%
18,000-19,000 TEU	24	5.74%	491,450	13.75%
19,000-20,000 TEU	6	1.44%	126,600	3.54%
	418	**100.00%**	**3,573,032**	**100.00%**

Source: Ocean Shipping Consultants

As Table 13 shows, it is anticipated that the capacity of ULCS vessels (defined as 12,000TEU and larger) will increase from a current level of around 3.4 million TEU to around 5.6 million TEU by the end of 2018 – an increase of 65 per cent. By this time around 25 per cent of total container fleet capacity will be in this size range. It is clear that at present demand is extremely unlikely to match this pace of growth and a further prolonged period of overcapacity is anticipated.

This development of ship size represents a continuing transformation of terminal requirements for the Asia-North America trades, in which a greater proportion and larger vessels will need to be catered for at container terminals, on both the West Coast for direct Transpacific services and the East Coast for Panama and Suez canal routes.

With this ongoing supply and demand imbalance, limited further ordering is anticipated, although the current alliance reorganisation could see a further assessment of the ordering of even larger vessels. It is known, for example, that shipyards are currently under-utilized and are soliciting orders – especially in Korea.

While demand on secondary trades remains strong, they are unable to fully absorb vessels that form the largest tonnage class and the supply/demand for shipping capacity is unlikely to regain equilibrium before mid-2018 – even with limited orders.

Vessels in the ULCS category will increase their share of the global fleet as current orders are delivered. The trend for much larger ships is now well-established and this continues to put pressure on all ports and terminals to remain competitive. The size of ships in service is expected to grow, with 18,000 TEU units becoming more common throughout 2017.

Table 13
Forecast ULCS fleet* development to 2018

	No. of ULCS	ULCS (>12,000) capacity	Total fleet capacity	ULCS share (%)

		('000 TEU)	('000 TEU)	
Existing fleet				
End - 2014	193	2,694.0	18,244.0	14.8%
Orderbook (scheduled delivery)				
2015	37	743.7	1,452.0	51.2%
2016	33	532.0	1,184.5	44.9%
2017	47	795.9	1,176.9	67.6%
2018	50	829.4	895.6	92.6%
Forecast fleet (end)				
2015	230	3,437.7	19,696.0	17.5%
2016	263	3,969.7	20,667.0	19.2%
2017	310	4,765.6	21,250.0	22.4%
2018	360	5,595.0	22,450.0	24.9%

Note: *ULCS=12,000 TEU+
Source: Ocean Shipping Consultants

Trade Lane Developments – East Coast North America

The East Coast of North America participates in two of the three major East-West trade routes, the Transatlantic and the Transpacific, which collectively account for an estimated 43 per cent of global trade.

Figure 12 provides a summary overview of the development of both TEU vessel capacity offered and shipping volume growth per annum for the period 1995-2015 for each of these major East-West routes.

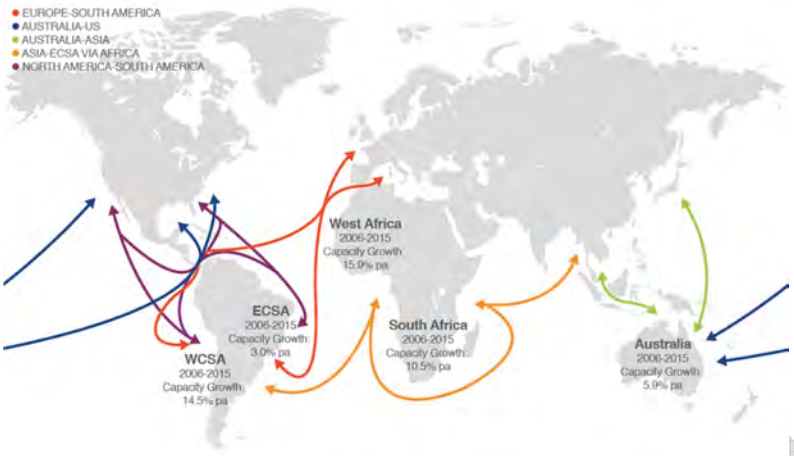
Figure 12: Key East-West Trade Routes – 1995-2015 Growth Summaries



Source: Ocean Shipping Consultants

There is also some North-South activity too for the eastern seaboard, as Figure 13 shows. These routes collectively on a global basis account for an estimated 17 per cent of global trade. For a port located on the east coast of North America, access to markets on the east and west coasts of Latin America is of importance, hence the ability of Montreal to retain connectivity to the MSC hub port in Freeport (Bah) is crucial in ensuring access to these markets.

Figure 13: Key North-South Trade Routes – 1995-2015 Growth Summaries



The introduction of new build deployment on primary trades means larger vessels are being displaced on secondary routes. As Table 14 shows, the average and largest size of container vessel in each of the three key East-West trades have seen continued increases the end of 2003 and end of 2015.

Table 14

Ship Size Development for North America East Coast Ports, 2003 vs 2015

Trade Route	Average Ship Size		Largest Ship Size	
	2003	2015	2003	2015
Transatlantic	2,661	3,857	4,661	8,749
All Water via Panama	3,968	4,655	4,460	6,572
All Water via Suez	3,469	6,996	4,174	9,300

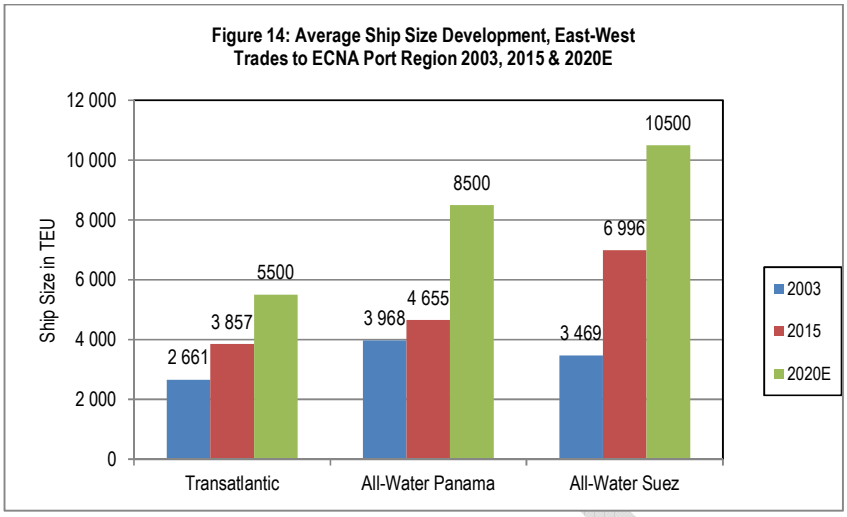
Notes:
MSC South Atlantic/US Gulf/Mexico service excluded from transatlantic
All Water Panama largest ship will not be fully loaded

Source: Ocean Shipping Consultants

The extent of the increases in average ships is especially noticeable for All Water options in Figure 14, where the rise is considerably pronounced. The recently-completed Panama Canal expansion project will see the All Water Panama option generate larger sizes of ships, while the continued appeal of sailing from Asia via the Suez Canal will continue to offer good links to Mid-East and Mediterranean hub ports

.

A continued rise in the size of average ships in the transatlantic trades is also likely, keeping pace with the mature expansion of the trade routes and the 'cascade' effect already noted in the industry generally.



If the largest vessels are compared directly for the same East-West trade routes for East Coast North America ports, then the desire for bigger ships to use the All Water via Suez Canal option is even more pronounced. This trend has been driven by the following:

- Desire of shipping lines to 'cascade' ships.
- Desire of North American shippers and ocean carriers to utilise alternative routes to the Transpacific and the use of US West Coast ports in California.
- Restrictions of the Panama Canal in terms of ship size deployments.

Although the Panama Canal expansion has been completed, these industry dynamics will also continue, making the All Water via Suez Canal option favourable to larger-scale shipping lines and alliances.

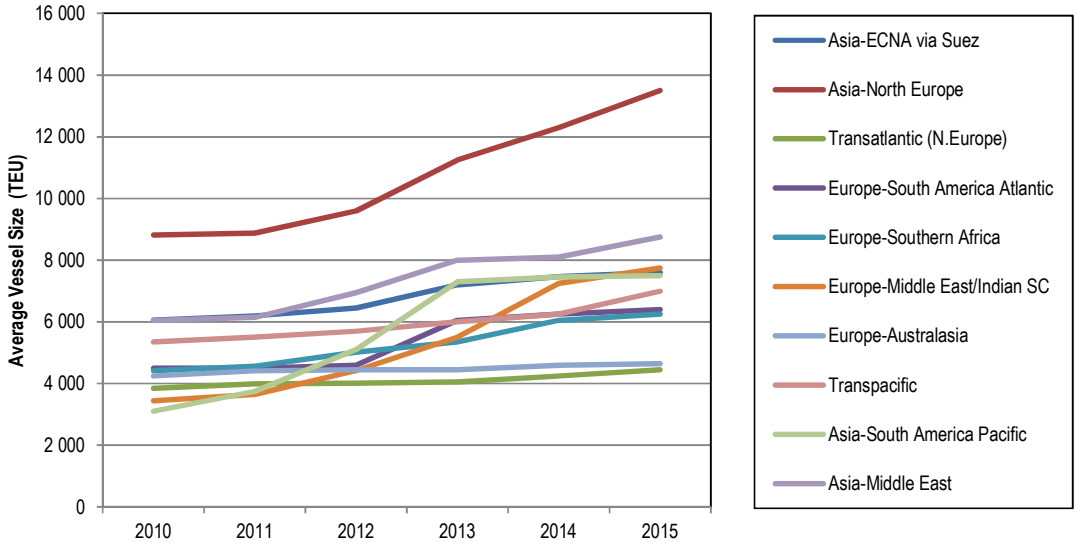
The new build vessels are deployed on routes with the largest demand concentration. These are the Asia-Europe and Transpacific routes. Vessels that have been displaced are now deployed on secondary deepsea trades. The cargo demand on these routes may not justify the deployment but have little option other than being idled.

The impact of this is that ports on secondary routes are seeing an increase in vessel sizes. This results in larger consignments and operating pressures on the terminal sector. Figure 15 allows for comparisons to other key trade lanes.

It is reasonable to expect the sizes of ships deployed in these other key container trades to also increase moving forward. It is already known that the Asia-Europe routes will see the largest ships in service that are in the process of being delivered in the short-term. This will, in-turn, drive the cascade process for all of the other trade lanes listed in Figure 15, although the capabilities and infrastructure at ports in each of the regions will also be an important factor in terms of actual sizes of ships that are able to call.

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Figure 15: Ship SIze Development, Key Container Trades 2010-2015



In terms of future size of ships deployed on the key East-West trade routes impacting Montreal (mainly through sizes of ships calling to ports that are then serving discretionary hinterlands, such as the US Midwest), it is reasonable to expect the trend for larger vessels to continue – especially for the All Water Panama Canal route once the expansion is completed.

While this assessment is almost entirely a qualitative exercise, it is still possible to note with reasonable accuracy a continuation of recent trends. This is due to continued ordering of ever-larger ships and the need for further vessel cascading.

On this basis, Table 15 takes the known position and subsequent development between 2003 and 2015 and offers a qualitative assessment on the likely position in 2020.

Table 15

Ship Size Development for East-West Trades, North America East Coast Ports, to 2020

Trade Route	Average Ship Size			Largest Ship Size		
	2003	2015	2020	2003	2015	2020
Transatlantic	2,661	3,857	5,500	4,661	8,749	12,500
All Water via Panama	3,968	4,655	8,500	4,460	6,572	12,500
All Water via Suez	3,469	6,996	10,500	4,174	9,300	18,500

Note: Information for 2003 & 2015 based on actuals, 2020 is a qualitative assessment

Source: Ocean Shipping Consultants

Regardless of the trade lane, with bigger vessels coming onto the market and these large vessels accounting for a larger share of the global fleet, liners will seek opportunities to introduce the largest segment of vessels onto trades.

The limitation of ship dimensions (400m length by 59m width) is intentional as vessels beyond this size could not be handled by all ports in the Far East-Europe route. The solution to this by the shipyards was to increase the carrying capacity from 14,000 TEU to 21,000 TEU (50%). There could be further but minimal increases in carrying capacity using the same dimensions.

Future breakthrough in dimensions would require a corresponding increase in length and width of the vessel (to maintain vessel structural integrity). This would require new cranes and berths that the current terminals do not have.

To realise this, a terminal related with a shipping line would likely need to take the lead to expand its current terminals to accommodate the new vessel size.

Nevertheless, whether on Asia-Europe schedules or as a direct result of the "cascading" process, the continued increase in size of container ships has placed extra pressure on ports and terminals to remain competitive in all regions. Specific items to be addressed include:

- Offer longer berthing quays to be able to berth and work ships simultaneously.
- Invest in larger cranes, that are higher and with a longer outreach, to work bigger ship bays.
- Ensure sufficient water depth exists, at both the terminal and approach channels.
- Provide efficient operations linking the quayside crane activity with storage yards, with increasing use of automation a favoured option in many geographic locations.
- Prepare for, and handle, larger exchanges, as shipping lines seek to make fewer ports calls but with more containers being discharged/loaded at each location – this is especially pertinent where transhipment hub activities are being undertaken (although that then also means that terminals must ensure good supporting feeder facilities (notably access to berthing) are available too.

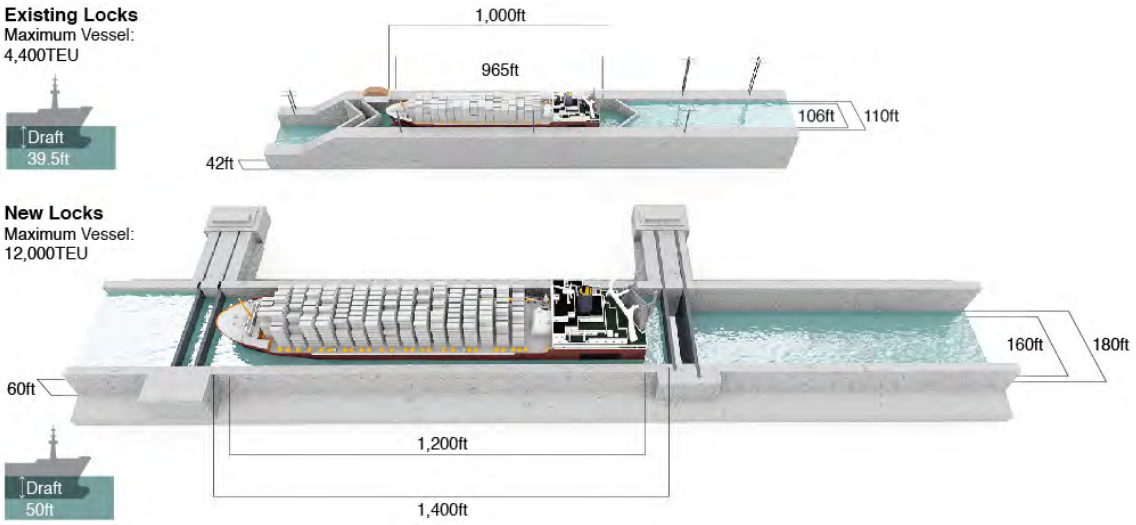
Impact of Suez Canal Potential and Impact of Expanded Panama Canal

Construction of the new Panama locks has been completed in 2016. The increase in size of the locks will be the new determining factor for vessels that will be able to transit the canal. The developments in the liner shipping especially have gone faster than forecasted and the latest generation of container vessels already exceeds the maximum capacity of the new locks.

Based on the new lock dimensions, max vessel length of 366m, width of 49m and vessel draft of 15.2m it is estimated that the largest container vessel that is allowed to pass will have a capacity of 12 – 13,000 TEU, although some observers feel that 14,000 TEU-sized ships might be possible, depending on design and load factors. Figure 16 offers a summary overview, based on information from the local office of Inchcape Shipping Services.

This step-change will drive changes in shipping services to take advantage of the economies of scale that can be achieved from using the new Panama Canal.

Figure 16: Summary of Container Vessel Sizes through the Panama Canal

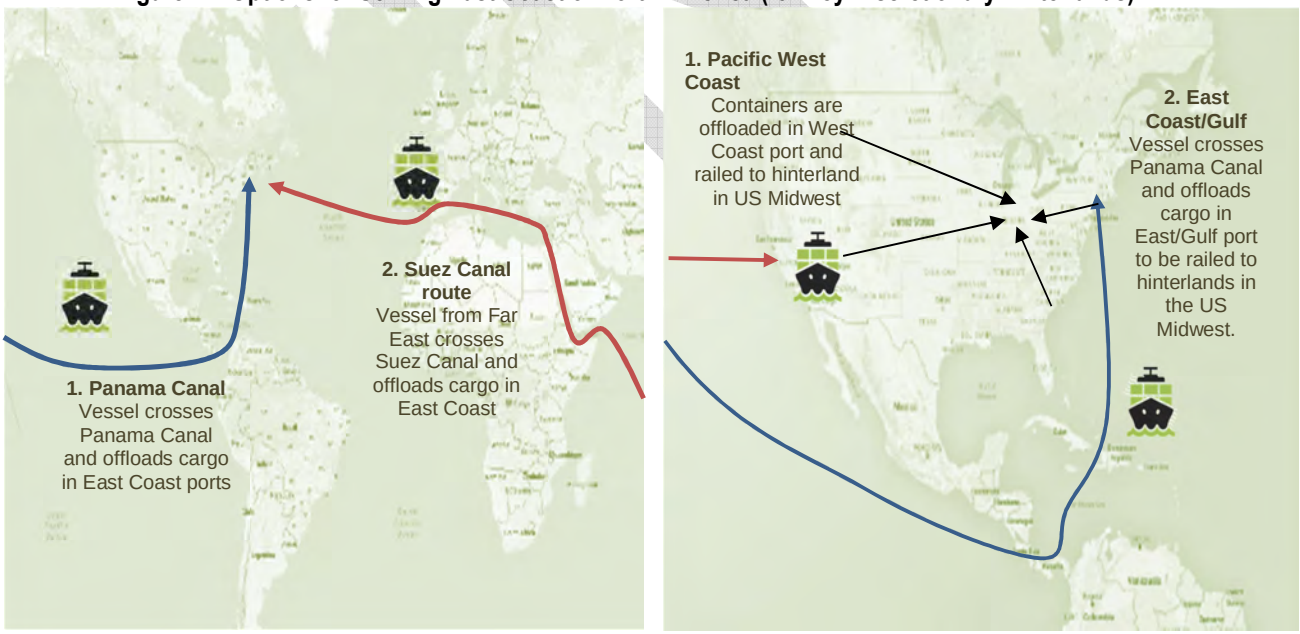


Source: Inchcape Shipping Services

While it has been possible to connect to the Far East to US East Coast ports through the Panama Canal, the limitation on the vessel sizes has made this less attractive as compared to using larger vessels which sail through the Suez Canal instead.

These routes can now deploy larger vessels through the Panama Canal to call at US East Coast ports.

Figure 17: Options for Serving East Coast of North America (for Key Discretionary Hinterlands)



Source: Ocean Shipping Consultants

Hence as Figure 17 identifies, containers from the Far East to important US hinterland markets such as the Midwest states can either:

1. Offload at West Coast ports and rail/truck to final destination
2. Sail through Panama Canal to East Coast or Gulf ports and rail/truck to final destination.

Moving forward, the expansion of the Panama Canal will allow larger container ships to transit, thereby negating the economies of scale that currently afford an advantage to the Suez Canal. The effect of these costs can be outlined, based on OSC research relating to the total logistics costs of moving one container from Asia to the key inland US destination of Chicago via gateway port, as the following confirms:

1. Logistics costs for routing one 40ft container between Shanghai and Chicago in 2016:

   - NY/NJ via Panama Canal: $2,497
   - NY/NJ via Suez Canal: $2,485
   - **Result:** **Suez Canal cheapest by $12 per container.**

2. Logistics costs for routing one 40ft container between Shanghai and Chicago in 2017 (after Panama Canal expansion completed):

   - NY/NJ via Panama Canal: $2,405
   - NY/NJ via Suez Canal: $2,459
   - **Result:** **Panama Canal cheapest by $54 per container.**

This is just one selected example, using one key port on the US East Coast. A similar analysis using other key ports, such as Savannah, outline the same basic over-riding trend, namely that the expansion of the Panama Canal to allow larger container vessels to transit will generate potential operating cost savings for ocean carriers and shippers.

This basic cost analysis does take into account the proposed changes being applied by the Panama Canal to its toll structure. The following confirms the level of potential reduction available, on the basis of a container ship that is 70-80 per cent utilised:

- Current tariff for ship of 5,000 TEU: US$114 per box.
- New tariff for ship of 6,000-8,999 TEU: US$111 per box.
- New tariff for ship of over 9,000 TEU: US$106 per box.

These figures do not exclude any potential volume discounts that apply once any agreed minimum traffic commitments have been met. However, on the basis of a 10,000 TEU ship that is around 80 per cent utilised, a saving of US$24,000 per transit will be made by the vessel operator.

The Panama Canal routing between Asia and the US East Coast will reclaim services back from the All Water Suez from 2017 onwards. There is a strong cost argument to help justify the decision for some shipping lines to make this switch back and will lead to a likely 50-50 per cent of TEU slots for each waterway on this trade route.

Impact of Changing Alliances

Shipping lines are forming alliances in order to improve the supply and demand imbalance and the approach and rationale adopted by the ocean carriers is an important consideration for all competing regional ports.

Since 2008, as a result of the beginning of the world economic slowdown, coupled with the start of the introduction of new, larger tonnage, major shipping lines decided to reorganise their services. Maersk Line, MSC and CMA CGM decided to embark upon an (at the time) unheard of level of co-operation, while similar Vessel Share Agreements (VSAs) and slot swap agreements were also struck between G6 members as well as members of the CKYH Alliance and what used to be regarded as 'outsider' shipping lines, such as Evergreen and Zim.

All shipping lines had the common aim of ensuring that their new larger vessels would be filled. In this way, they could justify the order of the new, bigger tonnage by taking the maximum possible advantage of the economies of scale, albeit at the expense of a slight loss of individual identity when it came to any service differentiation.

Nevertheless, there has clearly been an intention for major operators to refine and reorganise their Alliance partnerships, as was seen in 2015, with the new industry make-up now taking shape. By early 2017 the position will be much clearer as new arrangements commence, as summarised in Table 16, although the likely impact of Hanjin Shipping ceasing liner operations will further impact the position, depending on how the CHYKE alliance re-groups and where the Hanjin Shipping fleet is re-deployed and under which line's control.

The development of Alliances is being driven by network optimisation and can be best understood from the following perspectives:

- Centralised cost reduction – principally in head/regional offices and marketing;
- Increased buying power – for bunkers, terminal services, newbuilds, etc.;
- Greater concentrations for inland distribution;
- Increased shipping network coverage.

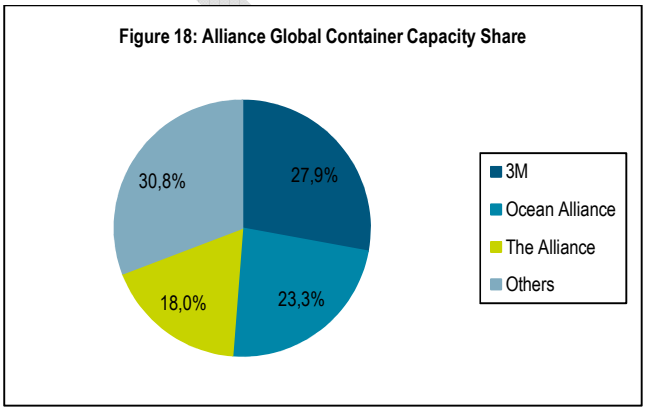
Table 16
Current & Proposed Shipping Alliances

Current	2017
2M: Maersk Line, MSC Ocean 3: CMA-CGM, UASC, Cosco Group G6: NYK, OOCL, APL, MOL, HMM, Hapag-Lloyd CHKYE: K Line, Yang Ming, Hanjin, Evergreen	3M: Maersk Line, MSC, HMM Ocean Alliance: CMA-CGM, Cosco Group, APL, Evergreen, OOCL The Alliance: NYK, MOL, K Line, Yang Ming, Hanjin, UASC, Hapag-Lloyd

Note: Hanjin included in The Alliance though subject to change

Source: Ocean Shipping Consultants

Clearly, major shipping lines are further consolidating into fewer and larger groupings on the major East-West trade lanes, with three major alliances expected to fully organise themselves during the forthcoming 12 months. Based on available public information, Figure 18 provides a summary of the share of annual TEU vessel capacity that these major groupings are expected to retain



The world's largest shipping alliance by container capacity, 2M, currently has approximately 28% market share. The alliance will be adding Hyundai Merchant Marine (HMM) as its newest member to create the 3M. Even though HMM would contribute towards a greater market share especially on transpacific routes, the company has been struggling for several years, accruing $4.48bn in debt. HMM is currently under a self-imposed rescue plan and has

lately managed to negotiate a reduction of about 20% in its charter payments. Despite these concerns, joining the 2M is expected to benefit HMM in terms of further reducing costs and increasing its competitiveness.

Significant competition to the 3M will take the form of the Ocean Alliance, comprising some of the biggest container operators. This alliance will include the newly formed China Cosco Shipping following the merging of Cosco and CSCL, CMA-CGM which recently completed the acquisition of the APL parent company Neptune Orient Lines as well as Evergreen and OOCL. The partnership will start in April 2017 and last for five years, operating 350 vessels among the members.

Also scheduled to start next April is The Alliance which will control 18% of the world's container fleet, more than 620 vessels, and will comprise NYK, MOL, K Line, Yang Ming and UASC. Hapag-Lloyd's merger with UASC currently nearing completion will further boost the group's capacity as the two lines will together form the world's fifth largest container operator.

The Alliance was to include Hanjin but the company's financial collapse stopped this happening, with all company assets being disposed of (at the time of writing in Q3/A4 2016). Indeed, in November 2016, approximately three months after filing for receivership, the last containers that had been stricken on vessels are being discharged at a number of ports, including Vancouver in Canada. Moreover, at the start of December 2016, there were only 10 ships still under the control of Hanjin Shipping and only two actually active.

These ships are part of the South Korean line's Asia-US network potentially being sold to Korea Line for a reported US$31.5 million (which includes client management and operational data, logistics management systems and subsidies in the US, China and Vietnam, plus four other unnamed countries). Hanjin's 54% in the Total Terminals Inc. (TTI) operations at Long Beach and Seattle have also been offered to Korea Line. The new, largescale Pier T facility at Long Beach, with a capacity of over 2.1 million TEU per annum, means this port will be substantially exposed to the impact of the Hanjin collapse, as will Seattle. On the East Coast of North America, only the All Water string one was a Hanjin-only operated service, so the impact is expected to be less severe than for West Coast ports, although Wilmington (NC) relied on Hanjin for the majority of its container traffic, so will see volumes falling. New York/New Jersey and Savannah could also see some minor .loss of traffic

Table17 provides a summary of the main East-West liner services calling to the major container ports on the East Coast of North America. These strings list the key ports of call that allow for subsequent access of cargo to be gained to such areas as the US Midwest, along with the actual operator and both average/largest size of vessel in service.

It is important to note Montreal's position with respect to changing alliance structure. The port remains a niche trade and shipping lines are also aware that vessels calling represent a full discharge/load because there are no other ports in the same region being called. Typically, vessels calling on the eastern seaboard will make a call at Savannah/Charleston, Virginia and then New York/New Jersey, with the likes of Boston, Baltimore, Philadelphia and Halifax also utilised on certain strings for some operators.

This means that changing alliances can impact the port used. However, for Montreal it is largely immune to these changing strategies because there are no other competing local ports on the same schedules. So, the good local demand and ability to also serve more discretionary hinterlands means that there will always be an incentive to call. This unique position is unlikely to change due to the ongoing alliance reorganisation.

On this basis, Montreal continues to appear on shipping line schedules as a dedicated trade lane and this position is not expected to change in the future.

Table 17

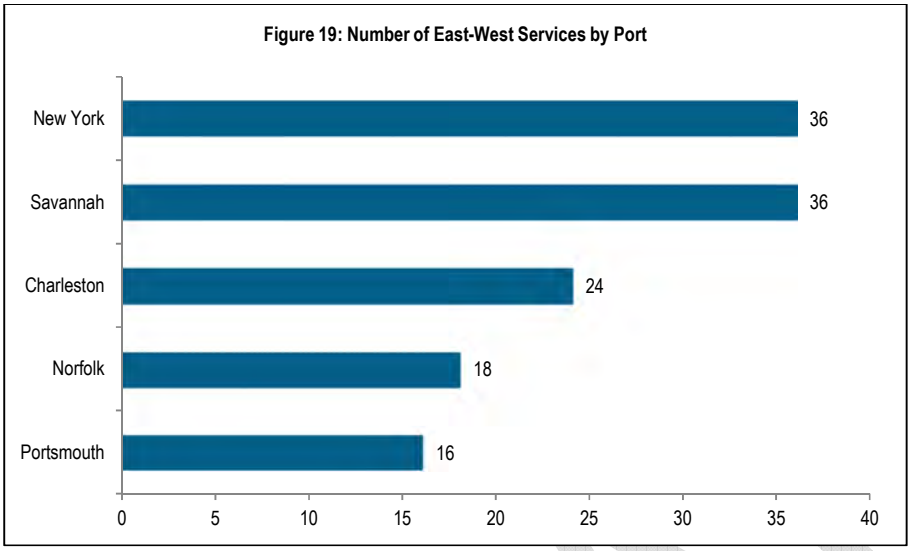
Summary of Main East-West Liner Services on East Coast North America, Q3 2016

Service Name	Operator	Regional Ports called	Average Vessel (TEU)	Largest Vessel (TEU)	Annualised Operational Capacity (TEU)
TP12-TP8/Empire -New Orient	Maersk, MSC	NYJ, NFK, BAL	8,650	9,411	451,026
TP11/America	Maersk, MSC	NYJ, CHS, SAV, MIA	8,503	8,845	443,362
TA2/NEUATL2	Maersk, MSC	NYJ, BAL	4,765	5,029	248,448
TA5/MEDUSEC	MSC, Maersk	NYJ, BOS, BAL, PMH, SAV, CHS	6,578	6,724	343,003
TP10/Amberjack	Maersk	SAV, NYJ, CHS, JAX	4,530	5,060	236,191
TA3/NEUATL3	Maersk, MSC	LEH, CHS, SAV, NOL, MOB	7,306	7,403	380,956
TA1/NEUATL1	Maersk	PMH, CHS, MIA, HOU	4,721	4,824	246,177
MECL1/SZX1	Maersk	CHS, SAV, HOU, SAV, PMH, NYJ	6,237	6,732	325,239
Indus Express	MSC	NYJ, PMH, CHS, SAV	8,322	9,178	433,917
Ecuador Express	MSC	BOS, NYJ, PHL	4,411	5,301	229,987
ACL	ACL	NYJ, BAL, NFK, NYJ, HFX	2,634	3,809	114,436
AWE1/AWH	Hanjin	NYJ, WNC, SAV	4,141	4,646	129,539
AWE3/AWY	Yangming, K Line	SAV, CHS, WNC	4,501	5,117	140,827
AWE4/AWK/ NUE4	K Line, Yangming, Cosco, Evergreen	NYJ, PMH, SAV	8,533	8,930	333,693
AW8/AUE	Evergreen, Hanjin, Cosco, K Line, Yangming	NYJ, PMH, SAV	8,538	9,030	445,215
AWE2/AWC/ NUE2	Cosco	NYJ, BOS, PMH	4,408	5,085	160,892
AWE1 (new format)	Hanjin	NYJ, WNC, SAV	6,655	6,655	101,103
NUE (new format)	Evergreen, Hanjin	SAV, CHS, BAL, NYJ	8,645	9,030	135,227
AWE4 (new format)	Cosco, Yangming	SHA, NYJ, BOS	8,564	8,626	133,965
AWE3 (new format)	K Line, Cosco	SAV, CHS, PMH	8,631	9,469	135,013
Victory Bridge	CMA CGM	CHS, SAV, MIA,HOU, NOL, MIA	4,241	4,256	221,138
Vespucci/APNE/ NEU1	CMA CGM, Hamburg Süd, UASC	SAV, CHS, PMH, NYJ	4,297	4,546	224,058
PDL/NASP	CMA CGM, Marfret	NYJ, SAV	2,824	2,824	73,626
Amerigo Express/ MENA/MAX/MEN	CMA CGM, UASC, CSCL, Hanjin	NYJ, NFK, SAV, MIA	6,626	6,892	345,490
NUE	Evergreen	CHS, BAL, PMH, NYJ	4,483	5,086	163,619
TAE/TAS1	Evergreen, Cosco, K Line, Yangming	NYJ, NFK, CHS	5,913	6,350	308,321
PA1	G6 Alliance	NYJ, HFX, NFK, SAV	4,930	5,024	239,913
AZX	G6 Alliance	HFX, NYJ, SAV, NFK	6,828	8,063	356,074
CEC	G6 Alliance	NYJ, SAV, CHS, NFK	8,830	9,592	460,445
AX1/TA1	G6 Alliance	NYJ, NFK, CHS, SAV	8,373	8,749	436,603
NCE	G6 Alliance	NYJ, NFK, SAV	4,907	5,075	153,509
NSC (SCE/NYE)	G6 Alliance	SAV, CHS, NYJ, NFK, JAX	4,907	5,059	153,524
PA2 (old format)	G6 Alliance	MIA, JAX, SAV, CHS, NYJ, NFK	4,790	5,087	174,851
NYX	G6 Alliance	NYJ, NFK, SAV	10,014	10,055	208,858
AX2/TA3	G6 Alliance	SAV, HOU, NOL, CHS	4,883	5,024	254,614
PA2 (new format)	G6 Alliance	MIA, SAV, JAX, CHS, NFK	6,724	6,724	105,183
SVS-SVN/AUE3	G6 Alliance, Evergreen	NFK, SAV, JAX, CHS	7,217	8,580	376,324
AX3/GAX	Hapag-Lloyd	CHS, SAV, PEV, HOU, SAV, NFK	3,237	3,237	168,786
Indamex	Hapag-Lloyd, CMA CGM, NYK, OOCL	NYJ, NFK, SAV, CHS	6,435	6,589	335,520
Columbus/AAE1-ANW1/AUC1-AWN1	CMA CGM, CSCL, UASC	HFX, NYJ, PMH, SAV, CHS	8,642	9,365	450,607
Manhattan Bridge/ AAE3/AUC2/ AUC2	CSCL, CMA CGM, UASC, Hamburg Süd	NYJ, PMH, SAV, MIA	4,320	4,646	225,278
Turkon	Turkon	NYJ, NFK, SAV, PTM	1,850	1,850	75,028
Z7S (Seven Star Express)	Zim	NYJ, NFK, SAV	5,138	8,458	267,893
ZCA	Zim	HFX, NYJ, PMH, SAV	4,253	4,253	221,741
ZCP	Zim	SAV, PMH, NYJ, HFX	5,019	5,117	261,683

Source: Ocean Shipping Consultants

Together these 45 services account for 11.4 million TEU of annual capacity and include all major operators and alliance group members. The largest vessel currently deployed in the G6 Alliance's NYX operation with 10,055 TEU capacity. However, while this may be the largest single vessel, the annualised TEU capacity is perhaps a better measure because it helps to outline the level of volumes moving on the service.

New York and Savannah receive the highest number of services followed by Savannah, as Figure 19 highlights, emphasising that the East Coast of North America generally remains at least a two-call port option, with (at least one, if not two) ports used in both the north and south Atlantic regions.



4.3 Key Conclusions – Impact on Montreal

- North America has a number of well-established gateway ports on all coasts. As well as serving local hinterlands, many ports compete to meet discretionary hinterlands, such as the US Midwest.
- Any port able to serve the US Midwest will be a competitive option to Montreal. However, the port remains very competitive and largely unrivalled for its more localised regions.
- Melford Bay and Sydney International Terminal continue to maintain plans to bring their projects to fruition. However, this developments have been under consideration for a long time already without actually being able to confirm specific construction and operating dates.
- Recent investment at many ports on the East Coast of North America was concentrated on deepening water to allow larger ships to call but there is now noted major terminal infrastructure investment. However, the introduction of Contrecoeur between 2020-2025 can be undertaken without contributing to major over-capacity on the East Coast of North America.
- Ship 'cascading' will continue for deep sea trades impacting the East Coast of North America. Bigger ships passing through the Panama Canal is already underway and the trend for larger ships sailing from Asia via the Suez Canal will continue as cargo potential at Mid-East and Mediterranean hubs grows.
- The demise of Hanjin Shipping will have some minor impact on the make-up of shipping alliances, but it will not slow the process of new major alliance partnerships forming by 2017. Montreal will be largely unaffected due to the unique way it is served directly without regional competing ports on the same liner schedule. Montreal remains a dedicated trade lane of import-export activity on shipping line schedules but needs to increase capacity in the future to maximise its competitiveness.

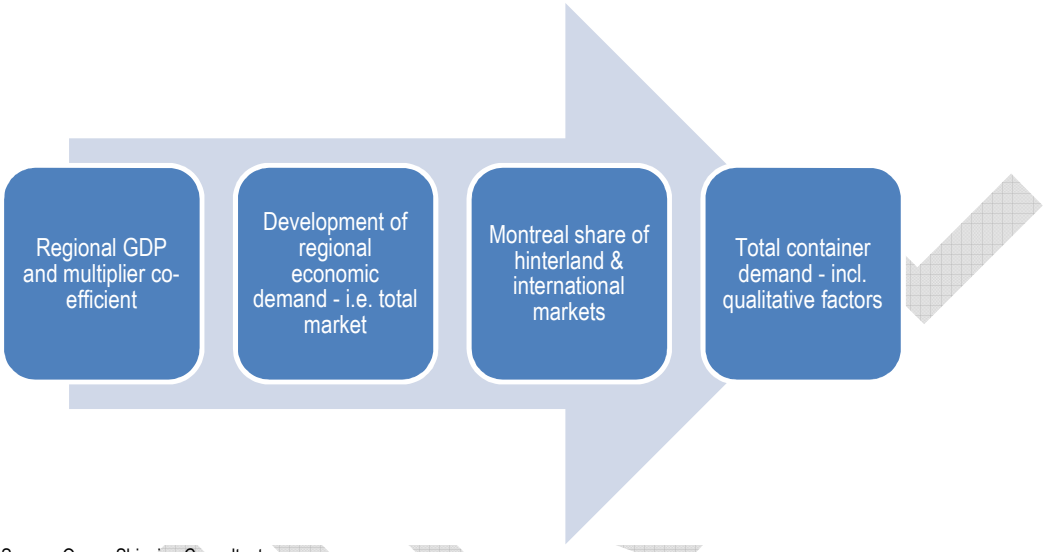
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5. PORT OF MONTREAL CONTAINER FORECASTS

5.1 Total Volumes

Before the Montreal container forecasts are shown in terms of the share per North American regional hinterland and the international markets, the first step is to provide a total for the port. As already outlined in Section 1, a four-step methodology process is utilised (as it was in the 2014 forecasts), as noted in Figure 20.

Figure 20: Summary of Forecasting Methodology Applied



Source: Ocean Shipping Consultants

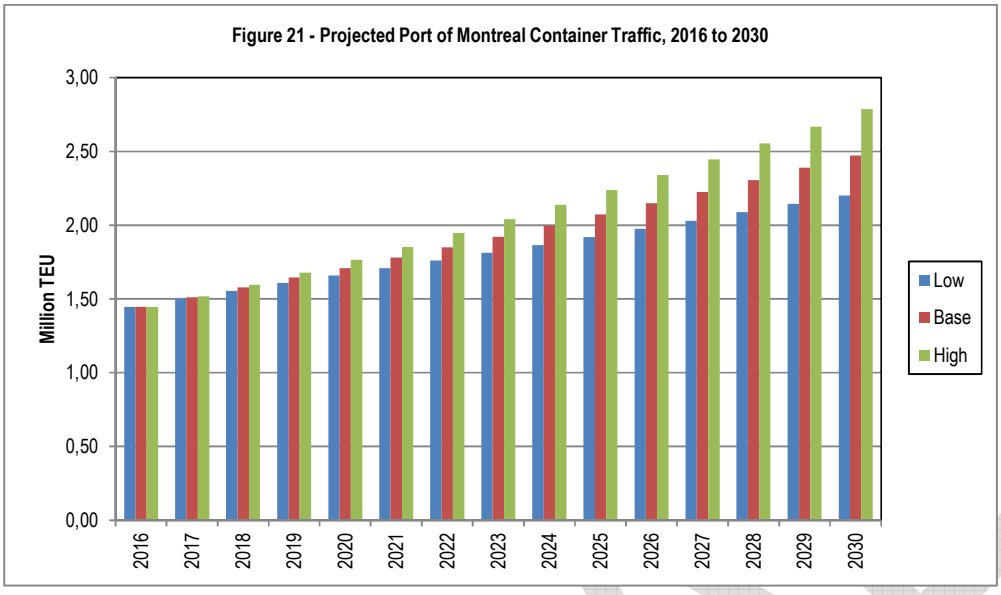
In developing estimations of the link between GDP development and overall North American container port demand, the co-efficients summarised in Table 18 have been utilised. That is to say, for example, for each percentage increase in GDP noted in the Base Case for the period between 2015-2016 an increase in port demand (container moves across the quay) of 1.7 per cent will be generated, with this figure reducing slightly over time as the economies continue to mature. The development and reduction in this co-efficient is a major aspect of demand projections used for the Montreal forecasts generated.

Table 18
Overall North American GDP Container Port Demand Multipliers

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Low	1.70	1.70	1.63	1.55	1.48	1.40	1.38	1.36	1.34	1.32	1.30	1.30	1.30	1.30	1.30	1.30
Base	1.70	1.70	1.65	1.65	1.50	1.60	1.56	1.52	1.48	1.44	1.40	1.38	1.36	1.34	1.32	1.30
High	1.70	1.70	1.70	1.70	1.70	1.70	1.66	1.62	1.58	1.54	1.50	1.48	1.46	1.44	1.42	1.40

Source: Ocean Shipping Consultants

A summary of the total container volumes for Montreal under each growth scenario to 2030 is shown in more detail in Figure 21.



The following summary of total container traffic for Montreal can be noted from 2016 when the volumes handled were at 1.45 million TEU:

- By 2020, the Base Case growth total figure will be 1.71 million TEU, with the Low Case/High Case options seeing 1.66-1.76 million TEU, respectively.
- By 2030, the Base Case option will see demand reach an estimated 2.47 million TEU, with the Low Case/High Case range being 2.20-2.79 million TEU, respectively.
- In terms of average annual growth between 2016 and 2030 the following should be noted:
  - Low Case: 3.0% per annum.
  - Base Case: 3.9 per annum.
  - High Case: 4.8% per annum.

In addition to the specific breakdown of container traffic by inland hinterland regions, international markets, split to truck & rail and share apportioned to individual port terminals, there are a number of accompanying and relevant qualitative factors that need to be included to help support the overall total port forecasts, including the following:

- **The introduction of CETA** – it is reasonable to expect this trade agreement to help with volume growth for Canadian ports. The EU region remains a key trading partner for Montreal, both in terms of North European countries and the Mediterranean area and this will not change moving forward. The introduction of any trade deal is expected to help increase overall cargo demand, although it can be difficult to quantify the exact amount. The Canadian international trade minister has already stated (in April 2016) that CETA will *"boost trade between the two sides by 23%"* which is in addition to growth otherwise seen outside CETA. The OSC forecasts already expect total North Europe traffic to rise by 48 per cent overall between 2016 and 2020, at an average of 2.0 per cent per annum during this same period. At the same time, it is important to note that while North Europe volumes will increase, they are being generated by a market region that is seeing its share of Montreal traffic actually decrease. Nevertheless, OSC does agree that CETA will certainly help aid volume potential and development to

Montreal, the forecasts provided do already take into account any potential upside generated by CETA directly.

- **Development of logistics parks** – the ability to offer distribution logistics facilities close to a marine container terminal is a major factor in helping shippers and ocean carriers with the onward movement of cargo to end user. These types of facilities represent a major factor helping a port continue to develop its volume throughput and maximise growth potential, if provided in the right location and under the right circumstances.

  In North America, the obvious example of where this strategy has been highly successful is at the Port of Savannah. Despite being an up-river port with more limited water depth (albeit that the position is being rectified with a large-scale water deepening programme), this container port has thrived over the past 10-15 years recording the highest average growth in North America since 2000 (averaging around 9.5 per cent per annum), out-performing better geographically-placed ports or those with much larger local markets to serve.

  The ability to allow shippers to distribute goods, especially via rail to more distant markets, immediately adjacent to the marine facilities has been a crucial part of the port's success because it allows the following:

  - Greatly lowers the cost (and time) from the marine terminal to distribution point where the container is emptied – there is one very short dray or an internal-port shift movement – as opposed to a trucking cost to a regional distribution centre.
  - The empty container is already at the port for return to Asia (for example) or if there is a backhaul and the unit is loaded at the warehousing at the port.
  - The Georgia Ports Authority has specifically targeted the development of relationships with major shippers and BCOs and continues to seek to bring these companies to the port directly – the traditional model of the shipping line bringing the cargo remains, but GPA itself continues to be highly pro-active in working directly with the owners of freight to meet their logistics needs, not just acting as the marine service provider. Savannah gained "first-mover" advantage in the US with its initiatives with shippers and BCOs and while other ports in the US have looked to do likewise, GPA has locked-in these freight movers to long-term contracts, while developing more logistics capacity to meet shippers and BCOs own growth. This is a strategy that can be followed in Montreal.
  - The Province's maritime policy framework involves earmarking $450 million for two logistics parks in the Greater Montreal area, including one facility at Contrecoeur. This represents a significant boost for helping to launch Contrecoeur container terminal because it will help support shipper/BCO logistics activities and distribution networks while offering potential for efficiencies and cost-savings, for serving both localised and more distant hinterlands.

- **UK "Brexit" vote** – the UK's decision to leave the EU is expected to bring shorter-term economic disruption for the UK directly, as opposed to the country's trading partners.

  As it is, while the UK is clearly an important member of the EU, for Canada it is only a relatively small trading partner and ultimately could be one that Canada develops its own direct trade deal with (as opposed to the UK being a collective part of the EU). While this process will take time, the impact on Canadian trade is not likely to be negative.

- **Role of shipping lines at Montreal** – the shipping lines calling to Montreal represent a stable and highly-knowledgeable group of operators who have (generally) served the port for a long time. The good local cargo demand and potential access to wider discretionary markets help to maintain a balanced trade, which will always appeal to ocean carriers. The port's upriver location means it is very

close to key consuming markets, meaning shorter inland time is spent getting to/from the end user. The introduction of localised logistics parks will further assist more efficient distribution of cargo arriving or departing from the Montreal container terminals.

The current (November 2016) services utilising Montreal are noted in Figure 22, sourced from the Montreal Port Authority, with the following key conclusions:

- There is a good mix of geographic regions connecting to Montreal directly – North Europe, Mediterranean, Caribbean and Africa

- Current shipping line customers are linking Montreal to major transhipment hub ports – i.e. Hapag Lloyd with Tanger-Med, Valencia and Cagliari, MSC with Gioia Tauro, Valencia and Sines, MSC with Freeport (Bah) and Caucedo. These connections will ensure that onward links to other regions is then possible by allowing container to be transhipped at these hub ports. A good example of this involves the Mid East and Asian regions.

  Currently, there are no direct services linking Montreal with these areas but as regions each are key providers of (growing) container volumes, generated by services using transhipment hubs in the Mediterranean.

- The port's shipping line customers include regular containers from four of the five largest individual operators currently available (based on TEU slots and volumes carried) – Maersk Line, MSC, CMA CGM and Hapag Lloyd (once the joint-venture with UASC is completed). These are all very well-established and stable shipping lines, a position not expected to change moving forward (ostensibly it is reasonable to assume that each ocean carrier will continue to operate and not suffer the same fate as experienced by Hanjin Shipping).

  Importantly, these are also four shipping lines who can generate significant volumes and will be able to support future capacity expansion at Montreal (indeed, these are operators who will expect to see extra capacity being developed in the future, to keep pace with their own growth plans).

- There is a good mix of different terminal use at Montreal by the shipping lines – this will help spread the degree of risk to the port authority, rather than have too much volume concentrated at too few facilities.

- The utilisation percentage share of the North European services is high for inbound ships, meaning that volume demand remains good, although an upsize in ships will be needed to avoid volume growth stagnation. For Mediterranean (and, therefore, both Mid East and Asia) services there is some scope for utilisation to increase, as expected moving forward.

  However, to keep pace with Asian demand, in particular, an increase in ship size is anticipated at some point moving forward. The Montreal Port Authority and government/state authorities are assessing the potential for deepening the St Lawrence River.

Figure 22: Montreal Container Service Profile, November 2016

	Service	Carriers	AVG Vessel Size	Rotation	Terminal

North Europe	AT 1 / GEX 1 / MTL Express	HL / MSC / OOCL	3,100 TEU	Antwerp, Bremerhaven, Le Havre, Liverpool	Cast : HL / OOCL Maisonn: MSC
	AT 2 / GEX 2	HL / OOCL	3,401 TEU	Hamburg, Southampton, Antwerp	Cast
	Canada Atlantic Service	Maersk Line / CMA CGM	2,215 TEU	Antwerp, Bremerhaven, Rotterdam, Halifax	Racine
MED	MCA	HL	2,737 TEU	Algeciras, Valencia, Cagliari, Salerno, Livorno, Genoa, Fos, Tangier-Med, Vigo	Racine
	Canada Express 1	MSC	2,722 TEU	Genoa, Livorno,, Gioia Tauro, Sines	Maisonneuve
	Canada Express 2	MSC	2,722 TEU	Valencia, Sines	Maisonneuve
Caribbean	Canada Gulf Bridge Service	MSC	2,221 TEU	St John, Freeport , Houston-Bayport, Veracruz, Altamira, Philadelphia	Viau / Maisonneuve
Africa	US-SA multipurpose	CSAL	—	Baltimore, Savannah, Tampa, New Orleans, Houston, Dakar, Onne, Durban, Cape Town, Walvis Bay, Richards Bay	Racine
Domestic	MTL-NFD Services	Oceanex	1,070 TEU	St Johns (NFD)	Bickerdike

Source: Montreal Port Authority

- **Balanced trade** – Montreal retains a highly unique ability to offer shipping lines that call the opportunity to ensure that there is a full discharge and load. This is very rare in North American ports (and indeed many ports on a global basis) and is proof of a good market to be served and appeals to shipping lines who do not have to endure the issue of serving unbalanced trades (which can mean ships entering or leaving more empty).

The container forecasts for Montreal are shown individually for each of the following key components within Section 5.2 to Section 5.6:

- Hinterland regions.
- International markets.
- Split between truck and rail.
- Split to inbound/outbound and full/empty traffic.
- Volumes per terminal at the port.

After these individual breakdowns, the total port supply-demand balance is also identified, to help indicate when future overall container traffic congestion can be anticipated.

5.2 Hinterland Regions

The major hinterland region container markets are as follows:

- Quebec – where Montreal enjoys a dominant market position. In the current analysis the position in 2013 is taken to comprise all containers shipped via Montreal to Quebec markets. Based on origin and

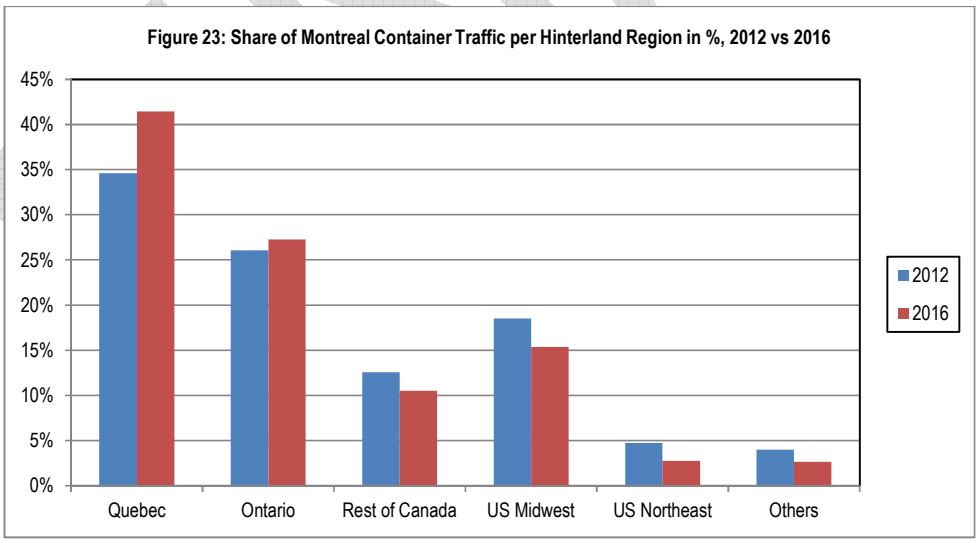
destination markets served by Halifax, an allowance has also been made for the share of this port's hinterland demand that moves through Montreal. At present no significant volumes are shipped from other ports to/from these markets. Volumes continue to grow, from 542, 800 TEU in 2013, to an estimated 592,800 for 2016, and the trend is expected to continue.

- Ontario - a significant transit market for Montreal. At present the primary routings for these containers are via Vancouver (and Prince Rupert) and Montreal. Once again, only negligible container volumes are currently shipped to these markets via US ports and Montreal's traffic levels are increasing, from 352,800 TEU in 2013 to over 390,400 TEU by 2016. Again, this trend is expected to continue.

- Other Canada - demand generated from other Canadian Provinces including shipments via the Pacific Gateway (Vancouver and Prince Rupert). A smaller total volume in 2013 of 108,500 TEU, but continuing to increase and by 2016 estimated to have reached 144,600 TEU.

- US Midwest - by far the largest potential market where Montreal has a role (although its share of this enormous volume is limited). The total container demand generated by this region, which can be served by all seaboards in North America and includes transit via Canadian ports remains highly competitive. The degree to which Montreal can maintain an economic and competitive service to these markets will be of central significance to the port's future demand potential. The 2013 confirmed total of 230,700 TEU has remained largely consistent since, with only a very small decline by 2016 to 216,900 TEU. However, it is anticipated that Montreal can increase this volume of traffic moving forward.

Figure 23 provides a summary of the short-term recent share development of each of the existing hinterland markets served by Montreal. The strong position of both Quebec and Ontario is noticeable, representing the two most dominant regions, a position that is expected to continue moving forward.



The future development of each of these markets is shown in Table 19. The methodology is based on the approach already outlined and the projected demand is provided to give an indication of the size of the total market in which Montreal can compete in moving forward. Positive annual growth is expected in each region to 2030, although the higher increases are likely in the US and Midwest due to predicted robust economic growth expectations.

Table 19

Forecast Potential Volume Development for Key Montreal Markets to 2030
- million TEU

	2016	2017	2018	2019	2020	2025	2030	CAGR '16-'30
Low								
Quebec	0.66	0.68	0.70	0.71	0.73	0.81	0.89	2.0%
Ontario	1.81	1.87	1.93	1.99	2.05	2.34	2.72	2.8%
Other Canada	1.00	1.04	1.07	1.10	1.13	1.27	1.41	2.3%
US & Midwest	12.63	13.21	13.80	14.38	14.96	17.94	21.23	3.5%
Others	1.50	1.55	1.60	1.65	1.69	1.90	2.11	2.3%
Base								
Quebec	0.66	0.68	0.70	0.72	0.74	0.85	0.96	2.6%
Ontario	1.81	1.88	1.96	2.03	2.10	2.51	2.93	3.3%
Other Canada	1.00	1.04	1.08	1.12	1.16	1.34	1.54	2.9%
US & Midwest	12.63	13.32	14.02	14.76	15.47	19.62	24.27	4.5%
Others	1.50	1.56	1.62	1.68	1.74	2.02	2.31	2.9%
High								
Quebec	0.66	0.68	0.71	0.74	0.76	0.90	1.05	3.1%
Ontario	1.81	1.89	1.97	2.07	2.16	2.68	3.25	4.0%
Other Canada	1.00	1.02	1.07	1.12	1.17	1.41	1.66	3.5%
US & Midwest	12.63	13.45	14.29	15.19	16.14	21.56	28.00	5.5%
Others	1.50	1.54	1.61	1.68	1.76	2.12	2.50	3.5%

Source: Ocean Shipping Consultants

For each of these markets that Montreal will continue to compete to serve, it will be the delivered costs of containers that will be the primary determinant of the port's market share, although there are other important factors too. For example, the availability of container capacity at marine terminals, access to trucking and intermodal rail and use of high-quality logistics distribution warehousing activities close to the port are all crucial factors.

Analysis confirms that in 2016 Montreal enjoyed the following shares of the key identified markets, which is derived by utilizing the port's recent volumes for each region as a share of the total demand available in each area:

- Quebec – 89.5 per cent;
- Ontario – 21.6 per cent;
- Other Canada – 14.5 per cent;
- US & Midwest – 2.1 per cent;
- Others – 3.9 per cent.

The degree to which these market shares will be sustained in the forecast period will be a key driver of port volumes.

Montreal is a well-established port option in these markets and the key determinant will be inland transport costs. The port is competitive locally and for transit but the position is set to change if Montreal remains limited by current draught restrictions and other ports, especially NY/NJ, Norfolk and Savannah are able to handle much larger vessels.

The future shares of these markets retained by Montreal are largely a qualitative assessment, albeit based on recent trends and the competitive strengths that the port can offer. Table 20 provides an overview of the Low Case, Base Case and High Case share options, with the following key conclusions:

- **Low Case** – continued increases in Quebec and Ontario shares, with Other Canada and Others remaining constant. A very minor increase in US & Midwest share.

- **Base Case** – slightly stronger growth in Quebec and Ontario shares, with Other Canada and Others again remaining constant. A marginally higher growth attracted of US & Midwest markets.

- **High Case** – Quebec and Ontario continue to rise by a bigger amount, with Other Canada and Others again staying constant. The US & Midwest markets rise to 2.4 per cent by 2040.

The rationale supporting these projected shares is largely as follows:

- Montreal will remain the dominant port for Quebec and the trend will continue. Incidentally, in 2013 Montreal retained an estimated share of this region of 92.5 per cent, so the longer term share returning to 92.6 per cent by 2030 is not unreasonable amount based on the very recent high share the port has retained and its competitive strengths moving forward.

- There have already been some small increases in Ontario share in the past couple of years, rising from 21.3 per cent for 2013, so the port's additional capacity, deeper access channels and excellent geographic location means Montreal remains the best-placed facility for these markets.

- US & Midwest remains the major volume market and also the most highly competitive. Montreal already retains a very small share of this traffic and potential exists to see some increases in share, even if just of a very small conservative amount as estimated in this analysis, for the following key reasons:

    - **Capacity** - good future terminal capacity available to facilitate container volume growth at the port, with potential for more capacity at Contrecoeur delivered without contributing to over-capacity at East Coast of North America container ports.

    - **Very solid and growing local markets** – i.e. shipping lines are calling with local cargo already and will continue to want to do so, hence could be tempted to fill larger ships with additional cargo for the US & Midwest as the ship will be calling to Montreal regardless. This is important – if a ship is already calling to Montreal for local cargo, then to help fill a (larger) ship, the ability to add cargo for other hinterlands is also possible, especially if Montreal is offering good intermodal rail services or regional logistics capabilities.

    - **Fast-growing shipping line customers** – i.e. while MSC's operating philosophy is to utilise Montreal for local cargo only, it is reasonable to assume the ocean carrier will, in time, look to also bring other region cargo on the same ships to help serve these markets.

    - **Logistics developments** – the availability of good-quality logistics facilities locally to the port will appeal to some shippers/ocean carriers. The Province's maritime framework earmarks $450 million to develop two logistics parks in the Greater Montreal area, including one at Contrecoeur. This will allow more cost-effective distribution of cargo to local and more distant hinterlands, including the US & Midwest

    - **Competitive alternative to US ports** – Montreal can be a viable option to these markets compared to other ports in the US, especially if there is congestion or operating issues (as evidenced from time-to-time at NY/NJ, for example).

    It should be noted that the increase in share attributed to Montreal is based on the current figure of 2.1% rising to a maximum of 2.3% by 2030. Even maintaining the current share will see volumes increase because the US & Midwest is itself a growing market.

Table 20
Forecast Montreal Market Share in Key Markets to 2030 in %

	2016	2017	2018	2019	2020	2025	2030

Low							
Quebec	89.8%	90.0%	90.1%	90.3%	90.4%	91.2%	91.9%
Ontario	21.6%	21.7%	21.9%	22.0%	22.2%	22.9%	23.7%
Other Canada	14.5%	14.5%	14.5%	14.5%	14.5%	14.5%	14.5%
US & Midwest	2.1%	2.1%	2.1%	2.1%	2.1%	2.2%	2.2%
Others	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%
Base							
Quebec	89.8%	90.0%	90.2%	90.4%	90.6%	91.6%	92.6%
Ontario	21.6%	21.8%	22.0%	22.2%	22.4%	23.4%	24.4%
Other Canada	14.5%	14.5%	14.5%	14.5%	14.5%	14.5%	14.5%
US & Midwest	2.1%	2.1%	2.1%	2.1%	2.1%	2.2%	2.3%
Others	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%
High							
Quebec	89.8%	90.1%	90.3%	90.6%	90.8%	92.1%	93.3%
Ontario	21.6%	21.8%	22.1%	22.3%	22.6%	23.8%	25.1%
Other Canada	14.5%	14.5%	14.5%	14.5%	14.5%	14.5%	14.5%
US & Midwest	2.1%	2.1%	2.1%	2.1%	2.1%	2.2%	2.3%
Others	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%

Source: Ocean Shipping Consultants

The hinterland outlook for demand at Montreal is positive moving forward, especially in the key markets served. The competitive position of the port's terminals will allow demand to expand steadily in line with the expansion of the various hinterland markets.

As Table 21 shows, under the Base Case it is anticipated that demand will increase by an average of over 4.2 per cent per annum until 2020, with each market offering a contribution to the growing total. By the end of the study period in 2030 a total of 2.47 million TEU is anticipated, with Quebec providing 0.89 million TEU, Ontario reaching 0.71 million TEU and the US Midwest markets a further 0.55 million TEU.

The Low Case and High Case growth options provide alternate volume ranges for each of the same hinterland markets, with all demand growth firmly based upon both local and transit container volumes.

The range of possible demand development under alternate cases is placed at between 2.70 million TEU and 2.78 million TEU in 2030, or for the short term to 2020 average annual growth of almost 3.5 per cent (Low Case) or 5.1 per cent (High Case).

It has been assumed that laden volumes will account for 88% of the total and empties contributing the remaining 12%. This split of projected container volumes is addressed in Section 4.5.

Each growth option records anticipated positive increase for Montreal across the hinterland markets served in the short and longer term.

Table 21
Forecast Total Montreal Volumes to 2030 - Hinterland Regions
- million TEU

	2016	2017	2018	2019	2020	2025	2030	CAGR '16-'30
Low								
Quebec	0.59	0.61	0.63	0.64	0.66	0.74	0.82	2.3%
Ontario	0.39	0.41	0.42	0.44	0.45	0.54	0.63	3.5%
Other Canada	0.14	0.15	0.15	0.16	0.16	0.18	0.20	2.5%
US & Midwest	0.26	0.27	0.29	0.30	0.31	0.39	0.47	4.3%
Others	0.06	0.06	0.06	0.06	0.07	0.07	0.08	2.5%
Total	**1.45**	**1.50**	**1.55**	**1.61**	**1.66**	**1.92**	**2.20**	**3.0%**
Growth % p.a. to 2020		*3.7%*	*3.5%*	*3.4%*	*3.2%*			
Base								
Quebec	0.59	0.61	0.63	0.65	0.67	0.78	0.89	3.0%
Ontario	0.39	0.41	0.43	0.45	0.47	0.59	0.71	4.4%

Other Canada	0.14	0.15	0.16	0.16	0.17	0.19	0.22	3.1%
US & Midwest	0.26	0.28	0.29	0.31	0.33	0.43	0.55	5.5%
Others	0.06	0.06	0.06	0.06	0.07	0.08	0.09	3.1%
Total	**1.45**	**1.51**	**1.58**	**1.64**	**1.71**	**2.07**	**2.47**	**3.9%**
Growth % p.a. to 2020		*4.5%*	*4.3%*	*4.3%*	*3.9%*			
High								
Quebec	0.59	0.62	0.64	0.67	0.69	0.83	0.98	3.6%
Ontario	0.39	0.41	0.44	0.46	0.49	0.64	0.81	5.4%
Other Canada	0.14	0.15	0.16	0.16	0.17	0.20	0.24	3.7%
US & Midwest	0.26	0.28	0.30	0.32	0.35	0.48	0.66	6.8%
Others	0.06	0.06	0.06	0.06	0.07	0.08	0.10	3.7%
Total	**1.45**	**1.52**	**1.59**	**1.68**	**1.76**	**2.24**	**2.78**	**4.8%**
Growth % p.a. to 2020		*4.8%*	*5.2%*	*5.1%*	*5.1%*			

Source: Ocean Shipping Consultants

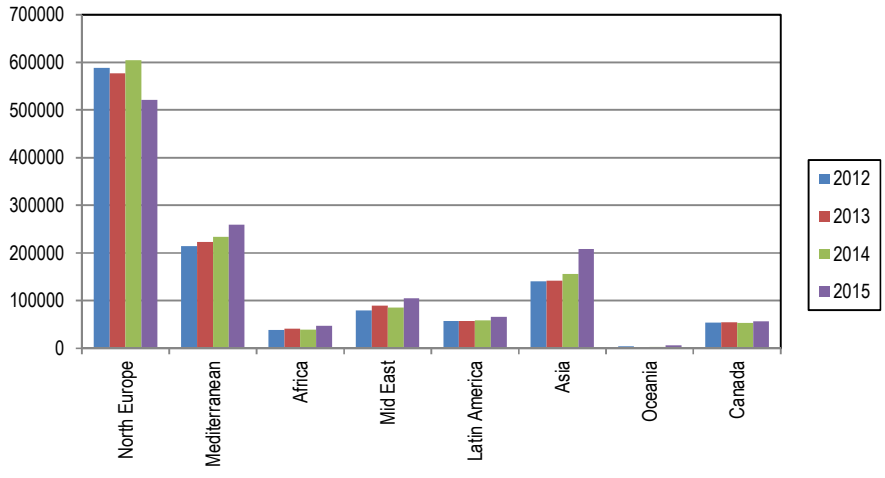
5.3 International Markets

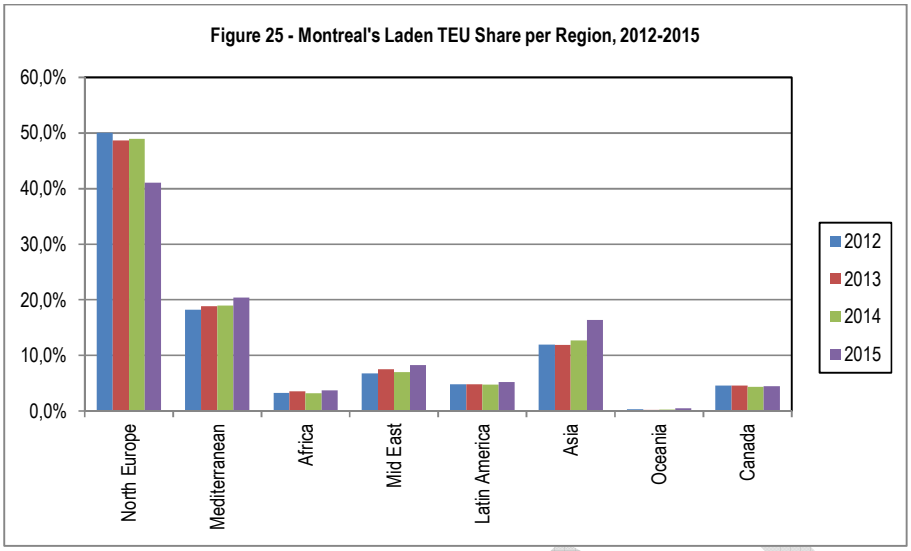
For the international markets responsible for generating/receiving Montreal's container cargo a consistent methodology and approach is maintained and the share of total projected traffic is attributable to each geographic region globally. Identifying the share moving to/from these global regions effectively identifies the trade lanes too.

The first step is to identify the current known laden volumes and share for of the port's container traffic for each of the geographic regions under consideration. These are shown in Figure 24 and Figure 25 for the period 2012 to 2015, with the following notable conclusions for this short-term recent period:

- A sharp decline in North Europe, from 50.0 per cent to 41.1%
- Small rises in the Mediterranean (18.2 per cent to 20.4 per cent), Africa (3.3 per cent to 3.7 per cent), Mid East (6.8 per cent to 8.3 per cent) and Latin America (4.8 per cent to 5.2 per cent).
- A notable rise in Asian traffic, from 12.0 per cent to 16.4 per cent.
- Canadian share remaining constant at around 4.5/4.6 per cent.

Figure 24: Montreal's Laden TEU Volumes per Region, 2012-2015





The next step is to take a qualitative view on how these shares per region could change in the future. The ability to handle larger ships is crucial to maintaining share of Asian traffic and with deeper water this region will see its share increase, while a similar trend is anticipated for the Mediterranean activity and some increases in the share of traffic moving to/from Africa and Mid East will also be gained – again, continued access to key Mediterranean hubs is important and will be governed by which shipping lines offer services. It is envisaged that MSC, for example, will remain crucial in this respect.

As a result of projected growth in share of Montreal traffic moving to/from Asia, Latin America and the Mid East, the traditional North Europe markets will see a decrease in share. This is consistent with trade demand and Montreal's changing shipping line customer dynamics.

Figure 26 outlines the noted changes over the assessment period. It is important to note that the North Europe share will decline but slowly and over a relatively long period of time, but is clearly being offset by good increases in other markets where demand itself will grow more strongly – the net conclusion is Montreal will be seeing more traffic moving to/from faster-growing regions.

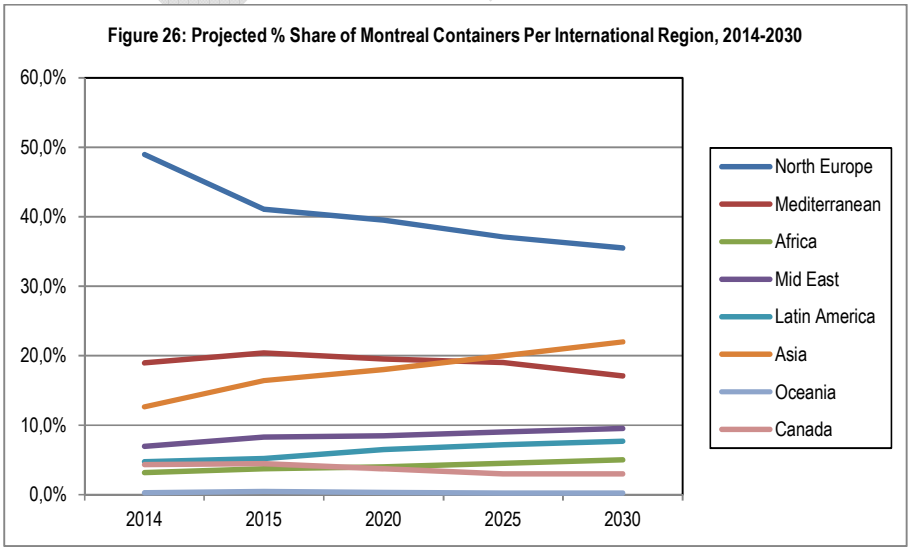


Table 22 provides a more specific breakdown of the share per international region to 2030, with these figures subsequently applied to the container projections over the forecast period.

Table 22

Share of Montreal Traffic per International Region to 2030 in %

	North Europe	Mediterranean	Africa	Mid East	Latin America	Asia	Oceania	Canada	Total
2014	49.0%	18.9%	3.2%	7.0%	4.7%	12.6%	0.3%	4.3%	100%
2015	41.1%	20.4%	3.7%	8.3%	5.2%	16.4%	0.5%	4.5%	100%
2020	39.5%	19.5%	4.0%	8.5%	6.5%	18.0%	0.3%	3.7%	100%
2025	37.1%	19.0%	4.5%	9.0%	7.2%	20.0%	0.2%	3.0%	100%
2030	35.5%	17.1%	5.0%	9.5%	7.7%	22.0%	0.2%	3.0%	100%

Source: Ocean Shipping Consultants

The starting point is the 2015 share generated by each international region, as noted. Taking these items into account and following a consistent methodology, Table 23 offers confirmation of the projected volumes for each region to 2030. The following key conclusions remain noteworthy:

- Volume growth is expected under each of the three economic scenarios during each of the five-year periods, though the CAGRs and traffic levels are quite varied.
- North Europe will continue to be the largest individual area, rising from 594,000 TEU in 2014 to 674,000 TEU in 2020 and then reaching 878,000 TEU by 2030 under the Base Case option. The Low Case-High Case range for this region will be 782,000-989,000 TEU in 2030. The CAGR for the period 2016-2030 is 2.8 per cent under the Base Case scenario, reflecting consistent increases in a mature market.
- Good annual volume growth is anticipated from all other international regions too, including the Mediterranean, Africa, Mid East, Latin America and Asia. Notably, by 2030 Base Case annual growth for Latin America and Asia will generate demand increases of 6.9 per cent and 6.1 per cent, respectively.
- Growth in Asian traffic is especially notable, with the 2016 total of 237,000 TEU rising to 308,000 TEU by 2020 and then 544,000 TEU by 2030 under the Base Case growth option.
- The Mid East region is also expected to see good annual growth and under the Base Case growth scenario the 2016 total of 120,000 TEU is projected to be 145,000 TEU by 2020 and 235,000 TEU by 2030 – reflective of 4.9 per cent average annual growth. The Low Case/High Case scenarios will see average growth of 4.1 per cent and 5.8 per cent per annum, respectively. Along with the Mediterranean, this region is an integral part of the introduction of larger ships entering East-West trade routes, with known port developments for handling transhipment traffic moving to more distant geographic locations via hub ports – these connections will further enhance Montreal's ability to increase its global geographic coverage away from just the traditional North Europe region.

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Table 23

Total Montreal Container Forecasts in Million TEU per International Region to 2030

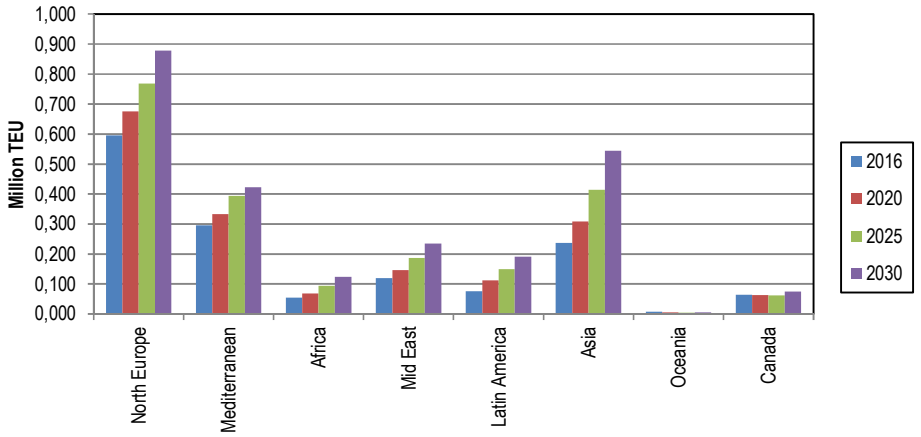
Low	North Europe	Mediterranean	Africa	Mid East	Latin America	Asia	Oceania	Canada	Total
2016	0.59	0.30	0.05	0.12	0.08	0.24	0.01	0.06	1.45
2020	0.66	0.32	0.07	0.14	0.11	0.30	0.00	0.06	1.66
2025	0.71	0.36	0.09	0.17	0.14	0.38	0.00	0.06	1.92
2030	0.78	0.38	0.11	0.21	0.17	0.48	0.00	0.07	2.20
CAGR	**2.0%**	**1.8%**	**5.2%**	**4.1%**	**6.0%**	**5.2%**	**-3.0%**	**0.2%**	**3.0%**
Base	**North Europe**	**Mediterranean**	**Africa**	**Mid East**	**Latin America**	**Asia**	**Oceania**	**Canada**	**Total**
2016	0.59	0.30	0.05	0.12	0.08	0.24	0.01	0.06	1.45
2020	0.67	0.33	0.07	0.15	0.11	0.31	0.01	0.06	1.71
2025	0.77	0.39	0.09	0.19	0.15	0.41	0.00	0.06	2.07
2030	0.88	0.42	0.12	0.23	0.19	0.54	0.00	0.07	2.47
CAGR	**2.8%**	**2.6%**	**6.1%**	**4.9%**	**6.9%**	**6.1%**	**-2.2%**	**1.0%**	**3.9%**
High	**North Europe**	**Mediterranean**	**Africa**	**Mid East**	**Latin America**	**Asia**	**Oceania**	**Canada**	**Total**
2016	0.59	0.30	0.05	0.12	0.08	0.24	0.01	0.06	1.45
2020	0.63	0.30	0.09	0.17	0.14	0.39	0.00	0.05	1.76
2025	0.83	0.43	0.10	0.20	0.16	0.45	0.00	0.07	2.24
2030	0.99	0.48	0.14	0.26	0.21	0.61	0.01	0.08	2.79
CAGR	**3.7%**	**3.5%**	**7.0%**	**5.8%**	**7.8%**	**7.0%**	**-1.4%**	**1.9%**	**4.8%**

Source: Ocean Shipping Consultants

Looking further at the Base Case international market projections to 2030, as shown in Figure 27, the importance and volumes associated with the North Europe region are still highly important. This market will remain the largest to Montreal in overall cargo total terms, even if growth itself on an annual basis will be much lower (not unsurprising for a large, mature economy).

Nevertheless, the potential offered by Asia, in particular, followed by the Mid East, Latin America and Africa is noteworthy and moving forward the degree of risk for Montreal because of its exposure to few larger markets will definitely be improved upon. The port will be serving a higher number of growing regions, underpinned by its larger traditional trading partners.

Figure 27: Projected Base Case Volume Development per Region, 2016-2030

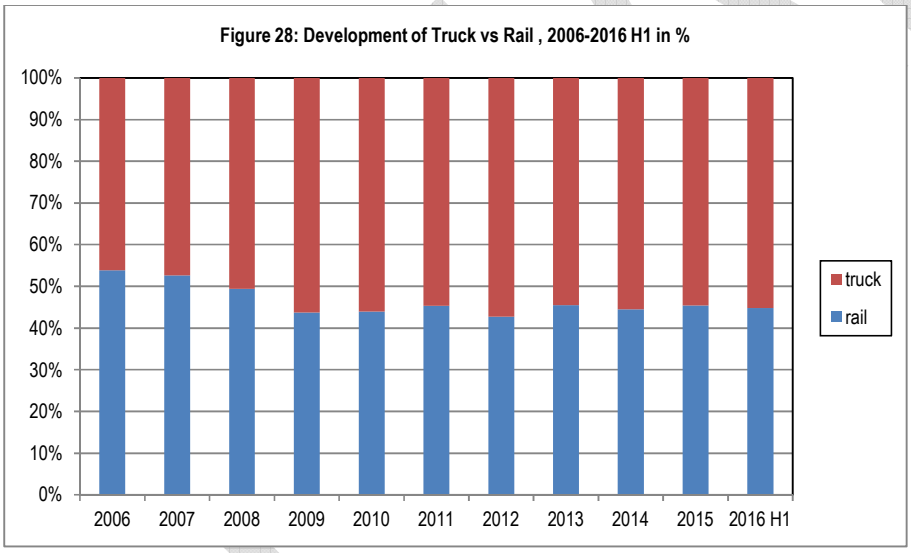


5.4 Truck & Rail Traffic Projections

Container volumes enter/leave Montreal's terminals by both truck and rail and offering efficient, non-congested infrastructure to service both options in the future remains of paramount importance to the success of the port. Admittedly, the Port Authority has limited direct control over the road network to/from its terminal boundaries, although maintaining strong, workable relationships with local and state authorities to help influence infrastructure policy and investment will remain a primary objective to continue to adopt.

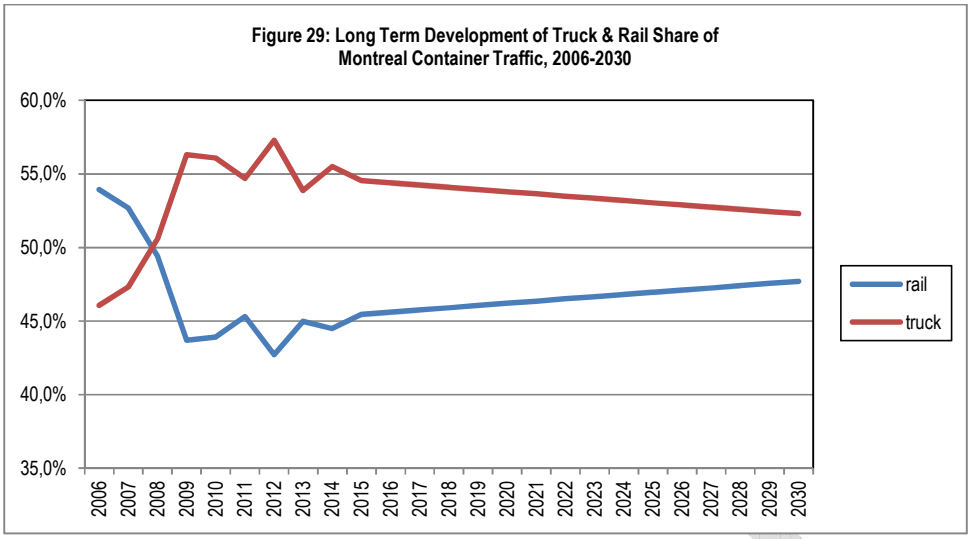
Figure 28 provides a summary of the share of truck and rail splits at Montreal in the period 2006 to H1 2016, with the following noted conclusions over this 10-year period:

- In 2006, the truck share was 46.1 per cent, with rail at 53.9 per cent, but by 2012 the amount moving via road had risen to 57.3 per cent, with rail falling to 42.7 per cent.
- Since 2012, the amount of containers going via rail has increased, with H1 2016 seeing a rise to 44.8 per cent of containers handled, with trucking falling back to 55.2 per cent.
- This trend is expected to continue for the forecast period. Montreal's local markets will continue to be served by trucks, but the port's competitiveness in serving US and Midwest markets via rail will see the difference in share between the two modes reduce.



Therefore, taking into account current and projected trends, Figure 29 offers an assessment of the anticipated long-term share of both truck and rail, which includes the recent historic position back to 2006. It is reasonable to expect the share of truck to continue to increase, while rail declines, albeit this will occur slowly

Shipping line activity will play some part in the trend too, for example the expected strong growth of MSC volumes at the port for local markets will be in contrast to the more conservative activities of Hapag Lloyd (which remains the current main provider of US & Midwest container activity). However, stronger rail volumes support the port's ability to compete for, and grow, its share of US and Midwest markets.



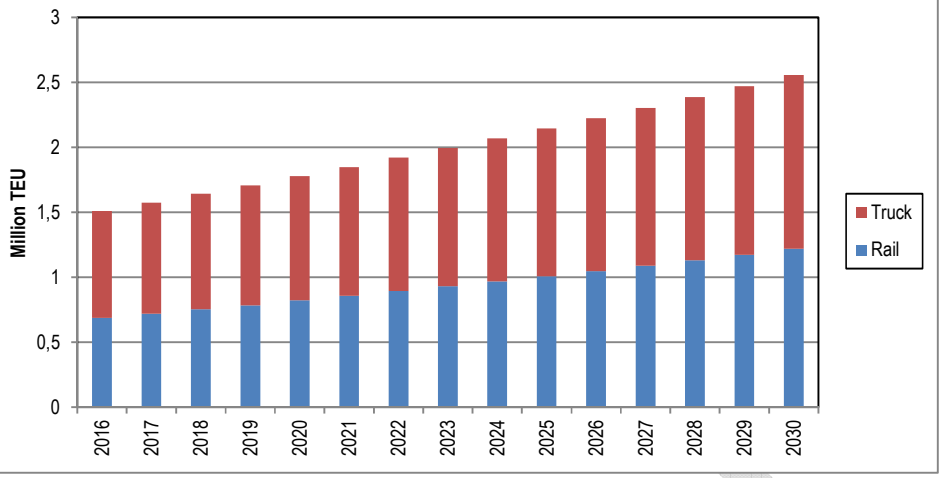
Using this projected split between truck and rail and the noted Montreal forecasts already established, Figure 30 gives an overview of the projected container volumes for each transportation mode:

- Truck volumes will increase from the 822,500 TEU in 2016 (a share of 54.4 per cent of total activity) to almost 956,900 TEU by 2020 (53.8 per cent) and nearly 1.34 million TEU by 2030 (52.3 per cent).
- Rail activity will rise from the 2016 figure of over 689,600 TEU (45.6 per cent) to almost 822,000 TEU in 2020 (46.2 per cent) and almost 1.22 million TEU by 2030 (47.7 per cent).
- Clearly, both truck and rail will remain highly crucial methods for the movement of containers to/from Montreal's container terminals, although the method used will continue to be influenced by the markets served. The local areas around the port will always be met by trucking and the port's development of supporting items like IT (i.e. trucking application for use by drivers and transport companies) and good gate access will ensure the smooth flow of trucks in and out of terminals.

  The ability to leverage existing rail infrastructure to/from the port's terminals is crucial as future cargo demand involves the ability to reach markets like the US Midwest. It is assumed that the port and the rail services available are able to continue to keep pace with future demand. This demand, and Montreal's competitiveness in serving it, will primarily dictate the difference between truck and rail. The truck demand will continue to be driven by the extent of volume growth in regions closer to the port, although it is believed that Montreal will over the forecast period see the gap narrowing.

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Figure 30: Projected Volumes of Montreal Container Traffic by Truck & Rail, to 2030



5.5 Volume Dynamics - Inbound/Outbound, Empty/Laden

Using recent container trends for inbound/outbound and empty/laden shares, it is possible to apportion the total Montreal container volumes to 2030. Each of these two components will be assessed separately.

Inbound/Outbound Volumes

In terms of container volumes entering or leaving Montreal, Figure 31 offers a summary of the development between 2008 and 2015, with the following noted conclusions:

- Before the Global Financial Crisis of 2008, higher volumes of containers were leaving Montreal compared the levels of activity entering the port's terminals.
- There was an overall drop in volumes from 2009 onwards, although outbound activity has remained the slightly more dominant activity – albeit that the difference between the inbound/outbound containers has decreased.
- In specific terms, in 2008 inbound containers accounted for a share of 47.5 per cent, compared to the 52.5 per cent for outbound boxes. By 2014, inbound had risen to 49.7 per cent and outbound fallen to 50.3 per cent.
- In 2015 inbound activity became the slightly larger component, generating a share of 50.3 per cent, while outbound was 49.7 per cent.

It is important to note that the key trend is how Montreal will remain a very balanced port in terms of inbound/outbound traffic. The percentage variance between these two types of traffic will also be small, further appealing to shipping line customers able to undertake a full discharge and a full load of containers per call.

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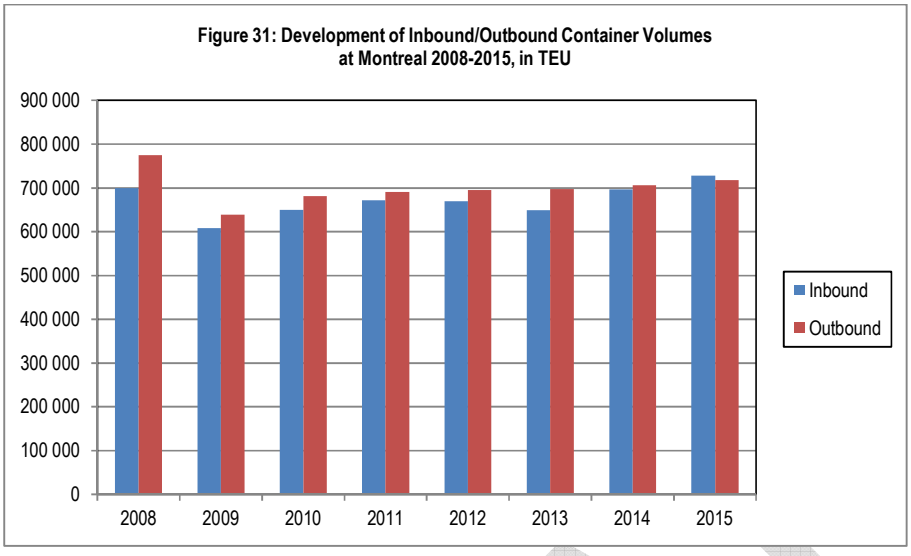
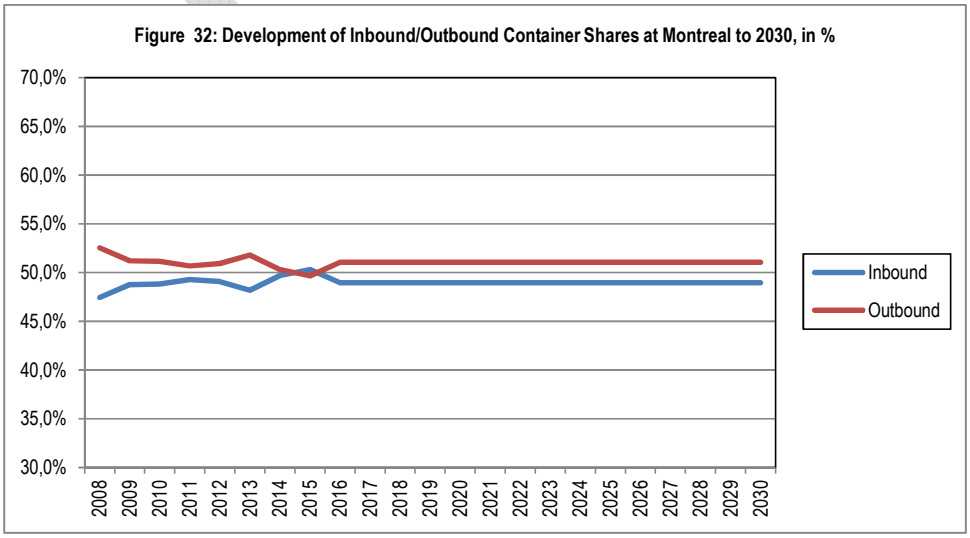


Figure 32 outlines the expected inbound/outbound container shares in the period to 2030, with the following projections showing that the trade activity in Montreal will remain balanced:

- Inbound share to rise from 50.3 per cent in 2016 to 50.4 per cent by 2020 and 50.7 per cent in 2030.
- Outbound share to fall from 49.7 per cent in 2016 to 49.6 per cent by 2020 and 49.3 per cent in 2030.

It is noted that there are plans in the Greater Montreal area to develop logistics parks and distribution warehousing. This is an initiative that could help to boost inbound container traffic, as has been noted in other ports in North America. The obvious example that can draw parallels to Montreal is at Savannah in Georgia, which is also an upriver port and has had a lesser water depth than at other, competing facilities.

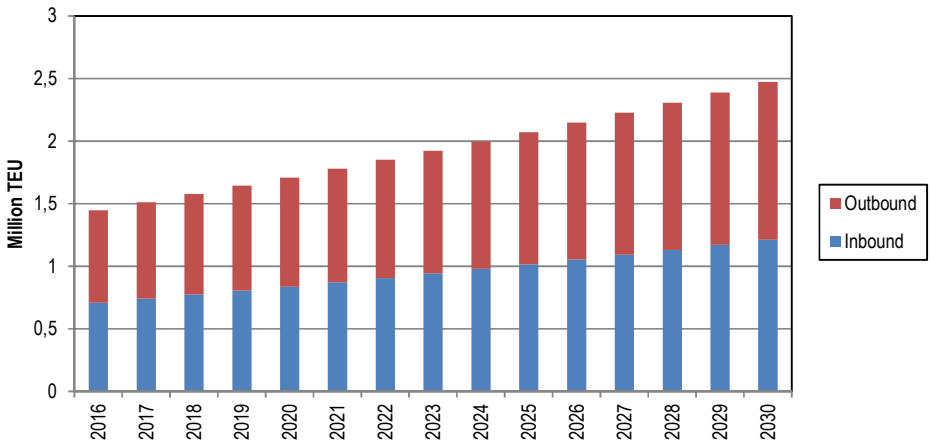
Through the continued development of more distribution warehousing, that allows cargo to be removed from containers at or very close to the port and then placed onto the rail network (which allows the empty container to be available for a quicker and more cost-effective return via ship), Savannah has been able to maintain very good container demand growth. There are notable similarities between Montreal and Savannah that can be noted, which means the development of distribution warehousing serving Montreal's terminals can aid future inbound demand growth.



Taking into account the projected share for inbound/outbound containers and Montreal's forecasts to 2030, Figure 33 offers confirmation of the Base Case split for these two key components, with the following summary clearly showing that the port will continue to serve highly-balanced trade:

- Inbound volumes will increase from 708,600 TEU in 2016 to 836,500 TEU in 2020, then reaching 1.01 million TEU in 2025 and almost 1.21 million TEU by 2030.
- Outbound volumes in 2016 of almost 739,000 TEU are expected to reach 872,200 TEU by 2020, before rising to almost 1.06 million TEU by 2025 and 1.26 million TEU by the end of 2030.

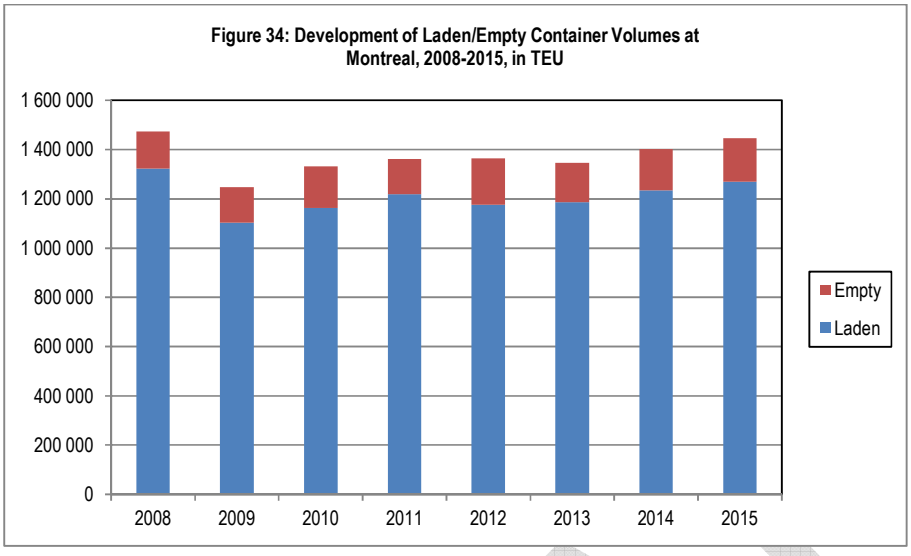
Figure 33:Development of Base Case Inbound/Outbound Container Traffic at Montreal to 2030



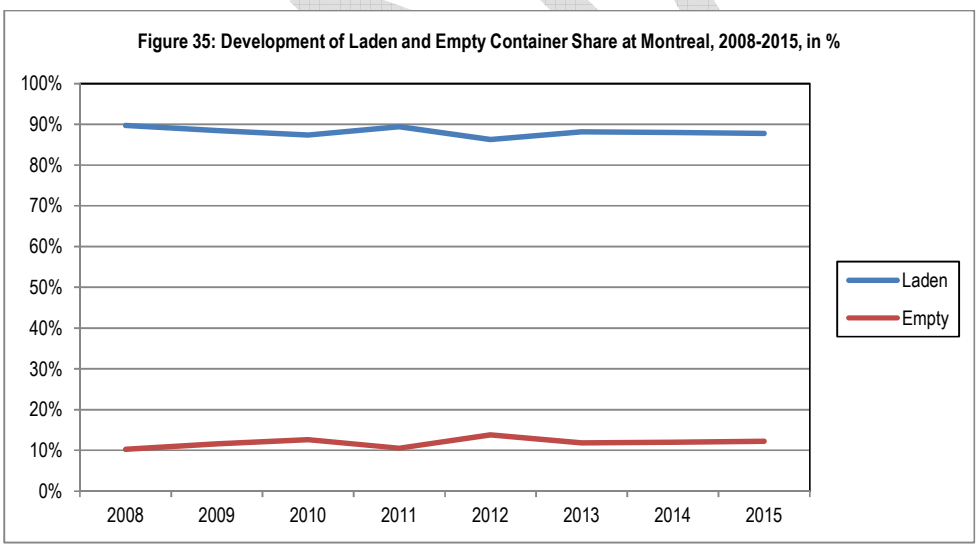
Empty/Laden Volumes

With Montreal being a largely balanced container trade, the share of empty units moving has remained relatively low in terms of share of activity and this position is expected to continue moving forward.

Figure 34 outlines the development of both laden and empty container volumes at the port since 2008, when laden containers totalled 1.32 million TEU, with empties contributing 151,100 TEU – this equated to an empty share of around 10 per cent of the port's total.



The overall level of consistency between laden and empty units in Montreal can be noted from Figure 35. Although there has been some very minor fluctuation, with the 2012 share of 14 per cent empties equating to 1.18 million TEU of laden containers and 187,700 TEU of empty units, a more typical 12 per cent is a reasonable assumption to apply to future forecast levels.



On the basis of Montreal remaining a very balanced port in terms of imports and exports and the recent short-term consistency of empties representing 12 per cent of total container activity, applying this same share to the forecasts generated is a reasonable and prudent approach. Figure 36 provides confirmation of the forecasts for each of these two components, with the following to be noted:

- The 2016 laden total of 1.27 million TEU will rise to 1.50 million TEU in 2020 and over 2.17 million TEU by 2030 – equivalent to a consistent share of 88 per cent of total container volumes.

- For empties, the total of 173,700 TEU in 2016 is expected to reach 205,000 TEU in 2020 and almost 296,700 TEU by then end of 2030 – equal to empty units representing a consistent 12 per share of total container volumes.

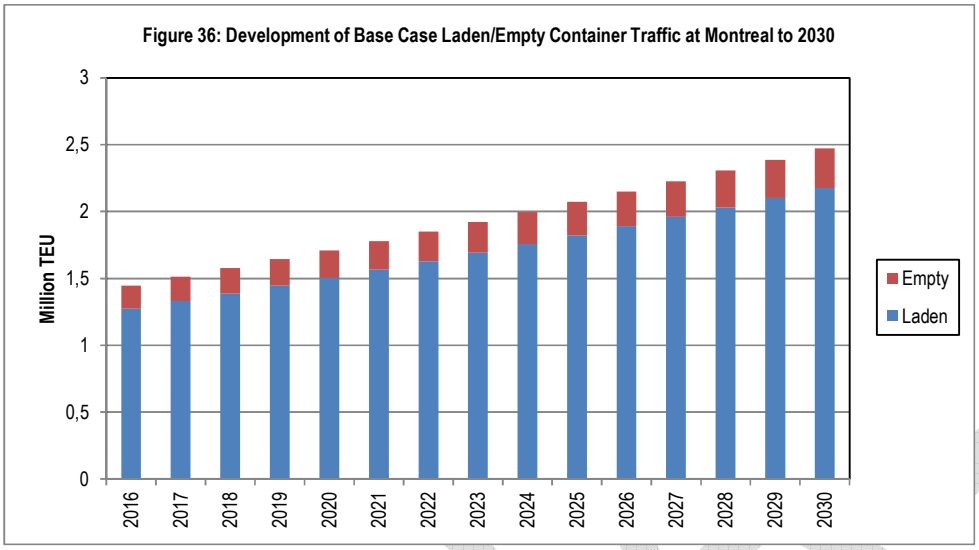


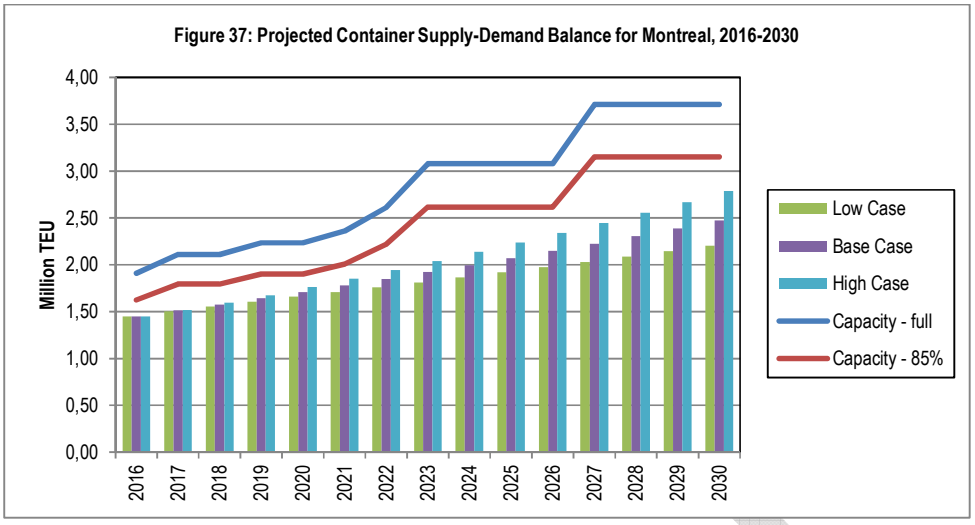
Figure 36: Development of Base Case Laden/Empty Container Traffic at Montreal to 2030

5.6 Port of Montreal Supply-Demand Analysis

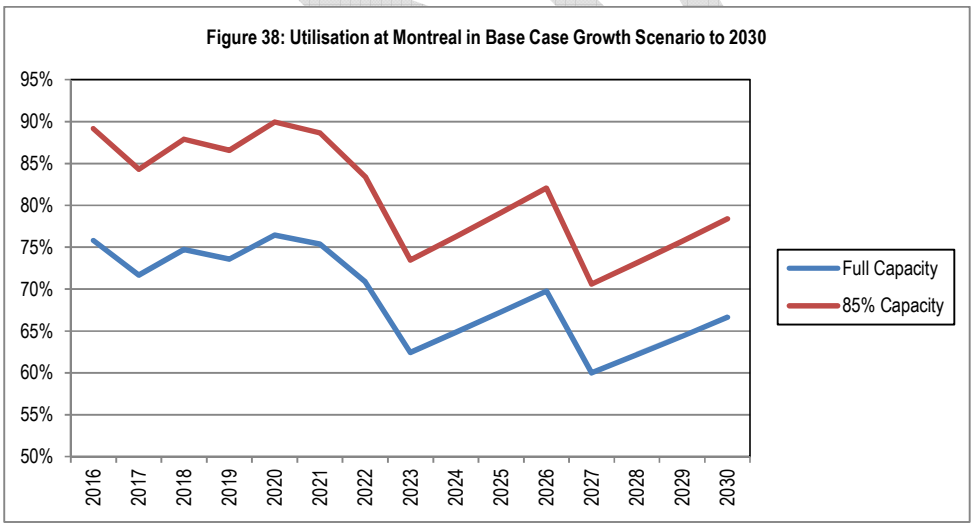
Based on the container forecasts generated already and the anticipated level of capacity likely to be available moving forward, it is possible to provide a supply-demand analysis for Montreal in overall terms, which will help to determine when terminal congestion is likely to occur and under which demand growth scenario.

Figure 37 takes the Low Case, Base Case and High Case demand projections for the port and compares each to two different capacity scenarios for the period to 2030:

1. Where 100 per cent of capacity is available
2. Where 85 per cent of capacity is used (on the basis that after 85 per cent terminals become congested and the operation is then working at less than optimal efficiency).

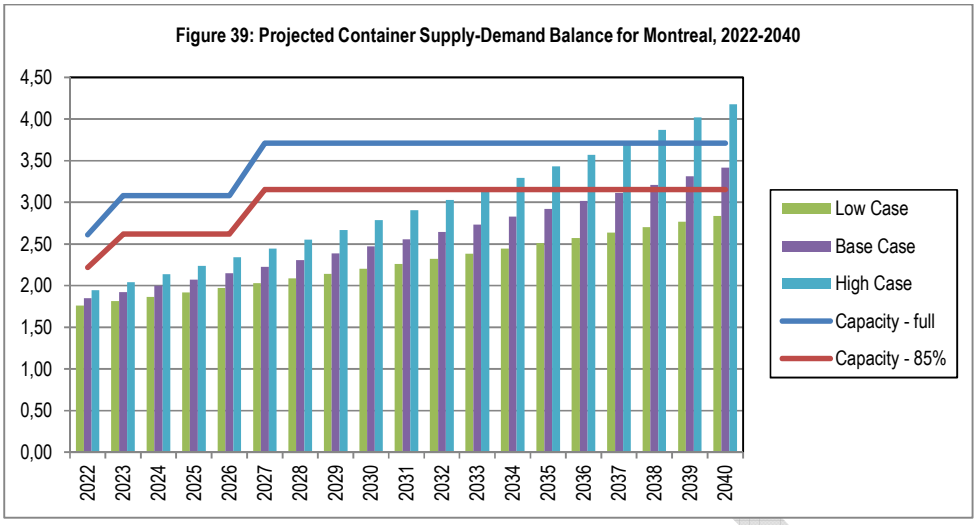


The impact of the supply-demand analysis can also be noted in Figure 38, which takes base case demand growth and relates it to amount of overall port capacity available. The introduction of capacity during the assessment period sees utilisation fall on several occasions, most notably in 2023 and again in 2027 when the Contrecoeur facility opens and expands. However, from 2027 onwards the level of utilisation soon begins to rise once again.



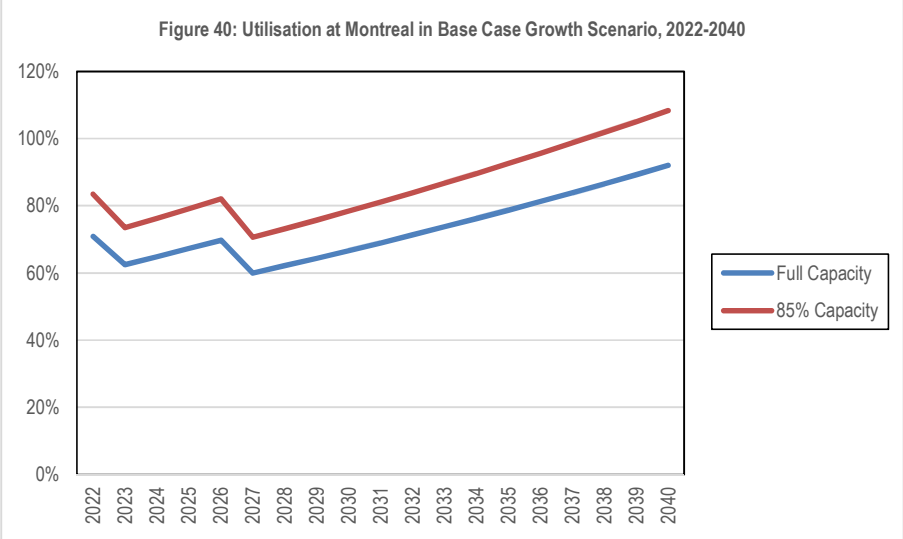
The need for additional capacity, while ensuring the optimum level of operating efficiency is maintained, is clearly evident moving forward over the longer term, even allowing for the subsequent development of Contrecoeur.

As Figure 39 notes, without further capacity additions Montreal will be enduring substantial congestion during the mid-2030s, even under the Low Case growth option.



Indeed, the growing higher levels of utilisation at the port can be clearly seen in Figure 40, which takes Base Case container growth and plots against the 85% capacity and full capacity levels.

The addition of capacity during the 2020s does lower the estimated utilisation but expected continued container demand thereafter means that by the mid-2030s there will be growing levels of congestion being endured by the port, with the situation continuing so that by the end of the decade the 85% capacity assessment will seem estimated utilisation above 100%.



5.7 Key Conclusions – Impact on Montreal

- Good container volume demand exists for Montreal moving forward. In the period to 2030, average growth of almost 4% per annum is expected under the Base Case growth option.

- Montreal is expected to remain a largely balanced port, with a consistent share of empties units moving. This is helped by the fact that shipping lines schedule calls primarily with the aim of a full discharge/load, a largely unique value proposition to the ports liner customers.
- It is reasonable to expect CETA to help drive overall demand, although there are other more tangible factors supporting growth at Montreal, including
    - Shipping line customers – major shipping lines who are leading operators able to generate sizeable volumes, including Hapag Lloyd (with potential to see UASC containers), CMA CGM and MSC.
    - Development of logistics parks and distribution warehousing in the Greater Montreal area are particularly important to support demand growth of shippers and help with supply-chain efficiencies and potential network cost-savings.
- Emerging economies will take a growing share of Montreal's container demand, with Asia (including India), the Mid East and Latin America offsetting the slower growth of mature and traditional regions, such as North Europe.
- Montreal's balanced trade will continue to appeal to its shipping line customers and the port will remain a dedicated trade lane on ocean carrier schedules. The good local hinterland demand will be complemented with the ability to compete for discretionary regions too, such as the US Midwest.
- The port will need to ensure sufficient terminal capacity is available and it can handle the cascading impact of bigger container ships wanting to call in the future. Contrecoeur capacity is needed in the early 2020s and can be delivered without contributing to any major over-supply of capacity on the East Coast of North America region. Further forward, Montreal will need to ensure further capacity is available in the 2030s.

FINAL

Étude sectorielle No. 30

Rapport d’étude d’impact en éclairage



SNC·LAVALIN

PORT DE MONTRÉAL
DÉVELOPPEMENT CONTRECOEUR

RAPPORT D'ÉTUDE D'IMPACT EN ÉCLAIRAGE
RÉVISION 03

PORT DE MONTRÉAL



Infrastructures

2017 | 07 | 17

Rapport
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1. OBJECTIF DE L'ÉTUDE

Les nouveaux secteurs de manutention des conteneurs, prévus dans le cadre du projet d'agrandissement du terminal portuaire de Contrecœur, seront éclairés pour permettre les opérations après le coucher du soleil. Cette étude vise à présenter des concepts et des solutions pour l'implantation d'un éclairage extérieur minimisant les impacts sur l'environnement adjacent au site, en plus de s'inscrire dans un objectif de réduction de la pollution lumineuse.

La présente étude traite quatre (4) zones éclairées de l'agrandissement projeté; soit la zone couvrant la cour de conteneurs et de déchargement des navires, le stationnement situé à l'ouest du site, la zone avec plusieurs voies ferroviaires en parallèle et le chemin d'accès emprunté par les camions, entre la cour et la Route 132. Les autres aires d'entreposage et de manutention sont considérées non éclairées sur la base des documents d'ingénierie consultés.

De plus, l'étude inclura aussi une grille de calcul d'éclairage en bordure des îles Bouchard et Saint-Sulpice afin de s'assurer qu'aucun éclairage des nouvelles installations ne se rende à ces îles.

2. ANALYSE DES VARIANTES D'AMÉNAGEMENT 1 ET 2

Au niveau des variantes du projet, il est à remarquer que la seule différence, en ce qui a trait aux zones éclairées, se situe au niveau du chemin d'accès emprunté par les camions donnant sur la Route 132. Dans la variante 1, le chemin d'accès arrive perpendiculairement à la Route 132, en face des installations d'Air Liquide Canada inc. Dans la variante 2, le chemin d'accès arrive aussi perpendiculairement à la Route 132, mais plus à l'est du Carrossier Pro-Color. Les deux (2) géométries de ce chemin d'accès sont sensiblement les mêmes et le concept d'éclairage présenté sera identique d'une variante à l'autre.

Pour les autres zones couvrant la cour de conteneurs et de déchargement des navires, le stationnement situé à l'ouest du site et les voies ferroviaires, ils sont de la même géométrie pour les deux (2) variantes et le concept d'éclairage présenté sera identique d'une variante à l'autre.

Afin de ne pas alourdir le présent rapport et en fonction de l'explication qui précède, seul l'éclairage de variante 1 a été simulé. Par analogie, les conclusions présentées de cette variante 1 s'appliquent entièrement à la variante 2.

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3. MÉTHODOLOGIE ET CRITÈRES D'ÉVALUATION

Afin de déterminer les impacts de l'agrandissement au niveau de la pollution lumineuse, une simulation d'éclairage informatisée a été produite à l'aide du logiciel AGI32 (version 17.5) de *Lighting Analysts Inc*., logiciel reconnu et éprouvé en simulation d'éclairage. Utilisant les données photométriques d'appareils d'éclairage réels, un modèle 3D, avec grilles de calcul de niveaux d'éclairage, a été construit et analysé.

La simulation a été effectuée afin d'obtenir un niveau d'éclairement moyen de 30 lux dans la cour des conteneurs et de 10 lux pour les voies de circulation. Cet éclairage est conforme avec les niveaux d'éclairement minimum sécuritaires, conformément au *Règlement Canadien sur la Santé et la Sécurité au Travail, Partie VI Éclairage, Annexe III* (Septembre 2016). Pour la zone ferroviaire éclairée, la simulation a été effectuée afin d'obtenir un niveau d'éclairement moyen de 30 lux dans la zone et est conforme avec les niveaux d'éclairement minimum sécuritaires recommandés par *l'Illuminating Engineering Society of North America* (IESNA).

La hauteur des lampadaires est telle que dictée à l'article 2.4.6 du document descriptif du projet préparé par l'APM en décembre 2015. Leur position ainsi que leur nombre ont été implantés de manière à obtenir les résultats escomptés et en fonction des allées d'entreposage et diffèrent de l'implantation initiale. Se référer à l'annexe 2 pour la position proposée.

Suivant cette simulation, l'évaluation de l'objectif de réduction de la pollution lumineuse des environnements adjacents au site sera faite sur deux (2) critères distincts :

- Flux lumineux horizontaux en LUX transmis au-dessus de l'horizon et indiquant la quantité d'éclairage éclairant le ciel.
- Flux lumineux verticaux en LUX traversant les limites de propriété et indiquant la quantité d'éclairage fuyant vers les propriétés voisines.

Ces critères d'analyse seront ensuite comparés et devront respecter les exigences LEED du Conseil du bâtiment durable du Canada[1]. Selon les exigences du crédit « *SS – Light Pollution Reduction* » [2], les limites d'obtention du crédit sont les suivantes :

- Pourcentage maximum de LUMENS (flux lumineux) émis au-dessus de l'horizon : 0 %
- Flux lumineux en LUX traversant verticalement la limite de propriété : 0,5 LUX (maximum)

De plus, les résultats de la simulation seront comparés avec les exigences et les recommandations de la norme BNQ 4930-100/2016 « Éclairage extérieur – Contrôle de la pollution lumineuse » en fonction de la zone d'éclairage « ZEN-1 Zone rurale », afin de s'assurer que les concepts présentés suivent les exigences de réduction de la pollution lumineuse.

[1] Critères extraits du guide de référence *CaGBC - LEED Reference Guide For Building Design And Construction* – Version 4

[2] Valeurs limites en fonction d'une zone géographique d'éclairage « LZ0 – Aucun éclairage ambiant » du guide MLO de l'*Illuminating Engineering Society (IESNA)* et l'*International Dark Sky Association (IDA). Consulter la section 3 pour la détermination de la zone géographique d'éclairage à considérer.*

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4. ÉTAT D'ÉCLAIREMENT INITIAL DES LIEUX

Afin de valider l'environnement existant pour déterminer la zone géographique d'éclairage à considérer, un relevé photométrique a été effectué le 29 septembre 2016 à 20 h avec un luxmètre de marque TES, modèle 1335 (étalonné le 2016-08-24), sur les zones éclairées qui seront situées en bordure du site, soit la cour des conteneurs (voir figure 1), la connexion du chemin d'accès des camions à la Route 132 de la variante 1 (voir figure 2) et la connexion du chemin d'accès des camions à la Route 132 de la variante 2 (voir figure 3). Les niveaux d'éclairement mesurés en LUX sont indiqués en VERT sur les figures ci-après.



Figure 1
Zone 1 : Cour des conteneurs – Source : www.google.com/maps

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Figure 2
Zone 2 : Accès camion à la Route 132 (Variante 1) – Source : www.google.com/maps

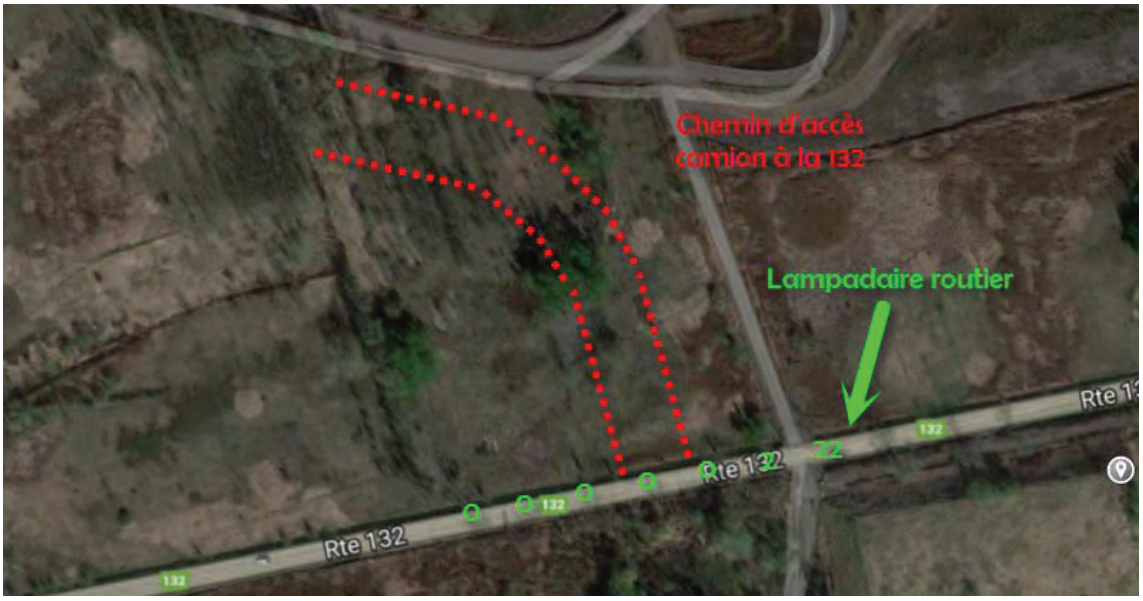


Figure 3
Zone 2 : Accès camion à la Route 132 (Variante 2) – Source : www.google.com/maps

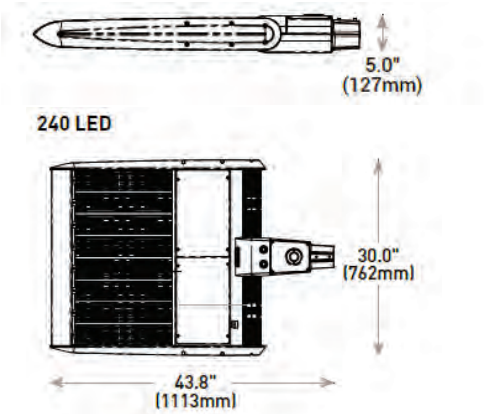
En fonction de ces relevés photométriques et en retranchant l'éclairage produit par les lampadaires routiers, nous pouvons conclure, comme indiqué à la section 2, que la zone géographique d'éclairage du secteur à l'étude correspond à la zone « LZ0 – Aucun éclairage ambiant » de l'IES/IDA. Ceci est valable pour les deux variantes de projet considérées.

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5. PROPOSITION D'APPAREILS D'ÉCLAIRAGE

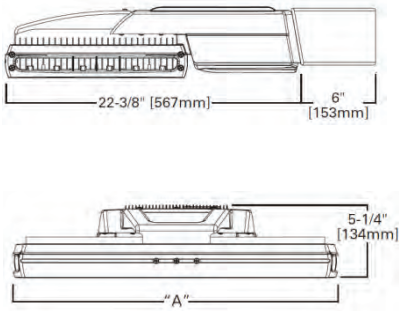
Lors de la simulation d'éclairage, des appareils d'éclairage à lampes DEL ont été utilisés sur des hauts mâts de 30 mètres dans le secteur de la cour des conteneurs. L'appareil utilisé est un luminaire de la série EDGE HIGH OUTPUT de CREE, luminaire adapté et couramment utilisé pour l'application avec haut mât.





Dans le secteur du stationnement et de la route, un luminaire d'application routière a été utilisé sur des fûts de hauteurs variables, allant de 6 mètres à 15 mètres de hauteur. L'appareil utilisé est un luminaire de la série VENTUS LED d'EATON.





De par leur construction, leur montage, et comme confirmé par des tests effectués en laboratoire indépendant, ces modèles d'appareils d'éclairage n'émettent aucun flux lumineux au-dessus de l'horizon et répondent tous au 1er critère d'analyse.

Bien que les luminaires utilisés lors du calcul d'éclairage soient des appareils adaptés pour les applications d'éclairage routier et de la cour de conteneurs, il est possible que d'autres manufacturiers offrent des appareils équivalents. Cependant, lors de la sélection de ces derniers, ils devront avoir les mêmes caractéristiques et répondre aux exigences énoncées.

Voir l'annexe 1 pour les fiches techniques des appareils d'éclairage utilisés.

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6. ÉTUDE D'IMPACT EN ÉCLAIRAGE

6.1 ANALYSE EN FONCTION DES EXIGENCES LEED

Voici les résultats de la simulation d'éclairage informatisée et réalisée avec le logiciel AGI32.

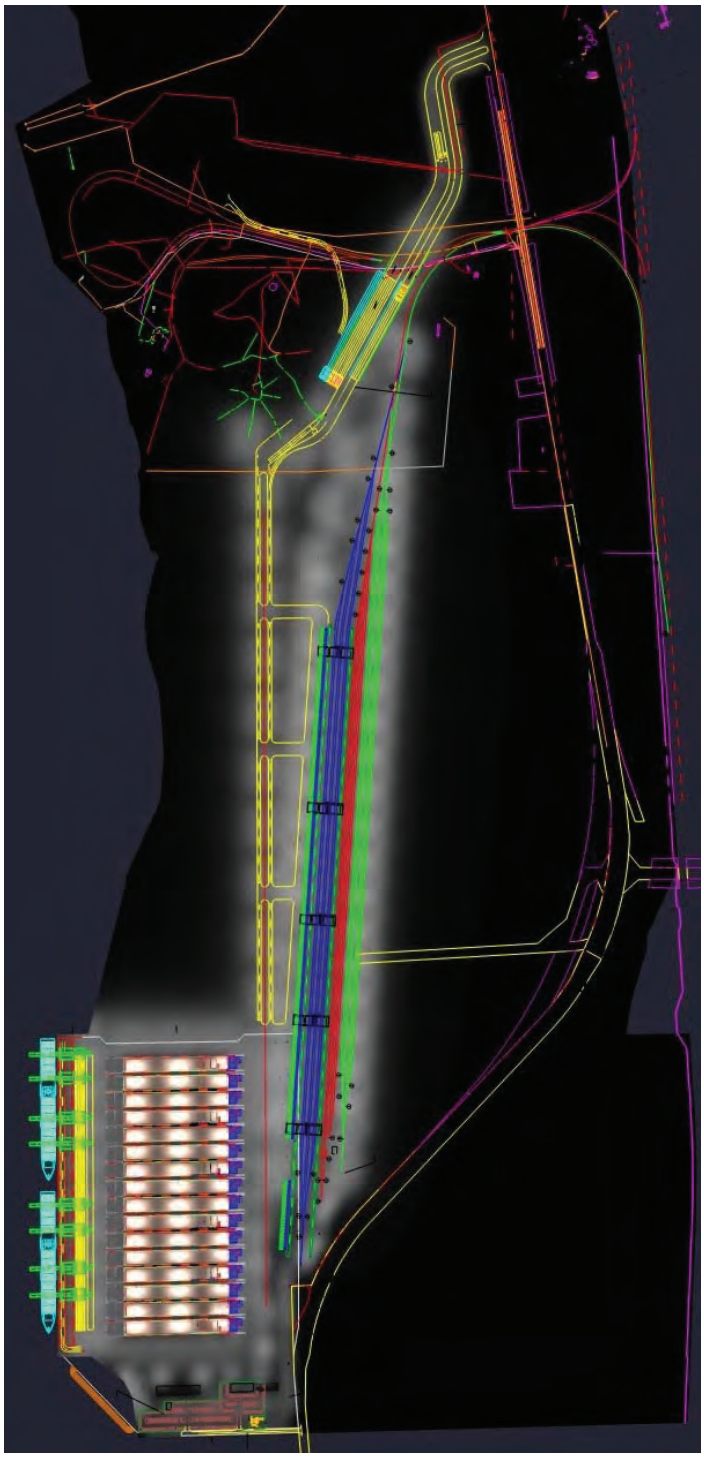
Zone d'éclairage	Niveau d'éclairement simulé *	Niveau seuil **
Cour de conteneurs	33,42 lux	> 30 lux (niveau moyen)
Chemin d'accès	23,23 lux	> 10 lux (niveau moyen)
Voie Ferroviaire	30.42 lux	> 30 lux (niveau moyen)
Bordure du site résidences Ouest (vertical)	0,5 lux	≤ 0,5 lux (maximum)
Bordure du site Route 132 Ouest (vertical)	0,5 lux	≤ 0,5 lux (maximum)
Iles Bouchard et Saint-Sulpice (vertical)	0,14 lux	≤ 0,5 lux (maximum)
Bordure du site entrée camions Route 132 (vertical)	0,4 lux	≤ 0,5 lux (maximum)

** Voir l'annexe 2 pour les résultats détaillés du calcul d'éclairage.*

*** Valeurs seuils dictés par les critères d'évaluation. Consulter la section 2.*

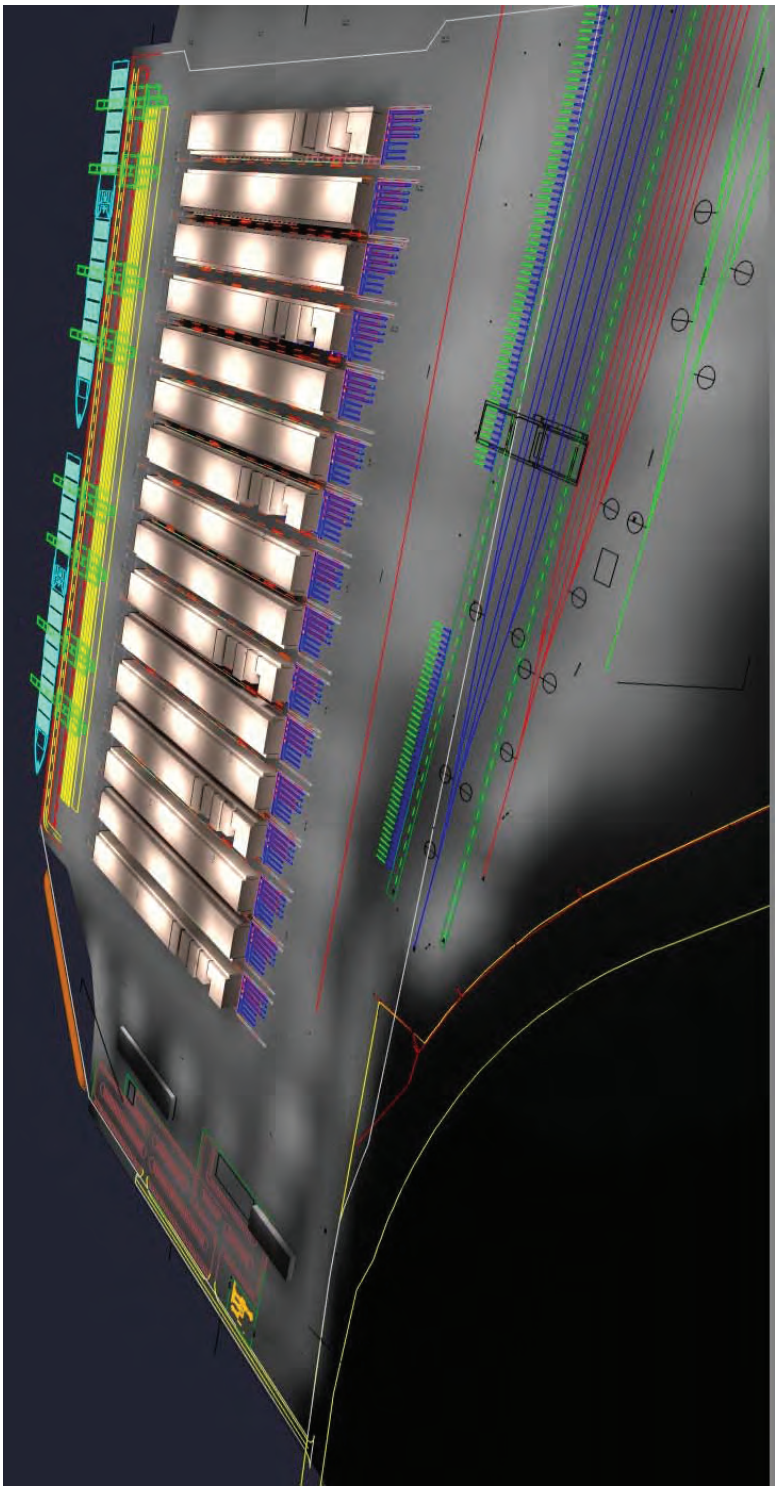
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L'impact visuel de l'implantation de l'éclairage sur les zones analysées sera le suivant :



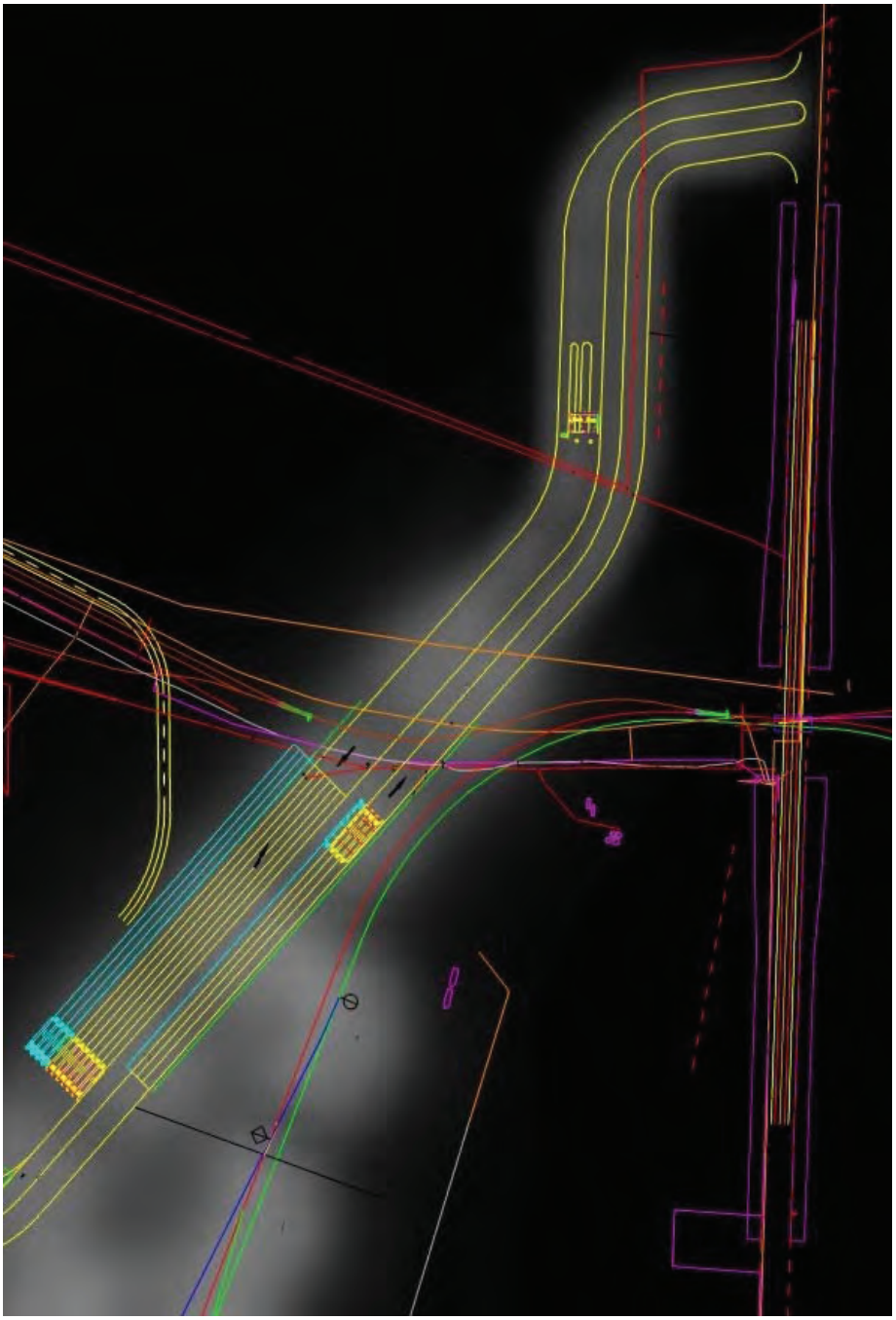
Rendu 1 : Vue en plan de l'agrandissement du terminal portuaire (Variante 1)

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Rendu 2 : Vue en perspective des installations de manutention des conteneurs (Variantes 1 et 2)

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Rendu 3 : Vue en perspective de l'entrée des camions (Variante 1)

En fonction des résultats de la simulation d'éclairage, les flux lumineux traversant les limites des propriétés sont tous inférieurs à 0,5 lux et répondent au 2e critère d'analyse.

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6.2 ANALYSE EN FONCTION DES EXIGENCES BNQ 4930-100/2016

Basé sur la définition des différentes zones d'éclairage nocturne (ZEN), le site de Contrecœur se situe dans la zone ZEN-1, car il sera implanté dans une zone rurale. En fonction des exigences du tableau A.1 et de la zone d'éclairage à considérer pour le site ZEN-1 (zone rurale), nous avons identifié trois (3) secteurs d'application où des critères sont requis. En voici l'analyse :

6.2.1 Espace industriel avec employés à l'œuvre (pour l'ensemble des zones éclairées, à l'exception du stationnement)

Les exigences de la norme du BNQ sont respectées par le concept proposé, car elles réfèrent aux exigences des règlements en Santé et sécurité pour déterminer les critères minimums à mettre en œuvre. Celles-ci ont donc été utilisées pour les simulations.

6.2.2 Espace industriel inoccupé (ex. : zones d'entreposage en vrac).

Puisque nous n'éclairons pas cette zone, l'ensemble des critères indiqués dans la norme du BNQ est par défaut respecté.

6.2.3 Espace du stationnement employé

Les exigences de réduction de flux lumineux vers le haut, de densité et de niveau d'éclairement (lux) sont respectées.

Selon le BNQ, l'éclairage devrait être automatiquement éteint 30 minutes après la fermeture du site et réduit de 75 % après 23 h (peu importe l'heure à laquelle le site ferme). Cet élément sera implanté lors de la préparation des plans et devis.

Selon le tableau, la couleur de l'éclairage de la zone du stationnement devrait être ambrée (minimalement 2200 degrés Kelvin et préférablement 1800 degrés Kelvin). Puisque le stationnement est adjacent à la cour de manœuvre des conteneurs, l'utilisation d'un éclairage ambré, à côté de l'éclairage blanc de la cour de manœuvre, aurait un impact important quant à la perception de l'éclairage, car ceci peut affecter la perception des contrastes de couleurs. L'éclairage du stationnement serait perçu très sombre par rapport à la cour de manœuvre, même si les niveaux réels mesurés sont acceptables. Basé sur la géométrie du site de Contrecœur, nous ne recommandons pas un éclairage ambré pour le stationnement, même si requis par le BNQ.

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7. CONCLUSION

Basé sur les éléments mentionnés aux sections précédentes, l'agrandissement du terminal portuaire de Contrecœur peut se faire en réduisant au minimum les effets de la pollution lumineuse sur les propriétés voisines et vers le ciel. De plus, les calculs indiquent également que les critères LEED sont aussi respectés en bordure des îles Bouchard et Saint-Sulpice, situées dans le fleuve, en face de l'agrandissement. À l'exception de la couleur d'éclairage de la partie stationnement, l'ensemble des critères BNQ sont aussi respectés.

En portant une attention particulière au choix et à la position des appareils d'éclairage, il est possible d'offrir un environnement de travail adapté aux fonctions du site, tout en respectant les critères exigeants en matière de réduction de pollution lumineuse, prescrits par le Conseil du bâtiment durable du Canada, chef de file en développement durable.

8. LIMITATIONS DU PRÉSENT RAPPORT D'ÉTUDE

Le présent rapport d'étude est destiné expressément aux fins du client.

Le contenu de ce rapport d'étude est élaboré au meilleur de notre connaissance, basé sur l'observation des lieux, des rencontres avec les responsables, des documents reçus du client ainsi que des observations faites au moment de sa rédaction. Les résultats et conclusions du présent rapport d'étude ne sont pas des certitudes absolues, mais plutôt des probabilités établies à partir de l'interprétation et de la signification des données recueillies durant le mandat.

Lors des relevés, les observations mentionnées ont été constatées et ne représentent pas nécessairement toutes les irrégularités pouvant se trouver dans les distributions électriques des diverses installations.

SNC-Lavalin inc. se réserve le droit d'amender le présent rapport d'étude, en tout ou en partie, s'il est découvert que celui-ci a été préparé à la suite de renseignements erronés. Il en sera ainsi advenant le cas où des informations complémentaires lui seraient transmises postérieurement.

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ANNEXE 1

FICHE TECHNIQUE DES APPAREILS D'ÉCLAIRAGE UTILISÉS LORS DE LA SIMULATION

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Cree Edge™ Series

LED High Output Area/Flood Luminaire featuring Cree TrueWhite® Technology

Product Description

The Cree Edge™ High Output Area/Flood luminaire is designed to deliver high lumen packages with precise optical control. The unit features a slim, low profile design that minimizes wind load and a rugged die cast aluminum adjustable arm that mounts to a horizontal or vertical 2" (51mm) IP, 2.375-2.50" (60-64mm) O.D. steel tenon. Tenon length must be a minimum of 3.75" (95mm). The direct mount bracket accessory allows for further mounting flexibility. Available with Cree TrueWhite® Technology, the Cree Edge™ High Output helps to beautifully render true colors and deliver value beyond energy savings.

Applications: Auto dealerships, parking lots, campuses, facade lighting, high-mast and general site lighting applications

Performance Summary

Utilizes Cree TrueWhite® Technology on 5000K Luminaires

Patented NanoOptic® Product Technology

Made in the U.S.A. of U.S. and imported parts

CRI: Minimum 70 CRI (4000K & 5700K); 90 CRI (5000K)

CCT: 4000K (+/- 300K), 5000K (+/- 300K), 5700K (+/- 500K) standard

Limited Warranty[1]: 10 years on luminaire/10 years on Colorfast DeltaGuard® finish

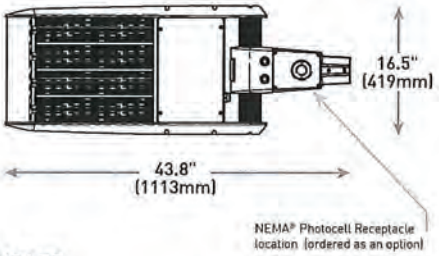
[1] See http://lighting.cree.com/warranty for warranty terms



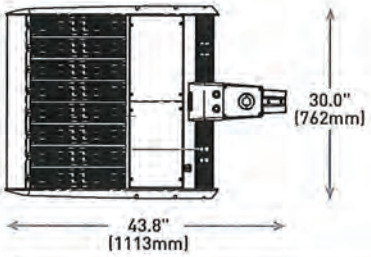
HV Mount (shown in horizontal position)



120 LED



240 LED



LED Count (x10)	Weight
12	45.3 lbs. (20.5kg)
24	80.5 lbs. (36.5kg)

HV Mount (shown in Vertical position) and Direct Mount Bracket - see page 13 for weight & dimensions

Accessories

Field-Installed	
Bird Spikes XA-BRDSPKXAK12 - 120 LED XA-BRDSPKXAK24 - 240 LED	**Backlight Control Shields** XA-30BLS-4 - Four-pack for 120 LED - Unpainted stainless steel XA-30BLS-8 - Eight-pack for 240 LED - Unpainted stainless steel

Ordering Information

Example: ARE-EHO-2M-HV-12-E-UL-SV-700

				HV		E				
Product	**Optic**			**Mounting***	**LED Count (x10)**	**Series**	**Voltage**	**Color Options**	**Drive Current**	**Options**
ARE-EHO	**2M** Type II Medium **2MB** Type II Medium w/BLS **3M** Type III Medium	**3MB** Type III Medium w/BLS **4M** Type IV Medium **4MB** Type IV Medium w/BLS	**5M** Type V Medium **5S** Type V Short **AF** Automotive Frontline-Optic™	**HV** Horizontal/ Vertical Tenon - For EHO-UNV direct mount bracket, refer to Tenons & Brackets on page 12	**12** **24**	**E**	**UL** Universal 120-277V **UH** Universal 347-480V	**BK** Black **BZ** Bronze **SV** Silver **WH** White	**700** 700mA **1000** 1000mA	**DIM 0-10V Dimming** - Control by others - Refer to Dimming spec sheet for details - Can't exceed specified drive current **F Fuse** - When code dictates fusing, use time delay fuse - Refer to ML spec sheet for availability with ML options - Not available with UH voltage - Available for U.S. applications only **ML Multi-Level** - Refer to ML spec sheet for details - Intended for downlight applications at 0° tilt - Not available with UH voltage or 240 LEDs with 1000mA drive current **R NEMA® Photocell Receptacle** - 3-pin receptacle per ANSI C136.10 - Intended for downlight applications with maximum 45° tilt - Consult factory for vertical tenon application - Photocell and shorting cap by others - Refer to ML spec sheet for availability with ML options **RL Rotate Left** - Optic is rotated to the left **RR Rotate Right** - Optic is rotated to the right **40K 4000K Color Temperature** - Minimum 70 CRI - Color temperature per luminaire **50K 5000K Color Temperature** - Minimum 90 CRI - Utilizes Cree TrueWhite® Technology - Color temperature per luminaire
FLD-EHO	**15** 15° Flood **25** 25° Flood	**40** 40° Flood **70** 70° Flood	**SN** Sign **N6** NEMA® 6							

* Reference EPA and pole configuration suitability data beginning on page 11

NOTE: Price adder may apply depending on configuration

Product Specifications

CREE TRUEWHITE® TECHNOLOGY

A revolutionary way to generate high-quality white light, Cree TrueWhite® Technology is a patented approach that delivers an exclusive combination of 90+ CRI, beautiful light characteristics and lifelong color consistency, all while maintaining high luminous efficacy – a true no compromise solution.

CONSTRUCTION & MATERIALS

- Slim, low profile, minimizing wind load
- Luminaire sides are rugged die cast aluminum with integral, weathertight LED driver compartments and high performance heat sinks
- Adjustable arm that mounts to a horizontal or vertical 2" (51mm) IP, 2.375-2.50" (60-64mm) O.D. steel tenon. Tenon length must be a minimum of 3.75" (95mm)
- Surface-mount directly to a vertical or horizontal surface with direct mount bracket (refer to Tenons and Brackets table on page 12)
- Luminaire may be field adjusted for use in uplight position. Please refer to installation instructions for details
- Extruded aluminum adjustable mounting shaft
- Luminaire is adjustable from horizontal 90° towards pole and 120° away from pole
- Exclusive Colorfast DeltaGuard® finish features an E-Coat epoxy primer with an ultra-durable powder topcoat, providing excellent resistance to corrosion, ultraviolet degradation and abrasion. Silver, bronze, black, and white are available
- **Weight:** See weight charts on pages 1 and 13

ELECTRICAL SYSTEM

- **Input Voltage:** 120-277V or 347-480V, 50/60Hz, Class 1 drivers
- **Power Factor:** > 0.9 at full load
- **Total Harmonic Distortion:** < 20% at full load
- Integral 10kV surge suppression protection standard
- When code dictates fusing, a slow blow fuse or type C/D breaker should be used to address inrush current
- **Maximum 10V Source Current:** 120 LED: 0.40mA; 240 LED: 0.80mA

REGULATORY & VOLUNTARY QUALIFICATIONS

- cULus Listed
- Suitable for wet locations
- Consult factory for CE Certified products
- 10kV surge suppression protection tested in accordance with IEEE/ANSI C62.41.2
- Meets FCC Part 15, Subpart B, Class A standards for conducted and radiated emissions
- Certified to ANSI C136.31-2001, 3G bridge and overpass vibration standards
- DLC qualified. Exceptions apply when ordered with backlight control, 5000K CCT with 1000mA drive current, or 5000K CCT with 700mA drive current and 2M, 3M, 4M, 5M, 5S, AF or 70 optics. Please refer to www.designlights.org/QPL for most current information
- Luminaire and finish endurance tested to withstand 5,000 hours of elevated ambient salt fog conditions as defined in ASTM Standard B 117
- Meets Buy American requirements within ARRA
- RoHS compliant. Consult factory for additional details

Electrical Data*

LED Count (x10)	System Watts 120-480V	Total Current (A)					
		120V	208V	240V	277V	347V	480V
700mA							
12	267	2.24	1.29	1.12	0.99	0.80	0.58
24	533	4.49	2.57	2.24	1.97	1.62	1.16
1000mA							
12	421	3.61	2.06	1.80	1.61	1.25	0.90
24	831	7.16	4.04	3.54	3.14	2.50	1.81

* Electrical data at 25°C (77°F). Actual wattage may differ by +/- 10% when operating between 120-480V +/- 10%

Recommended Cree Edge™ High Output Series Lumen Maintenance Factors (LMF)[1]

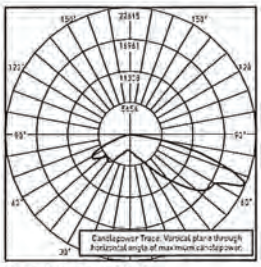
Ambient	Initial LMF	25K hr Projected[2] LMF	50K hr Projected[2] LMF	75K hr Calculated[3] LMF	100K hr Calculated[3] LMF
5°C (41°F)	1.04	1.01	0.99	0.98	0.96
10°C (50°F)	1.03	1.00	0.98	0.97	0.95
15°C (59°F)	1.02	0.99	0.97	0.96	0.94
20°C (68°F)	1.01	0.98	0.96	0.95	0.93
25°C (77°F)	1.00	0.97	0.95	0.94	0.92

[1] Lumen maintenance values at 25°C are calculated per TM-21 based on LM-80 data and in-situ luminaire testing
[2] In accordance with IESNA TM-21-11, Projected Values represent interpolated value based on time durations that are within six times (6X) the IESNA LM-80-08 total test duration (in hours) for the device under testing (IDUT) i.e. the packaged LED chip)
[3] In accordance with IESNA TM-21-11, Calculated Values represent time durations that exceed six times (6X) the IESNA LM-80-08 total test duration (in hours) for the device under testing (IDUT) i.e. the packaged LED chip)

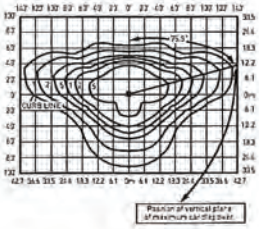
Photometry

All published luminaire photometric testing performed to IESNA LM-79-08 standards by a NVLAP accredited laboratory. To obtain an IES file specific to your project consult: http://lighting.cree.com/products/outdoor/area/cree-edge-high-output-1

2M



ITL Test Report #: 78643
ARE-EHO-2M-**-12-E-UL-1000-40K
Initial Delivered Lumens: 32,284

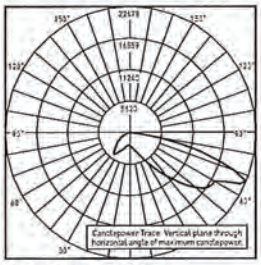


ARE-EHO-2M-**-24-E-UL-1000-50K
Mounting Height: 25' (7.6m) A.F.G.
Initial Delivered Lumens: 53,859
Initial FC at grade

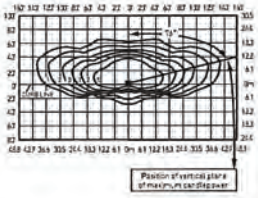
Type II Medium Distribution						
LED Count (x10)	4000K		5000K		5700K	
	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11
700mA						
12	25,637	B4 U1 G4	19,661	B3 U1 G3	26,173	B4 U1 G4
24	51,307	B5 U1 G5	39,348	B4 U1 G4	52,379	B5 U1 G5
1000mA						
12	35,102	B4 U1 G4	26,913	B4 U1 G4	35,815	B4 U1 G4
24	70,248	B5 U1 G5	53,859	B5 U1 G5	71,675	B5 U1 G5

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens
** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: www.ies.org/PDF/Erratas/TM-15-11BugRatingsAddendum.pdf. Valid with no tilt

2MB



ITL Test Report #: 78683
ARE-EHO-2MB-**-12-E-UL-1000-40K
Initial Delivered Lumens: 24,579



ARE-EHO-2MB-**-24-E-UL-1000-50K
Mounting Height: 25' (7.6m) A.F.G.
Initial Delivered Lumens: 40,569
Initial FC at grade

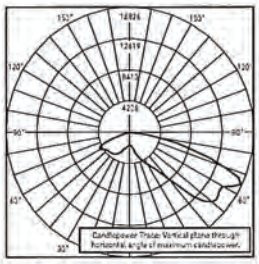
Type II Medium w/BLS Distribution						
LED Count (x10)	4000K		5000K		5700K	
	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11
700mA						
12	19,311	B2 U1 G3	14,810	B2 U1 G2	19,715	B2 U1 G3
24	38,647	B3 U1 G4	29,639	B3 U1 G4	39,454	B3 U1 G4
1000mA						
12	26,440	B2 U1 G3	20,272	B2 U1 G3	26,977	B3 U1 G3
24	52,914	B3 U1 G5	40,569	B3 U1 G4	53,989	B3 U1 G5

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens
** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: www.ies.org/PDF/Erratas/TM-15-11BugRatingsAddendum.pdf. Valid with no tilt

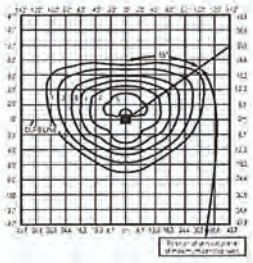
Photometry

All published luminaire photometric testing performed to IESNA LM-79-08 standards by a NVLAP accredited laboratory. To obtain an IES file specific to your project consult: http://lighting.cree.com/products/outdoor/area/cree-edge-high-output-1

3M



RESTL Test Report #: PL09277-001
ARE-EHO-3M-**-12-E-UL-1000-40K
Initial Delivered Lumens: 32,018

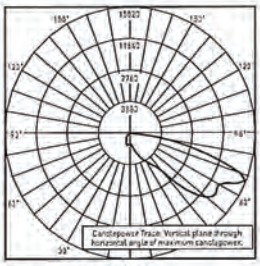


ARE-EHO-3M-**-12-E-UL-1000-40K
Mounting Height: 25' (7.6m) A.F.G.
Initial Delivered Lumens: 33,278
Initial FC at grade

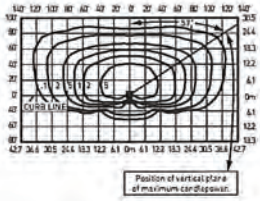
Type III Medium Distribution						
LED Count (x10)	4000K		5000K		5700K	
	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11
700mA						
12	24,305	B4 U1 G4	18,640	B3 U1 G3	24,813	B4 U1 G4
24	48,642	B5 U1 G5	37,304	B4 U1 G4	49,658	B5 U1 G5
1000mA						
12	33,278	B4 U1 G4	25,514	B4 U1 G4	33,954	B4 U1 G4
24	66,599	B5 U1 G5	51,061	B5 U1 G5	67,952	B5 U1 G5

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens
** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: www.ies.org/PDF/Erratas/TM-15-11BugRatingsAddendum.pdf. Valid with no tilt

3MB



ITL Test Report #: 78733
ARE-EHO-3MB-**-12-E-UL-1000
Initial Delivered Lumens: 23,622



ARE-EHO-3MB-**-24-E-UL-1000-50K
Mounting Height: 25' (7.6m) A.F.G.
Initial Delivered Lumens: 37,771
Initial FC at grade

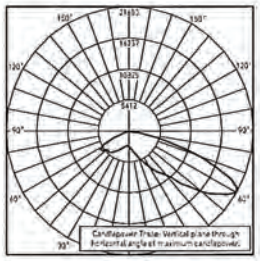
Type III Medium w/BLS Distribution						
LED Count (x10)	4000K		5000K		5700K	
	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11
700mA						
12	17,979	B2 U1 G3	13,789	B2 U1 G3	18,355	B2 U1 G3
24	35,982	B3 U1 G5	27,595	B3 U1 G4	36,733	B3 U1 G5
1000mA						
12	24,617	B2 U1 G4	18,874	B2 U1 G3	25,117	B2 U1 G4
24	49,265	B3 U1 G5	37,771	B3 U1 G5	50,266	B3 U1 G5

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens
** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: www.ies.org/PDF/Erratas/TM-15-11BugRatingsAddendum.pdf. Valid with no tilt

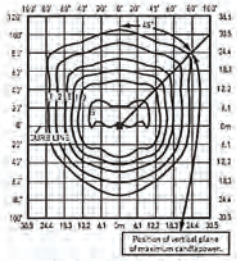
Photometry

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4M



RESTL Test Report #: PL09297-001
ARE-EHO-4M-**-12-E-UL-1000-40K
Initial Delivered Lumens: 34,817

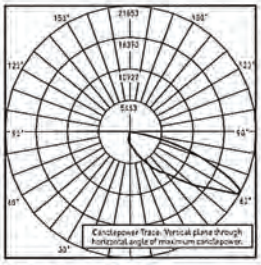


ARE-EHO-4M-**-12-E-UL-1000-40K
Mounting Height: 25' (7.6m) A.F.G.
Initial Delivered Lumens: 35,102
Initial FC at grade

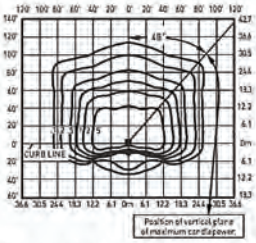
Type IV Medium Distribution						
LED Count (x10)	4000K		5000K		5700K	
	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11
700mA						
12	25,637	B4 U0 G3	19,661	B3 U0 G3	26,173	B4 U0 G3
24	51,307	B5 U0 G5	39,348	B4 U0 G4	52,379	B5 U0 G5
1000mA						
12	35,102	B4 U0 G4	26,913	B4 U0 G3	35,815	B4 U0 G4
24	70,248	B5 U0 G5	53,859	B5 U0 G5	71,675	B5 U0 G5

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens
** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: www.ies.org/PDF/Erratas/TM-15-11BugRatingsAddendum.pdf. Valid with no tilt

4MB



ITL Test Report #: 78734
ARE-EHO-4MB-**-12-E-UL-1000-40K
Initial Delivered Lumens: 25,113



ARE-EHO-4MB-**-24-E-UL-1000-50K
Mounting Height: 25' (7.6m) A.F.G.
Initial Delivered Lumens: 40,569
Initial FC at grade

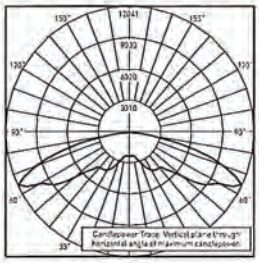
Type IV Medium w/BLS Distribution						
LED Count (x10)	4000K		5000K		5700K	
	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11
700mA						
12	19,311	B2 U1 G3	14,810	B2 U1 G2	19,715	B2 U1 G3
24	38,647	B3 U1 G5	29,639	B2 U1 G4	39,454	B3 U1 G5
1000mA						
12	26,440	B2 U1 G4	20,272	B2 U1 G3	26,977	B2 U1 G4
24	52,914	B3 U1 G5	40,569	B3 U1 G5	53,989	B3 U1 G5

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens
** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: www.ies.org/PDF/Erratas/TM-15-11BugRatingsAddendum.pdf. Valid with no tilt

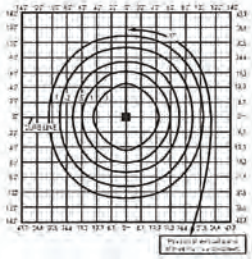
Photometry

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5M



RESTL Test Report #: PL09298-001
ARE-EHO-5M-**-12-E-UL-1000-40K
Initial Delivered Lumens: 36,005

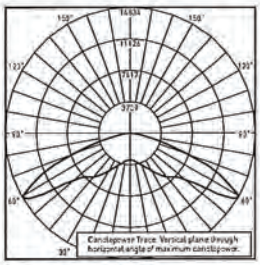


ARE-EHO-5M-**-12-E-UL-1000-40K
Mounting Height: 25' (7.6m) A.F.G.
Initial Delivered Lumens: 36,925
Initial FC at grade

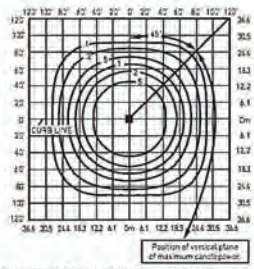
Type V Medium Distribution						
LED Count (x10)	4000K		5000K		5700K	
	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11
700mA						
12	26,969	B5 U0 G3	20,683	B4 U0 G3	27,532	B5 U0 G3
24	53,972	B5 U0 G5	41,392	B5 U0 G4	55,100	B5 U0 G5
1000mA						
12	36,925	B5 U0 G4	28,311	B5 U0 G3	37,675	B5 U0 G4
24	73,897	B5 U0 G5	56,657	B5 U0 G5	75,399	B5 U0 G5

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens
** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: www.ies.org/PDF/Erratas/TM-15-11BugRatingsAddendum.pdf. Valid with no tilt

5S



ITL Test Report #: 78687
ARE-EHO-5S-**-12-E-UL-1000-40K
Initial Delivered Lumens: 37,329



ARE-EHO-5S-**-24-E-UL-1000-50K
Mounting Height: 25' (7.6m) A.F.G.
Initial Delivered Lumens: 62,952
Initial FC at grade

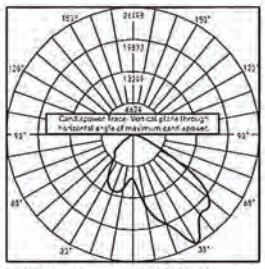
Type V Short Distribution						
LED Count (x10)	4000K		5000K		5700K	
	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11
700mA						
12	29,966	B5 U0 G3	22,981	B4 U0 G2	30,592	B5 U0 G3
24	59,969	B5 U0 G4	45,991	B5 U0 G4	61,222	B5 U0 G4
1000mA						
12	41,028	B5 U0 G4	31,456	B5 U0 G3	41,862	B5 U0 G4
24	82,108	B5 U0 G5	62,952	B5 U0 G4	83,776	B5 U0 G5

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens
** For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit: www.ies.org/PDF/Erratas/TM-15-11BugRatingsAddendum.pdf. Valid with no tilt

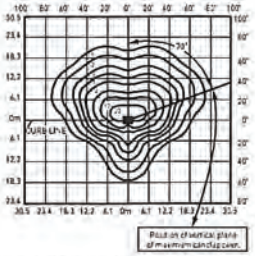
Photometry

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AF



RESTL Test Report #: PL09299-001
ARE-EHO-AF-**-12-E-UL-1000-40K
Initial Delivered Lumens: 38,346

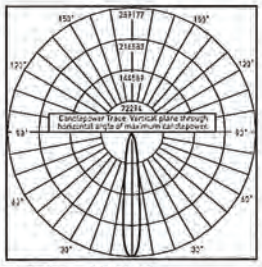


ARE-EHO-AF-**-12-E-UL-1000-40K
Mounting Height: 25' (7.6m) A.F.G.
Initial Delivered Lumens: 39,660
Initial FC at grade

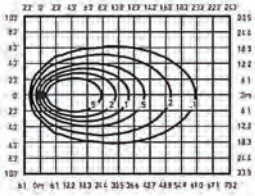
Automotive FrontlineOptic™ Distribution						
LED Count (x10)	4000K		5000K		5700K	
	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11	Initial Delivered Lumens*	BUG Ratings** Per TM-15-11
700mA						
12	28,967	B4 U0 G2	22,215	B3 U0 G2	29,572	B4 U0 G2
24	57,970	B5 U0 G2	44,458	B4 U0 G2	59,181	B5 U0 G2
1000mA						
12	39,660	B4 U0 G2	30,408	B4 U0 G2	40,466	B4 U0 G2
24	79,371	B5 U0 G3	60,854	B5 U0 G3	80,984	B5 U0 G3

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens
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15°



ITL Test Report #: 78519
FLD-EHO-15-**-12-E-UL-1000-40K
Initial Delivered Lumens: 38,859



FLD-EHO-15-**-24-E-UL-1000-50K
Mounting Height: 25' (7.6m) A.F.G. - 60° tilt
Initial Delivered Lumens: 64,351
Initial FC at grade

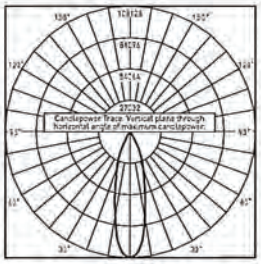
15° Flood Optic Distribution			
LED Count (x10)	4000K	5000K	5700K
	Initial Delivered Lumens*	Initial Delivered Lumens*	Initial Delivered Lumens*
700mA			
12	30,631	23,492	31,271
24	61,302	47,013	62,583
1000mA			
12	41,940	32,155	42,792
24	83,932	64,351	85,638

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

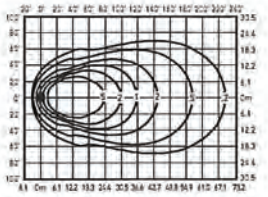
Photometry

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25°



ITL Test Report #: 78520
FLD-EHO-25-**-12-E-UL-1000-40K
Initial Delivered Lumens: 38,828

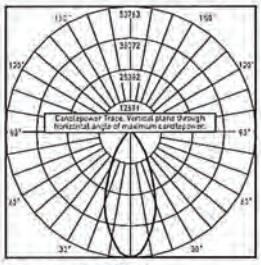


FLD-EHO-25-**-24-E-UL-1000-50K
Mounting Height: 25' (7.6m) A.F.G. - 60° tilt
Initial Delivered Lumens: 64,351
Initial FC at grade

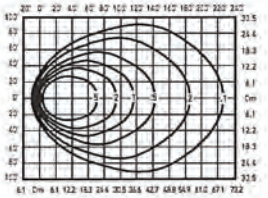
25° Flood Optic Distribution			
LED Count (x10)	4000K	5000K	5700K
	Initial Delivered Lumens*	Initial Delivered Lumens*	Initial Delivered Lumens*
700mA			
12	30,631	23,492	31,271
24	61,302	47,013	62,583
1000mA			
12	41,940	32,155	42,792
24	83,932	64,351	85,638

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

40°



ITL Test Report #: 78521
FLD-EHO-40-**-12-E-UL-1000-40K
Initial Delivered Lumens: 36,476



FLD-EHO-40-**-24-E-UL-1000-50K
Mounting Height: 25' (7.6m) A.F.G. - 60° tilt
Initial Delivered Lumens: 62,952
Initial FC at grade

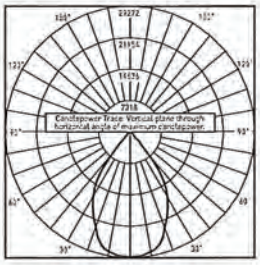
40° Flood Optic Distribution			
LED Count (x10)	4000K	5000K	5700K
	Initial Delivered Lumens*	Initial Delivered Lumens*	Initial Delivered Lumens*
700mA			
12	29,966	22,981	30,592
24	59,969	45,991	61,222
1000mA			
12	41,028	31,456	41,862
24	82,108	62,952	83,776

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

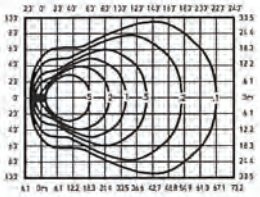
Photometry

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70°



ITL Test Report #: 78522
FLD-EHO-70-**-12-E-UL-1000-40K
Initial Delivered Lumens: 33,030

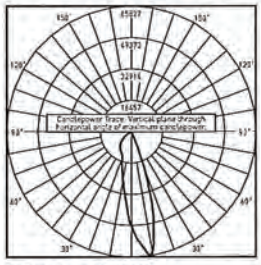


FLD-EHO-70-**-24-E-UL-1000-50K
Mounting Height: 25' (7.6m) A.F.G. - 60° tilt
Initial Delivered Lumens: 57,357
Initial FC at grade

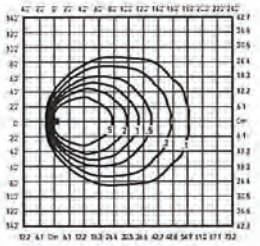
70° Flood Optic Distribution			
LED Count (x10)	4000K	5000K	5700K
	Initial Delivered Lumens*	Initial Delivered Lumens*	Initial Delivered Lumens*
700mA			
12	27,302	20,938	27,872
24	54,639	41,903	55,780
1000mA			
12	37,381	28,660	38,141
24	74,809	57,357	76,330

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

SN



ITL Test Report #: 78563
FLD-EHO-SN-**-12-E-UL-1000-40K
Initial Delivered Lumens: 34,961



FLD-EHO-SN-**-24-E-UL-1000-50K
Mounting Height: 25' (7.6m) A.F.G. - 60° tilt
Initial Delivered Lumens: 58,056
Initial FC at grade

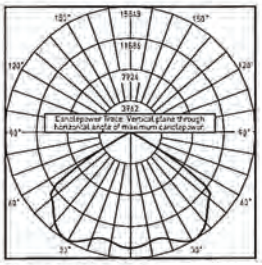
Sign Optic Distribution			
LED Count (x10)	4000K	5000K	5700K
	Initial Delivered Lumens*	Initial Delivered Lumens*	Initial Delivered Lumens*
700mA			
12	27,635	21,193	28,212
24	55,305	42,414	56,460
1000mA			
12	37,837	29,010	38,606
24	75,722	58,056	77,260

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

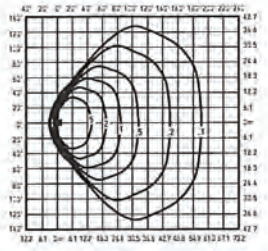
Photometry

All published luminaire photometric testing performed to IESNA LM-79-08 standards by a NVLAP accredited laboratory. To obtain an IES file specific to your project consult: http://lighting.cree.com/products/outdoor/area/cree-edge-high-output-1

N6



ITL Test Report #: 78562
FLD-EHO-N6-**-12-E-UL-1000-40K
Initial Delivered Lumens: 38,110



FLD-EHO-N6-**-24-E-UL-1000-50K
Mounting Height: 25' (7.6m) A.F.G. - 60° tilt
Initial Delivered Lumens: 64,351
Initial FC at grade

NEMA 6 Distribution			
LED Count (x10)	4000K	5000K	5700K
	Initial Delivered Lumens*	Initial Delivered Lumens*	Initial Delivered Lumens*
700mA			
12	30,631	23,492	31,271
24	61,302	47,013	62,583
1000mA			
12	41,940	32,155	42,792
24	83,932	64,351	85,638

* Initial delivered lumens at 25°C (77°F). Actual production yield may vary between -10 and +10% of initial delivered lumens

Luminaire EPA

Horizontal/Vertical Tenon Mount and EHO-UNV Direct Mount Bracket											
LED Count (x10)	Luminaire Weight	Single		2 @ 90°	2 @ 180°	2 @ 180°	3 @ 90°	3 @ 120°	3 @ 180°	4 @ 90°	4 @ 180°
Tenon Configuration If used with Cree tenons, please add tenon EPA with Luminaire EPA											
		Vertical	Horizontal	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical
		 PB-1A*; PW-1A3; EHO-UNV	 Horizontal Tenon	 PB-2A*; PB-2R2.375; PW-2A3; (2) EHO-UNV	 PB-2A*; PB-2R2.375; PW-2A3 (picture does not apply)	 PB-2A*; PB-2R2.375; PW-2A3 (picture doesn't apply)	 PB-3A*; PB-3R2.375; (3) EHO-UNV	 PB-3A*; PB-3R2.375	 PB-3A*; PB-3R2.375	 PB-4A*(90); PB-4R2.375; (4) EHO-UNV	 PB-4A*(180); PB-4R2.375
0° Tilt											
12	45.3 lbs. (20.6kg)	1.41	1.41	2.35	2.83	2.83	3.76	3.76	4.24	4.70	5.66
24	80.5 lbs. (36.6kg)	1.41	1.41	2.80	2.83	N/A	4.22	4.22	N/A	5.61	N/A
10° Tilt											
12	45.3 lbs. (20.6kg)	1.49	1.41	2.90	2.98	2.98	4.39	4.39	5.96	5.81	7.95
24	80.5 lbs. (36.6kg)	2.38	1.97	2.38	4.76	N/A	6.18	6.18	N/A	7.59	N/A
20° Tilt											
12	45.3 lbs. (20.6kg)	2.11	1.71	3.53	4.22	4.22	5.64	5.64	8.45	7.05	11.26
24	80.5 lbs. (36.6kg)	3.46	3.11	4.87	6.92	N/A	7.12	7.12	N/A	9.74	N/A
30° Tilt											
12	45.3 lbs. (20.6kg)	2.69	2.30	4.11	5.39	5.39	6.80	6.80	10.78	8.22	14.37
24	80.5 lbs. (36.6kg)	4.59	4.23	6.97	9.19	N/A	10.60	10.60	N/A	12.01	N/A
45° Tilt											
12	45.3 lbs. (20.6kg)	3.50	3.11	4.91	6.99	6.99	8.40	8.40	13.98	9.82	18.64
24	80.5 lbs. (36.6kg)	6.03	5.73	7.44	10.31	N/A	13.48	13.48	N/A	14.89	N/A
60° Tilt											
12	45.3 lbs. (20.6kg)	4.12	3.74	5.54	8.25	8.25	9.66	9.66	16.49	11.08	21.99
24	80.5 lbs. (36.6kg)	7.24	6.91	8.65	12.37	N/A	15.89	15.89	N/A	17.30	N/A
70° Tilt											
12	45.3 lbs. (20.6kg)	4.41	4.03	5.83	8.83	8.83	10.24	10.24	17.65	11.65	23.54
24	80.5 lbs. (36.6kg)	7.76	7.45	9.17	15.51	N/A	16.93	16.93	N/A	18.34	N/A
80° Tilt											
12	45.3 lbs. (20.6kg)	4.59	4.21	6.00	9.18	9.18	10.59	10.59	18.36	12.01	24.47
24	80.5 lbs. (36.6kg)	8.06	7.79	9.48	16.12	N/A	17.54	17.54	N/A	18.95	N/A
90° Tilt											
12	45.3 lbs. (20.6kg)	4.64	4.26	6.06	9.29	9.29	10.70	10.70	18.58	12.12	24.77
24	80.5 lbs. (36.6kg)	8.14	7.89	9.56	16.29	N/A	17.70	17.70	N/A	19.12	N/A

Note: Not for use with aluminum tenons

Tenon EPA

Part Number	EPA
PB-1A*	None
PB-2A*	0.82
PB-3A*	1.52
PB-4A*(90)	1.11
PB-4A*(180)	2.22
PB-2R2.375	0.92
PB-3R2.375	1.62
PB-4R2.375	2.32
PW-1A3**	0.47
PW-2A3**	0.94
WM-2	0.08
WM-2L	0.13
WM-4L	0.32
EHO-UNV	0.22

Tenons and Brackets‡ (must specify color)

Square Internal Mount Vertical Tenons (Steel)
- Mounts to 3-6" (76-152mm) square aluminum or steel poles

PB-1A* – Single
PB-2A* – 180° Twin
PB-3A* – 180° Triple
PB-4A*(90) – 90° Quad
PB-4A*(180) – 180° Quad

Wall Mount Brackets
- Mounts to wall or roof

WM-2 – Horizontal
WM-2L – Extended Horizontal
WM-4L – Extended L-Shape

Round External Mount Vertical Tenons (Steel)
- Mounts to 2.375" (60mm) O.D. round aluminum or steel poles or tenons

PB-2R2.375 – Twin
PB-3R2.375 – Triple
PB-4R2.375 – Quad

Mid-Pole Bracket
- Mounts to square pole

PW-1A3** – Single
PW-2A3** – Double

Direct Mount Bracket
- Mounts to minimum 4" (102mm) round or square; aluminum or steel pole or can be surface-mounted directly to a vertical or horizontal surface
- See Direct Mount Configurations table below
- Poles must be field drilled for direct mount

EHO-UNV

‡ Refer to the Bracket and Tenons spec sheet for more details

* Specify pole size: 3 (3"), 4 (4"), 5 (5"), or 6 (6") for single, double or triple luminaire orientation or 4 (4"), 5 (5"), or 6 (6") for quad luminaire orientation
** These EPA values must be multiplied by the following ratio: Fixture Mounting Height/Total Pole Height. Specify pole size: 3 (3"), 4 (4"), 5 (5"), or 6 (6")

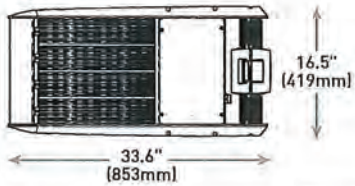
Direct Mount Configurations

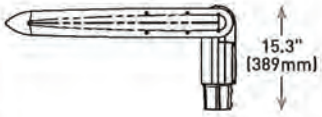
Compatibility with EHO-UNV Direct Mount Bracket					
LED Count (x10)	2 @ 90°	2 @ 180°	3 @ 90°	3 @ 120°	4 @ 90°
4" Square					
12	✓	✓	N/A	N/A	N/A
24	✓	✓	N/A	N/A	N/A
4" Round					
12	N/A	✓	N/A	N/A	N/A
24	N/A	✓	N/A	N/A	N/A
5" Square					
12	✓	✓	✓	N/A	✓
24	✓	✓	✓	N/A	✓
5" Round					
12	N/A	✓	N/A	✓	N/A
24	N/A	✓	N/A	✓	N/A
6" Square					
12	✓	✓	✓	N/A	✓
24	✓	✓	✓	N/A	✓
6" Round					
12	✓	✓	✓	✓	✓
24	✓	✓	✓	✓	✓

Cree Edge™ LED High Output Area/Flood Luminaire

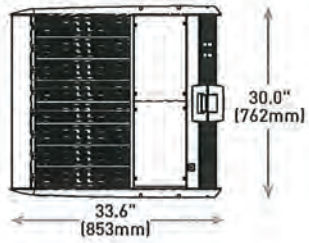
HV Mount (shown in vertical position)

120 LED





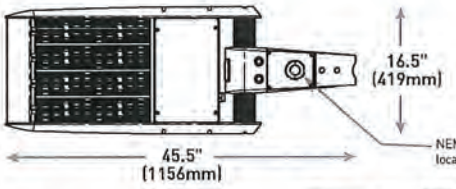
240 LED

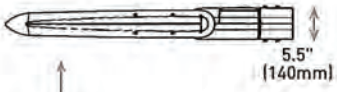


LED Count (x10)	Weight
12	45.3 lbs. (20.5kg)
24	80.5 lbs. (36.5kg)

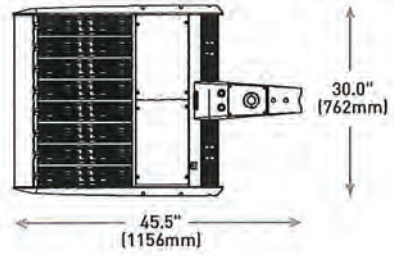
Direct Mount Bracket (accessory sold separately)

120 LED





240 LED



LED Count (x10)	Weight
12	45.3 lbs. (20.5kg)
24	80.5 lbs. (36.5kg)

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US: lighting.cree.com/lighting T (800) 236-6800 F (262) 504-5415

Canada: www.cree.com/canada T (800) 473-1234 F (800) 890-7507

McGraw-Edison

DESCRIPTION

The Ventus™ LED area luminaire provides uncompromising optical performance and outstanding versatility for a wide variety of area and roadway applications. Patent pending modular LightBAR™ technology delivers uniform and energy conscious illumination to walkways, parking lots, roadways, building areas and any security lighting application. UL/cUL Listed for wet locations.

Catalog #		Type
Project		
Comments		Date
Prepared by		

SPECIFICATION FEATURES

Construction
Die-cast aluminum frame secures thermally conductive, extruded aluminum heat sink to independent electrical chamber. Heavy-wall, die-cast aluminum housing and door isolates driver components for cooler operation. The unique construction allows for passive cooling and natural cleaning of the extruded heat sink ensuring reliable operation at 40°C high ambient conditions. Stainless steel fasteners and hinging allow access to electrical components for installation and maintenance. Optional tool-less hardware available for ease of entry into electrical chamber.

Optics
Choice of twelve patented, high-efficiency AccuLED Optics™ distributions. Optics are precisely designed to shape the light output, maximizing efficiency and application spacing. AccuLED Optics technology creates consistent distributions with the scalability to meet customized application requirements. Offered Standard in 4000K (+/- 275K) CCT and minimum 70 CRI. Optional 3000K CCT, 5000K CCT and 5700K CCT. For the ultimate level of spill light control, an optional house-side shield accessory can be field or factory installed. The house-side shield is designed to seamlessly integrate with the SL2, SL3 or SL4 optics.

Electrical
LED drivers mount to die-cast aluminum back housing for optimal heat sinking, operation efficacy, and prolonged life. Standard drivers feature electronic universal voltage (120-277V 50/60Hz), 347V 60Hz or 480V 60Hz operation. 480V is compatible for use with 480V Wye systems only. Greater than 0.9 power factor, less than 20% harmonic distortion, and is suitable for operation in -40°C to 40°C ambient environments. All fixtures are shipped standard with 10kV/10kA common – and differential – mode surge protection. LightBARs feature an IP66 enclosure rating and maintain greater than 95% lumen maintenance at 60,000 hours per IESNA TM-21. Occupancy sensor and dimming options available.

Mounting
Cast aluminum 6" arm includes bolt guides allowing for easy positioning of fixture during installation to pole or wall surface. Standard single carton packaging of housing, square pole arm and round pole adapter for contractor friendly arrival of product on site. Optional internal mast arm mount accepts a 1-1/4" to 2" O.D. horizontal tenon, while a two-bolt clamping mechanism secures fixture. Cast-in leveling guides provide +/-5° vertical leveling adjustment. Tenon adapters available to slipfit over poles equipped with 2-3/8" or 3-1/2" O.D. tenon. 3G vibration rated.

Finish
Cast components and arm finished in super TGIC polyester powder coat paint, 2.5 mil nominal thickness for superior protection against fade and wear. Standard colors include black, bronze, grey, white, dark platinum and graphite metallic. RAL and custom color matches available. Consult the McGraw-Edison Architectural Colors brochure for the complete selection.

Warranty
Five-year warranty.

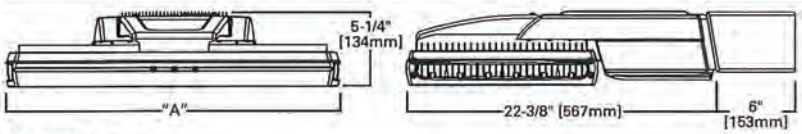


VTS
VENTUS LED

2 - 12 LightBARs
Solid State LED

AREA LUMINAIRE

DIMENSIONS



DIMENSIONAL DATA

Number of LightBars	"A" Width	Weight		EPA [Square Feet]	
		Without Arm	With Arm	Without Arm	With Arm
2-4	12-7/8" [328mm]	24 lbs. [10.91 kgs.]	29 lbs. [13.18 kgs.]	0.94	1.00
5-8	18" [458mm]	30 lbs. [13.64 kgs.]	35 lbs. [15.91 kgs.]	1.10	1.20
9-12	25-7/8" [658mm]	39 lbs. [17.73 kgs.]	44 lbs. [20.00 kgs.]	1.31	1.44

CERTIFICATION DATA
UL/cUL Listed
LM79 / LM80 Compliant
IP66 LightBARs
3G Vibration Rated
DesignLights Consortium™ Qualified*
ISO 9001

ENERGY DATA
Electronic LED Driver
>0.9 Power Factor
<20% Total Harmonic Distortion
120-277V/50Hz & 60Hz, 347V/60Hz, 480V/60Hz
-40°C Minimum Temperature
40°C Ambient Temperature Rating
50°C Ambient Temperature Rating (HA option)

SHIPPING DATA
Approximate Net Weight:
(See Tabulated Reference Data)

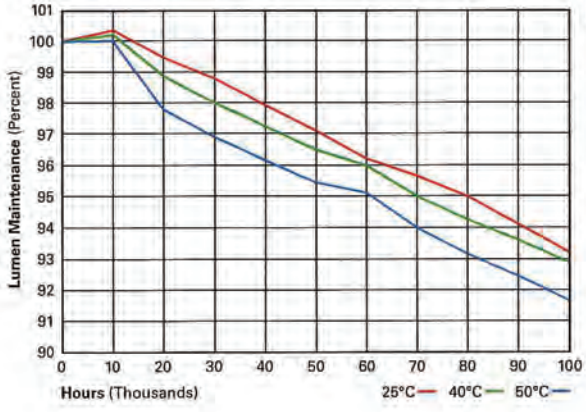
POWER AND LUMENS BY BAR COUNT (21 LED LIGHTBAR)

Number of LightBARs		E02	E03	E04	E05	E06	E07	E08	E09	E10	E11	E12
Drive Current		350mA Drive Current										
Power (Watts)		52W	75W	97W	127W	149W	173W	195W	226W	247W	270W	292W
Current @ 120V (A)		0.44	0.63	0.82	1.07	1.26	1.45	1.63	1.89	2.08	2.26	2.45
Current @ 277V (A)		0.20	0.28	0.36	0.48	0.56	0.64	0.71	0.84	0.92	0.99	1.07
Power (Watts)		58W	82W	99W	132W	159W	174W	196W	227W	247W	271W	293W
Current @ 347V (A)		0.19	0.28	0.29	0.39	0.48	0.56	0.57	0.68	0.76	0.85	0.86
Current @ 480V (A)		0.15	0.20	0.21	0.30	0.36	0.41	0.42	0.51	0.57	0.62	0.63
T2	Lumens	6,173	9,260	12,347	15,434	18,520	21,607	24,694	27,780	30,867	33,954	37,041
	BUG Rating	B2-U0-G2	B3-U0-G3	B3-U0-G3	B3-U0-G3	B3-U0-G3	B4-U0-G4	B4-U0-G4	B4-U0-G4	B4-U0-G4	B4-U0-G4	B4-U0-G4
T3	Lumens	6,117	9,175	12,233	15,292	18,350	21,409	24,467	27,525	30,584	33,642	36,700
	BUG Rating	B2-U0-G2	B3-U0-G3	B3-U0-G3	B3-U0-G3	B3-U0-G3	B4-U0-G4	B4-U0-G4	B4-U0-G4	B4-U0-G4	B4-U0-G4	B4-U0-G4
T4	Lumens	5,953	8,929	11,905	14,882	17,858	20,835	23,811	26,787	29,764	32,740	35,716
	BUG Rating	B1-U0-G2	B2-U0-G2	B2-U0-G2	B2-U0-G3	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5
5MQ	Lumens	6,398	9,597	12,795	15,994	19,193	22,392	25,591	28,790	31,989	35,187	38,386
	BUG Rating	B3-U0-G1	B3-U0-G2	B4-U0-G2	B4-U0-G2	B4-U0-G2	B4-U0-G2	B5-U0-G3	B5-U0-G3	B5-U0-G3	B5-U0-G4	B5-U0-G4
5WQ	Lumens	6,315	9,472	12,630	15,787	18,945	22,102	25,260	28,417	31,575	34,732	37,890
	BUG Rating	B3-U0-G1	B4-U0-G2	B4-U0-G2	B4-U0-G2	B5-U0-G3	B5-U0-G3	B5-U0-G3	B5-U0-G4	B5-U0-G4	B5-U0-G4	B5-U0-G4
5XQ	Lumens	6,325	9,488	12,650	15,813	18,975	22,138	25,301	28,463	31,626	34,788	37,951
	BUG Rating	B3-U1-G2	B3-U1-G3	B4-U1-G3	B4-U1-G3	B4-U1-G4	B5-U1-G4	B5-U2-G5	B5-U2-G5	B5-U2-G5	B5-U2-G5	B5-U2-G5
SL2	Lumens	6,018	9,026	12,035	15,044	18,053	21,061	24,070	27,079	30,088	33,096	36,105
	BUG Rating	B1-U0-G2	B2-U0-G2	B2-U0-G2	B3-U0-G3	B3-U0-G3	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G4	B4-U0-G4
SL3	Lumens	6,034	9,051	12,067	15,084	18,101	21,118	24,135	27,152	30,169	33,186	36,202
	BUG Rating	B1-U0-G2	B2-U0-G2	B2-U0-G2	B2-U0-G3	B3-U0-G3	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G5
SL4	Lumens	5,802	8,703	11,604	14,505	17,406	20,307	23,207	26,108	29,009	31,910	34,811
	BUG Rating	B1-U0-G2	B2-U0-G2	B2-U0-G2	B2-U0-G3	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5
RW	Lumens	6,231	9,346	12,462	15,577	18,692	21,808	24,923	28,039	31,154	34,270	37,385
	BUG Rating	B3-U0-G3	B3-U0-G3	B4-U0-G4	B4-U0-G4	B4-U0-G4	B4-U0-G4	B5-U0-G5	B5-U0-G5	B5-U0-G5	B5-U0-G5	B5-U0-G5
SLL/SLR	Lumens	5,375	8,062	10,749	13,436	16,124	18,811	21,498	24,186	26,873	29,560	32,247
	BUG Rating	B1-U0-G2	B1-U0-G3	B2-U0-G3	B2-U0-G3	B2-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5	B3-U0-G5

LUMEN MAINTENANCE

Ambient Temperature	25,000 Hours*	50,000 Hours*	60,000 Hours*	100,000 Hours	Theoretical L70 (Hours)
25°C	> 99%	> 97%	> 96%	> 93%	> 450,000
40°C	> 98%	> 97%	> 96%	> 92%	> 425,000
50°C	> 97%	> 96%	> 95%	> 91%	> 400,000

* Per IESNA TM-21 data.



LUMEN MULTIPLIER

Ambient Temperature	Lumen Multiplier
10°C	1.02
15°C	1.01
25°C	1.00
40°C	0.99
50°C	0.96

LIGHTBAR OPERATION WITH 2L BI-LEVEL SWITCHING OPTION

Number of LightBars	Circuit 1	Circuit 2
2	1	1
3	2	2
4	2	2
5	3	2
6	3	3
7	4	3
8	4	4
9	5	4
10	6	4
11	7	4
12	8	4

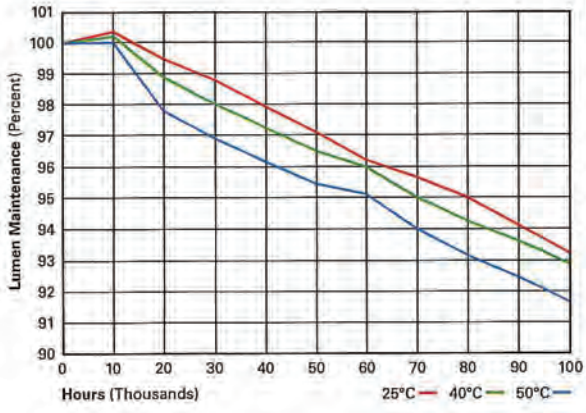
POWER AND LUMENS BY BAR COUNT (7 LED LIGHTBAR)

Number of LightBARs		F02	F03	F04	F05	F06	F07	F08	F09	F10	F11	F12
Drive Current		1A Drive Current										
Power (Watts)		55W	78W	102W	133W	157W	180W	204W	235W	259W	283W	307W
Current @ 120V (A)		0.46	0.66	0.86	1.12	1.31	1.51	1.71	1.97	2.17	2.37	2.57
Current @ 277V (A)		0.21	0.29	0.37	0.50	0.58	0.66	0.74	0.88	0.96	1.04	1.12
Power (Watts)		60W	85W	105W	137W	164W	181W	204W	236W	259W	284W	308W
Current @ 347V (A)		0.19	0.28	0.30	0.41	0.49	0.58	0.60	0.71	0.79	0.88	0.90
Current @ 480V (A)		0.15	0.21	0.22	0.31	0.37	0.43	0.44	0.53	0.59	0.65	0.66
T2	Lumens	5,096	7,644	10,193	12,741	15,289	17,837	20,385	22,933	25,482	28,030	30,578
	BUG Rating	B2-U0-G2	B2-U0-G2	B3-U0-G3	B3-U0-G3	B3-U0-G3	B3-U0-G3	B3-U0-G3	B4-U0-G4	B4-U0-G4	B4-U0-G4	B4-U0-G4
T3	Lumens	5,050	7,574	10,099	12,624	15,149	17,673	20,198	22,723	25,248	27,772	30,297
	BUG Rating	B2-U0-G2	B2-U0-G2	B3-U0-G3	B3-U0-G3	B3-U0-G3	B3-U0-G3	B4-U0-G4	B4-U0-G4	B4-U0-G4	B4-U0-G4	B4-U0-G4
T4	Lumens	4,914	7,371	9,828	12,285	14,742	17,199	19,656	22,114	24,571	27,028	29,485
	BUG Rating	B1-U0-G2	B1-U0-G2	B2-U0-G2	B2-U0-G2	B2-U0-G3	B2-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G4
5MQ	Lumens	5,281	7,922	10,563	13,204	15,844	18,485	21,126	23,767	26,407	29,048	31,689
	BUG Rating	B3-U0-G1	B3-U0-G1	B3-U0-G2	B4-U0-G2	B4-U0-G2	B4-U0-G2	B4-U0-G2	B5-U0-G3	B5-U0-G3	B5-U0-G3	B5-U0-G3
5WQ	Lumens	5,213	7,820	10,426	13,033	15,640	18,246	20,853	23,459	26,066	28,672	31,279
	BUG Rating	B3-U0-G1	B3-U0-G2	B4-U0-G2	B4-U0-G2	B4-U0-G2	B4-U0-G3	B5-U0-G3	B5-U0-G3	B5-U0-G3	B5-U0-G4	B5-U0-G4
5XQ	Lumens	5,222	7,832	10,443	13,054	15,665	18,276	20,886	23,497	26,108	28,719	31,330
	BUG Rating	B3-U1-G2	B3-U1-G3	B4-U1-G3	B4-U1-G3	B4-U1-G3	B4-U1-G4	B5-U1-G4	B5-U2-G4	B5-U2-G5	B5-U2-G5	B5-U2-G5
SL2	Lumens	4,968	7,451	9,935	12,419	14,903	17,387	19,870	22,354	24,838	27,322	29,806
	BUG Rating	B1-U0-G1	B2-U0-G2	B2-U0-G2	B2-U0-G2	B3-U0-G3	B3-U0-G3	B3-U0-G3	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4
SL3	Lumens	4,981	7,471	9,962	12,452	14,943	17,433	19,924	22,414	24,905	27,395	29,886
	BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	B2-U0-G2	B2-U0-G3	B3-U0-G3	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G4
SL4	Lumens	4,790	7,184	9,579	11,974	14,369	16,764	19,158	21,553	23,948	26,343	28,738
	BUG Rating	B1-U0-G2	B1-U0-G2	B2-U0-G2	B2-U0-G2	B2-U0-G3	B3-U0-G3	B3-U0-G3	B3-U0-G4	B3-U0-G4	B3-U0-G4	B3-U0-G4
RW	Lumens	5,144	7,716	10,287	12,859	15,431	18,003	20,575	23,147	25,719	28,290	30,862
	BUG Rating	B3-U0-G3	B3-U0-G3	B3-U0-G3	B4-U0-G4	B4-U0-G4	B4-U0-G4	B4-U0-G4	B4-U0-G4	B5-U0-G5	B5-U0-G5	B5-U0-G5
SLL/SLR	Lumens	4,437	6,655	8,874	11,092	13,311	15,529	17,747	19,966	22,184	24,403	26,621
	BUG Rating	B1-U0-G2	B1-U0-G3	B2-U0-G3	B2-U0-G3	B2-U0-G3	B2-U0-G4	B2-U0-G4	B3-U0-G4	B3-U0-G5	B3-U0-G5	B3-U0-G5

LUMEN MAINTENANCE

Ambient Temperature	25,000 Hours*	50,000 Hours*	60,000 Hours*	100,000 Hours	Theoretical L70 (Hours)
25°C	> 99%	> 97%	> 96%	> 93%	> 450,000
40°C	> 98%	> 97%	> 96%	> 92%	> 425,000
50°C	> 97%	> 96%	> 95%	> 91%	> 400,000

* Per IESNA TM-21 data.



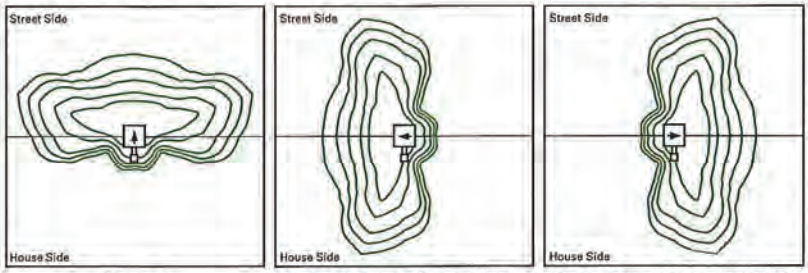
LUMEN MULTIPLIER

Ambient Temperature	Lumen Multiplier
10°C	1.02
15°C	1.01
25°C	1.00
40°C	0.99
50°C	0.96

LIGHTBAR OPERATION WITH 2L BI-LEVEL SWITCHING OPTION

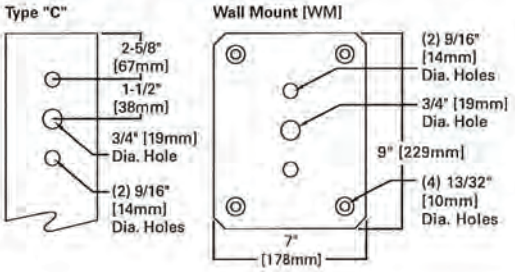
Number of LightBars	Circuit 1	Circuit 2
2	1	1
3	2	2
4	2	2
5	3	2
6	3	3
7	4	3
8	4	4
9	5	4
10	6	4
11	7	4
12	8	4

OPTIC ORIENTATION



Standard | Optics Rotated Left @ 90° [L90] | Optics Rotated Right @ 90° [R90]

DRILLING PATTERNS



ORDERING INFORMATION

Sample Number: VTS-E12-LED-E1-T3-GM

Product Family [1,2,3]	Number of LightBARs [4,5]		Lamp Type	Voltage	Distribution	Color
VTS=Ventus	**E02**=(2) 21 LED LightBARs **E03**=(3) 21 LED LightBARs **E04**=(4) 21 LED LightBARs **E05**=(5) 21 LED LightBARs **E06**=(6) 21 LED LightBARs **E07**=(7) 21 LED LightBARs **E08**=(8) 21 LED LightBARs **E09**=(9) 21 LED LightBARs **E10**=(10) 21 LED LightBARs **E11**=(11) 21 LED LightBARs **E12**=(12) 21 LED LightBARs	**F02**=(2) 7 LED LightBARs **F03**=(3) 7 LED LightBARs **F04**=(4) 7 LED LightBARs **F05**=(5) 7 LED LightBARs **F06**=(6) 7 LED LightBARs **F07**=(7) 7 LED LightBARs **F08**=(8) 7 LED LightBARs **F09**=(9) 7 LED LightBARs **F10**=(10) 7 LED LightBARs **F11**=(11) 7 LED LightBARs **F12**=(12) 7 LED LightBARs	**LED**=Solid State Light Emitting Diodes	**E1**=Electronic (120-277V) **347**=347V [6,7] **480**=480V [6,7,8]	**T2**=Type II **T3**=Type III **T4**=Type IV **5MQ**=Type V Square Medium **5WQ**=Type V Square Wide **5XQ**=Type V Square Extra Wide **SL2**=Type II with Spill Control **SL3**=Type III with Spill Control **SL4**=Type IV with Spill Control **RW**=Rectangular Wide **SLL**=90° Spill Light Eliminator Left **SLR**=90° Spill Light Eliminator Right	**AP**=Grey **BZ**=Bronze **BK**=Black **DP**=Dark Platinum **GM**=Graphite Metallic **WH**=White

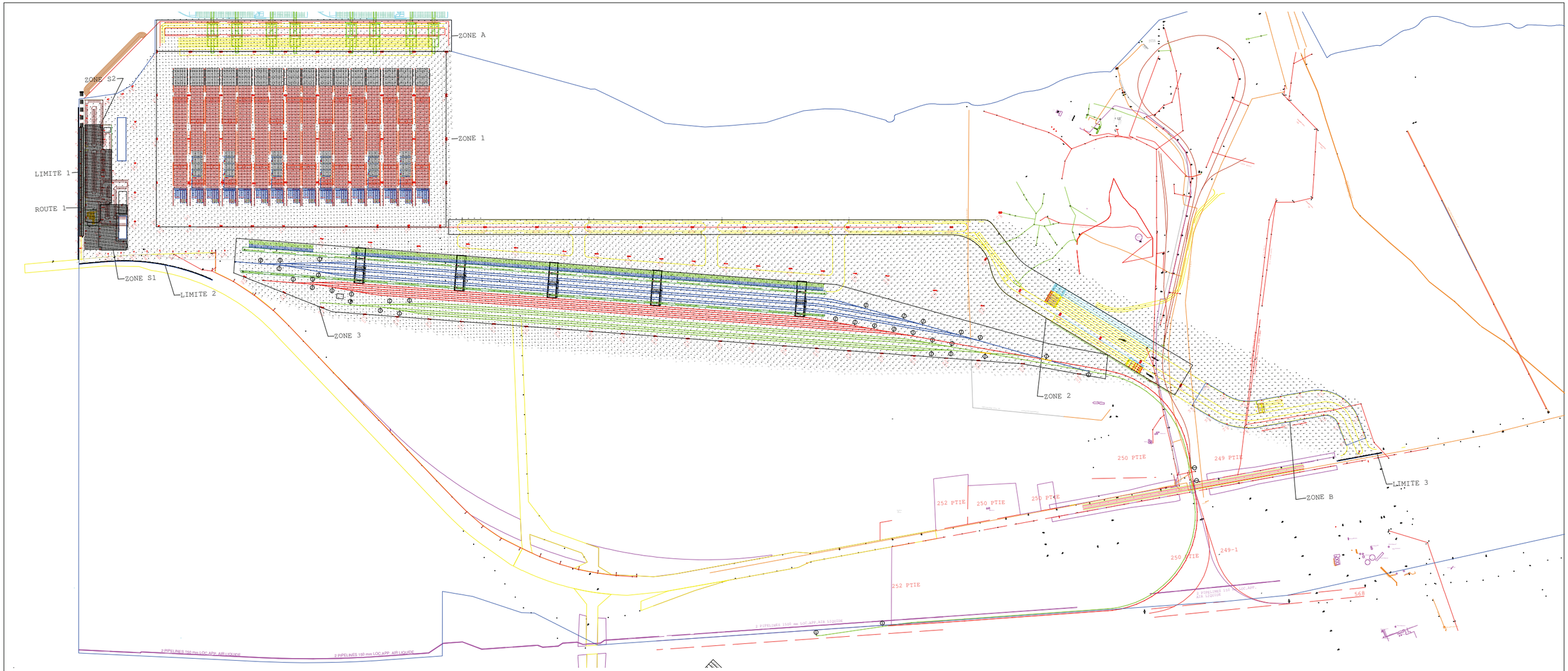
Options (Add as Suffix)	Accessories (Order Separately) [23]
P=Button Type Photocontrol (120, 208, 240 or 277V. Must Specify Voltage) [6] **R**=NEMA Twistlock Photocontrol Receptacle **PER7**=NEMA 7-PIN Twistlock Photocontrol Receptacle [8] **HA**=50°C High Ambient Temperature Rating [10,11] **2L**=Two Circuits [2,12,13,14] **L90**=Optics Rotated 90° Left [15] **R90**=Optics Rotated 90° Right [15] **7030**=70 CRI / 3000K CCT [16] **7050**=70 CRI / 5000K CCT [16] **7060**=70 CRI / 5700K CCT [16] **8030**=80 CRI / 3000K CCT [16] **TH**=Tool-less Door Hardware **LCF**=LightBAR Cover Plate Matches Housing Finish **WG**=Wire Guard **WM**=Wall Mount with Arm **IM**=Integral Mast Arm **MS-LXX**=Motion Sensor for On/Off Operation [17] **MS/X-LXX**=Motion Sensor for Bi-Level Operation [18] **MS/DIM-LXX**=Motion Sensor for Dimming Operation [19,20] **DIM**=0-10V Dimming Drivers [21] **HSS**=Factory Installed House Side Shield [22]	**VA1033-XX**=Single Tenon Adapter for 2-3/8" O.D. Tenon **VA1034-XX**=2@180° Tenon Adapter for 2-3/8" O.D. Tenon **VA1035-XX**=3@120° Tenon Adapter for 2-3/8" O.D. Tenon **VA1036-XX**=4@90° Tenon Adapter for 2-3/8" O.D. Tenon **VA1037-XX**=2@90° Tenon Adapter for 2-3/8" O.D. Tenon **VA1038-XX**=3@90° Tenon Adapter for 2-3/8" O.D. Tenon **VA1039-XX**=2@120° Tenon Adapter for 2-3/8" O.D. Tenon **VA1040-XX**=Single Tenon Adapter for 3-1/2" O.D. Tenon **VA1041-XX**=2@180° Tenon Adapter for 3-1/2" O.D. Tenon **VA1042-XX**=3@120° Tenon Adapter for 3-1/2" O.D. Tenon **VA1043-XX**=4@90° Tenon Adapter for 3-1/2" O.D. Tenon **VA1044-XX**=2@90° Tenon Adapter for 3-1/2" O.D. Tenon **VA1045-XX**=3@90° Tenon Adapter for 3-1/2" O.D. Tenon **VA1046-XX**=2@120° Tenon Adapter for 3-1/2" O.D. Tenon **FSIR-100**=Wireless Configuration Tool for Occupancy Sensor [24] **OA/RA1016**=NEMA Photocontrol - Multi-Tap **OA/RA1027**=NEMA Photocontrol - 480V **OA/RA1201**=NEMA Photocontrol - 347V **MA1253**=10kV Circuit Module Replacement **LB/HSS**=Field Installed House Side Shield [25]

NOTES:
1. Customer is responsible for engineering analysis to confirm pole and fixture compatibility for all applications. Refer to our white paper WP513001EN for additional support information.
2. DesignLights Consortium™ Qualified. Refer to www.designlights.org Qualified Products List under Family Models for details.
3. 6" arm and round pole adapter included with fixture.
4. 21 LED LightBAR powered at 350mA, 7 LED LightBAR powered at 1A.
5. Standard 4000K CCT and nominal 70CRI.
6. Not available with HA option.
7. Must specify voltage.
8. Only for use with 480V Wye systems. Per NEC, not for use with ungrounded systems, impedance grounded systems or corner grounded systems (commonly known as Three Phase Three Wire Delta, Three Phase High Leg Delta and Three Phase Corner Grounded Delta systems).
9. Must specify DIM option to add dimming driver(s). Only available in E02-E06 and F02-F06.
10. Not available with DIM option or MS/DIM-LXX.
11. Not available with button photocontrol or motion sensor. 120 - 277V only.
12. Requires two electrical circuits to luminaire. See LightBAR operation table for additional information.
13. Consult factory before ordering in combination with MS-LXX or MS/X-LXX options.
14. Not available in 347V or 480V.
15. Not available with 5MQ, 5WQ or 5XQ distributions. Not available with HSS option.
16. Extended lead times apply.
17. Sensor housed in external box mounted to the luminaire. Available in E02-E12 and F02-F12 configurations. Replace XX with mounting height in feet for proper lens selection, (e.g., MS-L25). Consult factory for additional information.
18. Sensor housed in external box mounted to the luminaire. Available in E02-E12 and F02-F12 configurations. Replace X with number of bars operating in low output mode and replace XX with mounting height for proper lens selection, (e.g., MS/3-L25). Maximum 4 bars in low output mode. Consult factory for additional information.
19. Not available with HA option. Only available in F02-F06 and E02-E06. Includes Dimming Drivers. Not available in 347V or 480V.
20. Replace XX with mounting height in feet for proper lens selection, (e.g., MS/DIM-L25).
21. Available in E02-E06 and F02-F06 only.
22. Only for use with SL2, SL3 and SL4 distributions. Not available with L90 or R90 options.
23. Replace XX with color suffix.
24. Only compatible with MS/DIM-LXX motion sensor.
25. One required for each LightBAR. Not available with L90 or R90 options.

ANNEXE 2

RÉSULTATS COMPLETS DU CALCUL D'ÉCLAIRAGE INFORMATISÉ

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SNC·LAVALIN

Projet : Port de Montréal - Développement Contrecoeur Rapport d'étude d'impact en éclairage		Calcul fait par : R. St-Pierre, tech.	Réf. SNC-Lavalin : 639223
		Vérifié par : A. Cloutier, ing., PA LEED	No réf. client : -
Titre : Simulation d'éclairage Plan du site - Variante 1		Date : 2017-03-17	Échelle : Aucune
			Feuillet : Page 1 of 7

Tableau des luminaires

Symbole	Qté	Identification	Disposition	LLF	Description	Lumens par luminaire	Watts par Luminaire	Watts Totaux
	4	L2	SINGLE	0.850	ARE-EHO-4MB-xx-12-E-UL-xx-1000-40K or BXAKxJ12E-UX7 (1000mA)	25113	426.2	1704.8
	2	L4	SINGLE	0.850	ARE-EHO-3M-xx-12-E-UL-xx-700-xxxx-40K	23881	275.62	551.24
	18	P1	SINGLE	0.850	ARE-EHO-4MB-xx-12-E-UL-xx-1000-40K or BXAKxJ12E-UX7 (1000mA)	25113	426.2	7671.6
	12	P4	SINGLE	0.850	VTS-E02-LED-E1-SL2-HSS	3623	52.1	625.2
	3	P5	SINGLE	0.850	ARE-EDG-4MB-DA-12-E-UL-XX-525-40K (BXAL1J12E-UC7)	13153	198.4	595.2
	6	P5B	SINGLE	0.850	ARE-EDG-4MB-DA-12-E-UL-XX-525-40K (BXAL1J12E-UC7)	13153	198.4	1190.4
	2	P5c	4 @ 90 DEGREES	0.850	ARE-EDG-4MB-DA-12-E-UL-XX-525-40K (BXAL1J12E-UC7)	13153	198.4	1587.2
	2	P5d	6 @ 60 DEGREES	0.850	ARE-EDG-4MB-DA-12-E-UL-XX-525-40K (BXAL1J12E-UC7)	13153	198.4	2380.8
	9	P7	SINGLE	0.850	VTS-E04-LED-E1-SL4-HSS	8042	97.2	874.8
	1	P7B	SINGLE	0.850	VTS-E02-LED-E1-SL3-HSS	3426	52.1	52.1
	6	P7C	SINGLE	0.850	VTS-E04-LED-E1-SL3	12068	97.2	583.2
	29	P8	SINGLE	0.850	VTS-E03-LED-E1-SL4-HSS	6031	75.2	2180.8
	52	T1	GROUP	0.850	9 appareils de type L3 (ARE-EHO-4M-xx-12-E-UL-xx-1000-xxxx-4	N.A.	N.A.	198932.8
	1	T112	GROUP	0.850	10 appareils type L3	N.A.	N.A.	4250.7
	40	T113	GROUP	0.850	12 appareils de type L3	N.A.	N.A.	204033.6
	1	T1a	GROUP	0.850	8 appareils de type L3 (ARE-EHO-4M-xx-12-E-UL-xx-1000-xxxx-4	N.A.	N.A.	3400.56
	1	T1b	GROUP	0.850	9 appareils de type L3 (ARE-EHO-4M-xx-12-E-UL-xx-1000-xxxx-4	N.A.	N.A.	3825.63
	3	T2	GROUP	0.850	5 appareils de type L3 (ARE-EHO-4M-xx-12-E-UL-xx-1000-xxxx-4	N.A.	N.A.	6376.05
	3	T2a	GROUP	0.850	5 appareils de type L3 (ARE-EHO-4M-xx-12-E-UL-xx-1000-xxxx-4	N.A.	N.A.	6376.05
	1	T3	GROUP	0.850	4 appareils de type L3 (ARE-EHO-4M-xx-12-E-UL-xx-1000-xxxx-4	N.A.	N.A.	1700.28
	1	T3b	GROUP	0.850	4 appareils de type L3 (ARE-EHO-4M-xx-12-E-UL-xx-1000-xxxx-4	N.A.	N.A.	1700.28
	1	T4	GROUP	0.850	7 appareils de type L1 (ARE-EHO-4MB-xx-12-E-UL-xx-1000-40K)	N.A.	N.A.	2983.4
	2	T5	GROUP	0.850	8 appareils de type L1 (ARE-EHO-4MB-xx-12-E-UL-xx-1000-40K)	N.A.	N.A.	6819.2
	1	T5a	GROUP	0.850	8 appareils de type L1 (ARE-EHO-4MB-xx-12-E-UL-xx-1000-40K)	N.A.	N.A.	3409.6
	1	T5b	GROUP	0.850	8 appareils de type L1 (ARE-EHO-4MB-xx-12-E-UL-xx-1000-40K)	N.A.	N.A.	3409.6
	3	T6	GROUP	0.850	2 appareils de type L1 (ARE-EHO-4MB-xx-12-E-UL-xx-1000-40K)	N.A.	N.A.	2557.2
	2	T1c	GROUP	0.850	9 appareils de type L3 (ARE-EHO-4M-xx-12-E-UL-xx-1000-xxxx-4	N.A.	N.A.	7651.261



Modèle Cree : ARE-EHO

Sommaire des Calculs

Identification	Description	Type de Calculs	Unités	Moy	Max	Min	Moy/Min	Max/Min
Limite 1_Side_2	Bordure du site Résidence Ouest - vertical	Illuminance	Lux	0.36	0.5	0.0	N.A.	N.A.
Limite 2_Side_1	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.17	0.3	0.1	1.70	3.00
Limite 2_Side_10	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.33	0.4	0.3	1.10	1.33
Limite 2_Side_11	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.33	0.4	0.3	1.10	1.33
Limite 2_Side_12	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.35	0.4	0.3	1.17	1.33
Limite 2_Side_13	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.39	0.4	0.3	1.30	1.33
Limite 2_Side_14	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.39	0.4	0.3	1.30	1.33
Limite 2_Side_15	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.39	0.5	0.3	1.30	1.67
Limite 2_Side_16	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.39	0.5	0.3	1.30	1.67
Limite 2_Side_17	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.39	0.4	0.3	1.30	1.33
Limite 2_Side_18	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.39	0.4	0.3	1.30	1.33
Limite 2_Side_19	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.39	0.4	0.3	1.30	1.33
Limite 2_Side_2	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.30	0.3	0.3	1.00	1.00
Limite 2_Side_20	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.40	0.4	0.4	1.00	1.00
Limite 2_Side_21	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.40	0.4	0.4	1.00	1.00
Limite 2_Side_22	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.41	0.5	0.4	1.03	1.25
Limite 2_Side_23	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.41	0.5	0.3	1.37	1.67
Limite 2_Side_24	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.39	0.5	0.3	1.30	1.67
Limite 2_Side_25	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.38	0.5	0.3	1.27	1.67
Limite 2_Side_26	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.36	0.5	0.3	1.20	1.67
Limite 2_Side_27	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.35	0.5	0.3	1.17	1.67
Limite 2_Side_28	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.35	0.4	0.3	1.17	1.33
Limite 2_Side_29	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.34	0.4	0.3	1.13	1.33
Limite 2_Side_3	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.30	0.4	0.3	1.00	1.33
Limite 2_Side_30	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.35	0.4	0.3	1.17	1.33
Limite 2_Side_31	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.35	0.4	0.3	1.17	1.33
Limite 2_Side_4	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.32	0.4	0.3	1.07	1.33
Limite 2_Side_5	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.33	0.4	0.3	1.10	1.33
Limite 2_Side_6	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.34	0.4	0.3	1.13	1.33
Limite 2_Side_7	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.33	0.4	0.3	1.10	1.33
Limite 2_Side_8	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.32	0.4	0.3	1.07	1.33
Limite 2_Side_9	Bordure du site Route 132 Ouest - vertical	Illuminance	Lux	0.32	0.4	0.3	1.07	1.33
Limite 3_Side_2	Bordure du site Entrée camions route 132 - vertical	Illuminance	Lux	0.15	0.4	0.0	N.A.	N.A.
Mur Îles_Side_1	Îles Bouchard et Saint-Sulpice (Vertical)	Illuminance	Lux	0.07	0.14	0.01	7.00	14.00
Route 1_Illum	Chemin accès aux stationnements	Illuminance	Lux	9.39	18	2	4.70	9.00
Zone 1	Cour des conteneurs	Illuminance	Lux	33.42	56	13	2.57	4.31
Zone 2	Chemin d'accès	Illuminance	Lux	23.23	56	7	3.32	8.00
Zone 3	Voies Ferroviaires	Illuminance	Lux	30.42	71	4	7.61	17.75
Zone A	Secteur des grues de quai	Illuminance	Lux	23.55	53	4	5.89	13.25
Zone B	Chemin - Entrée des camions	Illuminance	Lux	14.45	33	5	2.89	6.60
Zone S1	Stationnement 1	Illuminance	Lux	13.17	38	2	6.59	19.00
Zone S2	Stationnement 2	Illuminance	Lux	12.14	46	3	4.05	15.33



Modèle Eaton : Ventus (VTS)

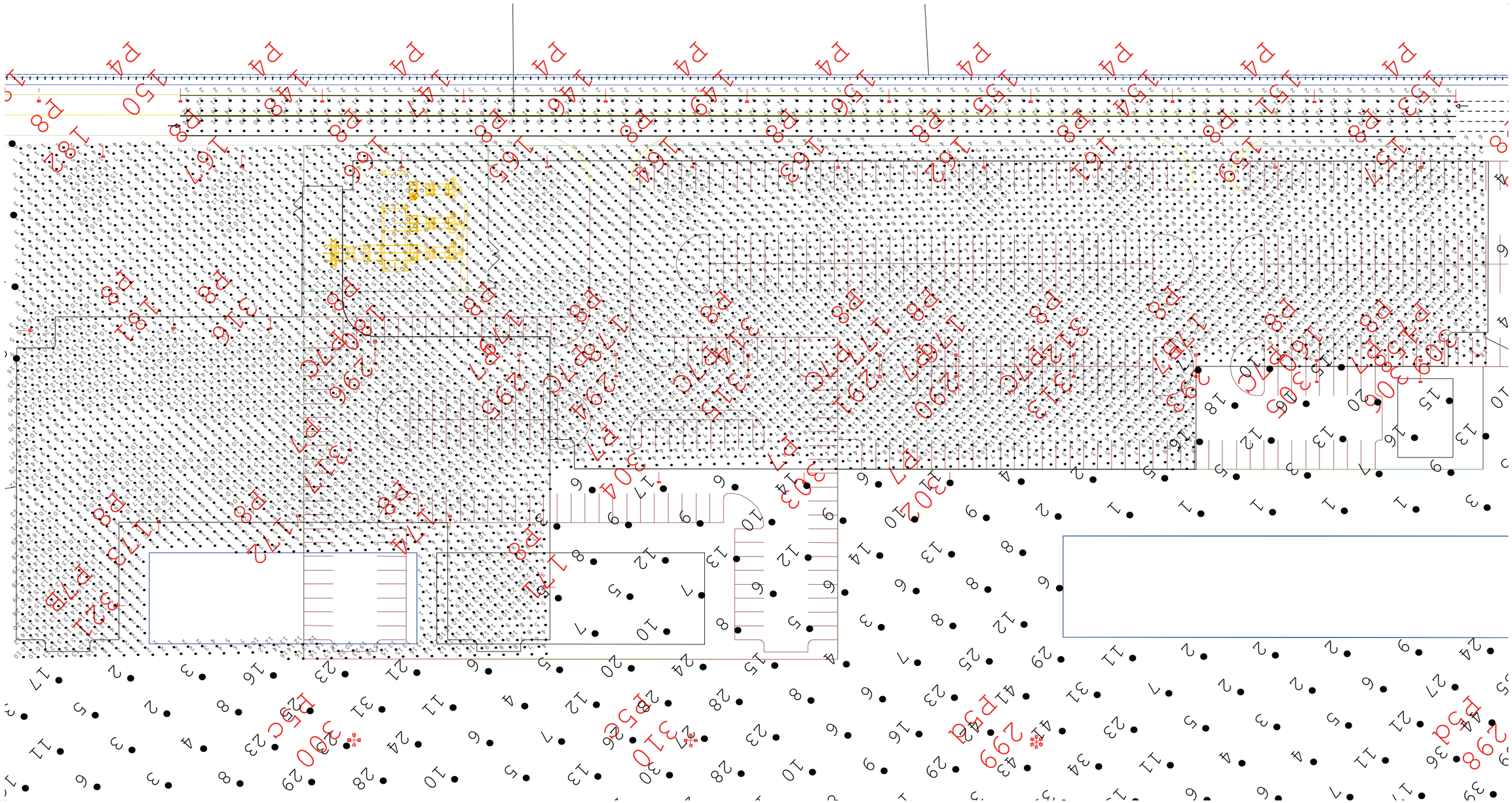
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Projet :
Port de Montréal - Développement Contrecoeur
Rapport d'étude d'impact en éclairage

Titre :
Simulation d'éclairage
Tableaux des luminaires et sommaire des calculs

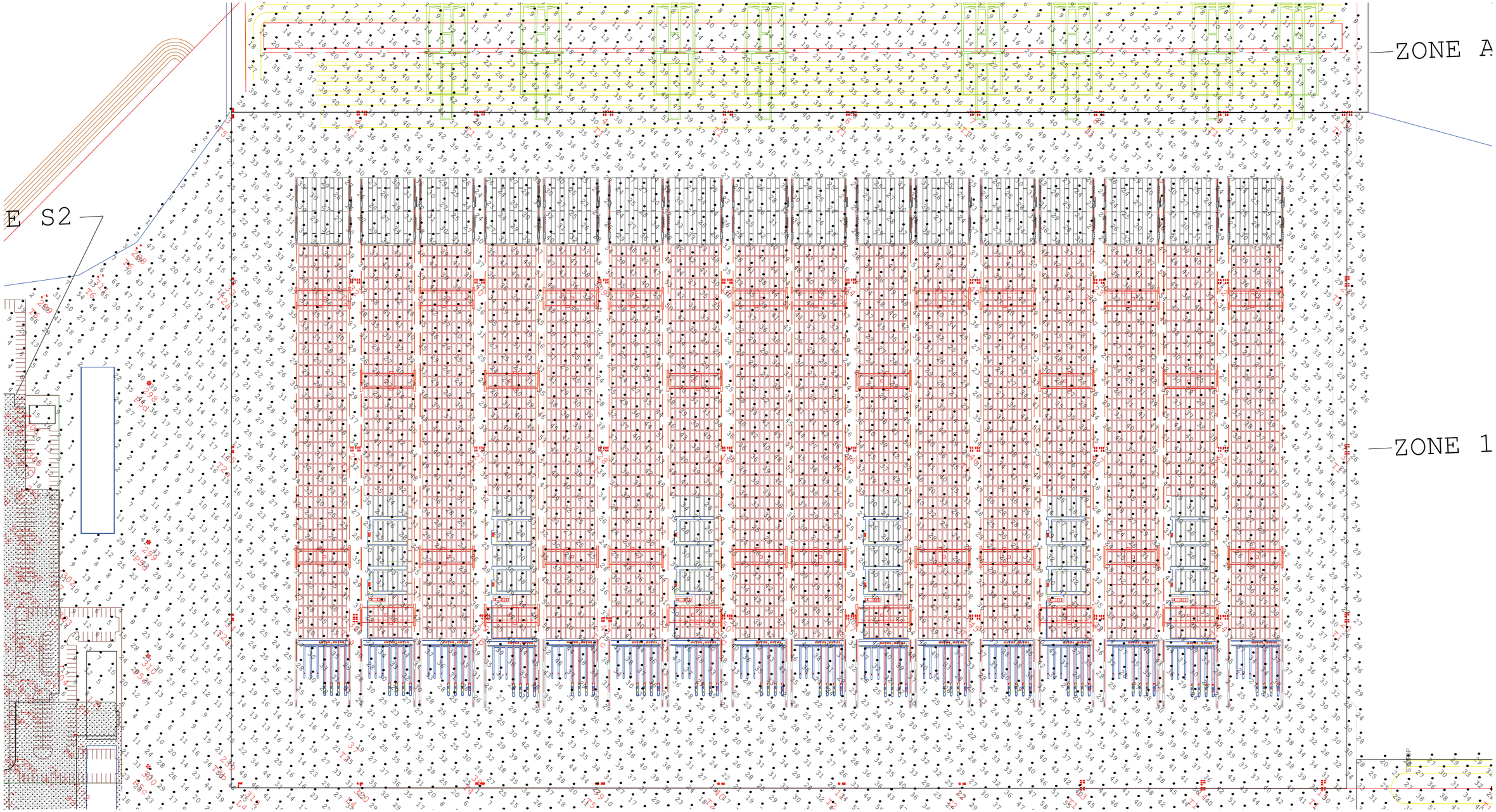
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Vérifié par : A. Cloutier, ing., PA LEED
Date : 2017-03-17

Réf. SNC-Lavalin : 639223
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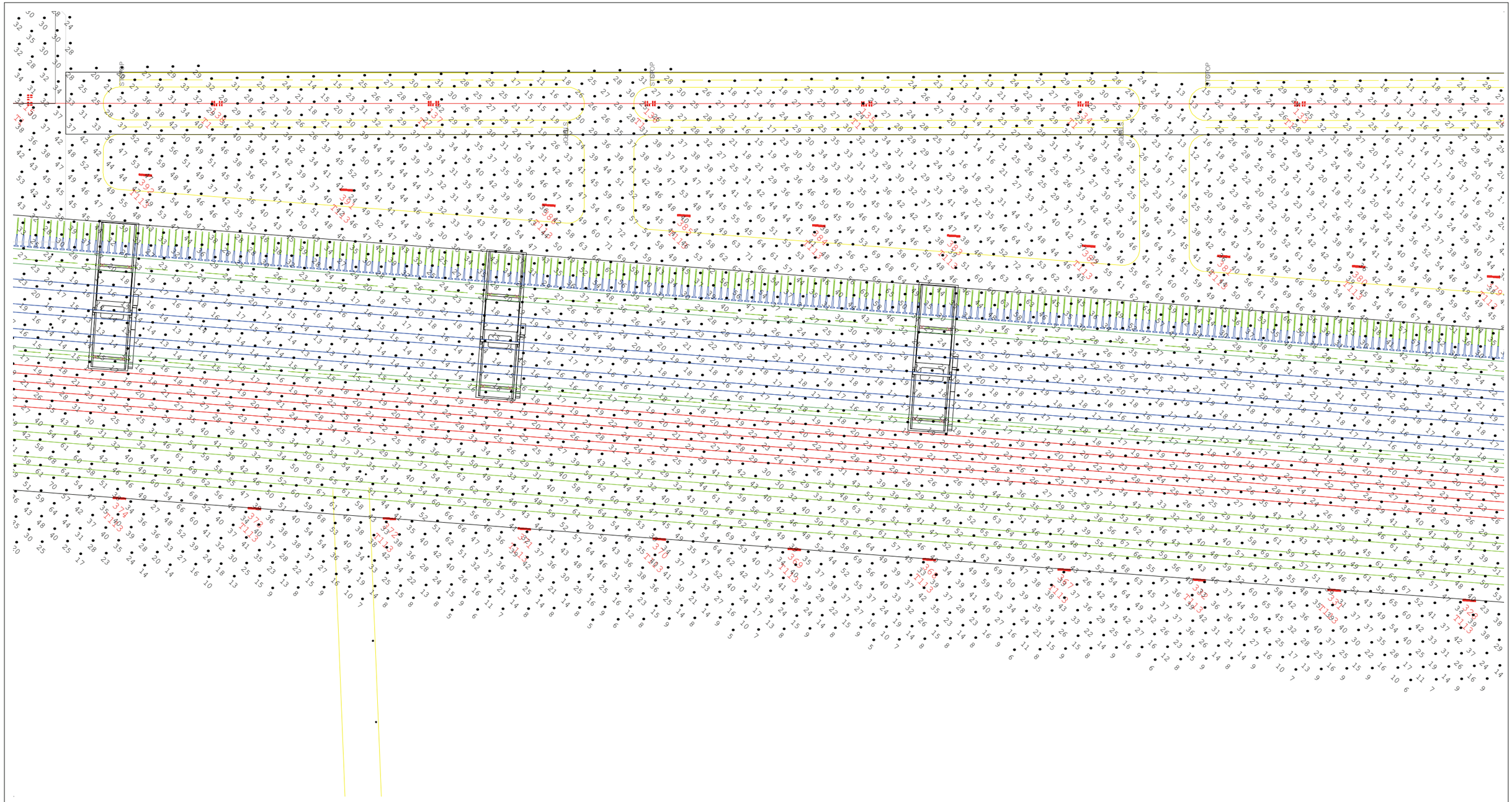
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		Vérifié par : A. Cloutier, ing., PA LEED	No réf. client : -
Titre : Simulation d'éclairage Zone des stationnements		Date : 2017-03-17	Échelle : Aucune
			Feuillet : Page 3 of 7

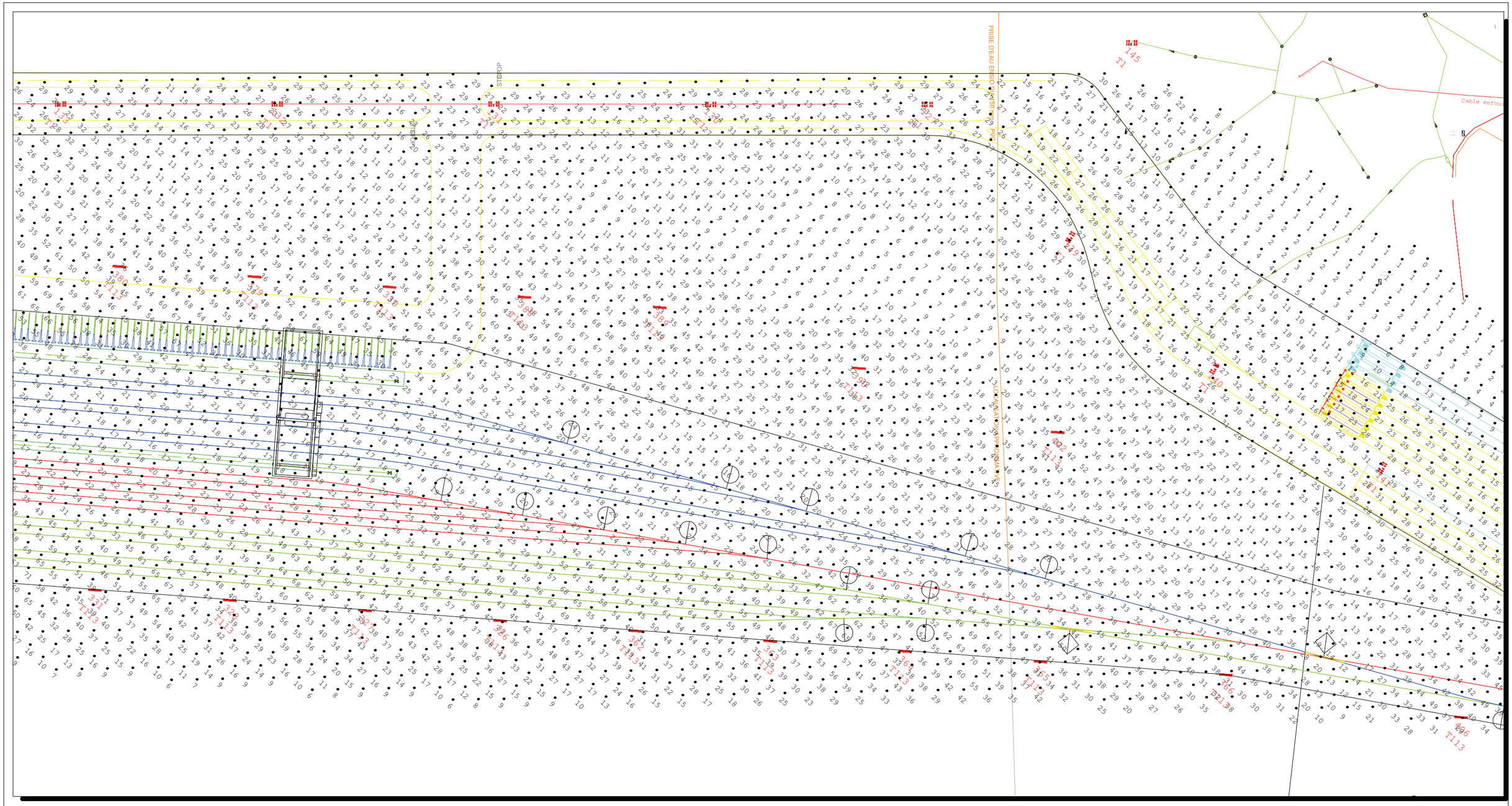


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		Vérifié par : A. Cloutier, ing., PA LEED	No réf. client : -
Titre : Simulation d'éclairage Cour des conteneurs		Date : 2017-03-17	Échelle : Aucune
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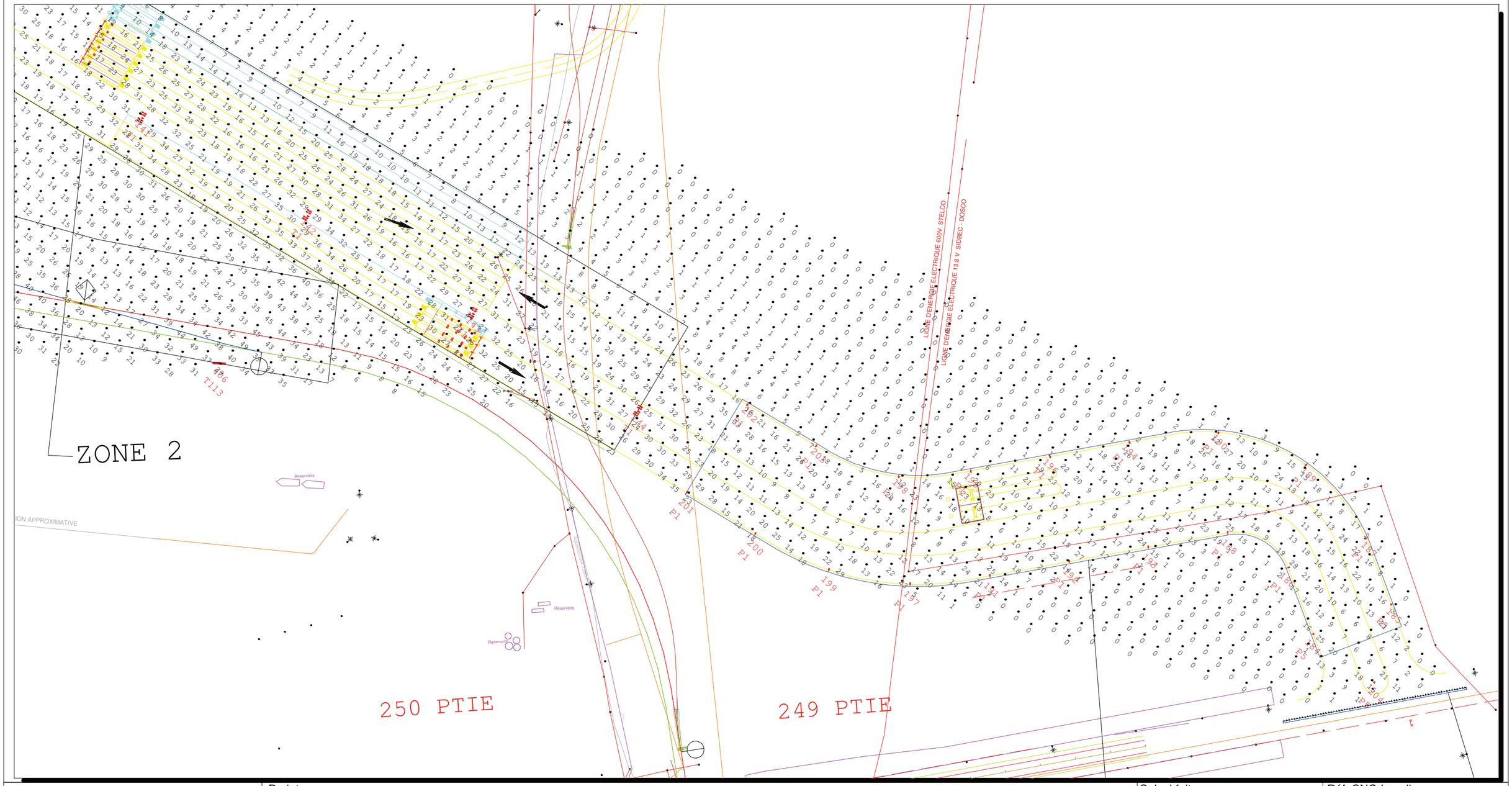


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		Vérifié par : A. Cloutier, ing., PA LEED	No réf. client : -
	Titre : Simulation d'éclairage Chemin d'accès et voies ferroviaires	Date : 2017-03-17	Échelle : Aucune
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Projet :	Port de Montréal - Développement Contrecoeur Rapport d'étude d'impact en éclairage
Titre :	Simulation d'éclairage Chemin d'accès et voies ferroviaires
Calcul fait par :	R. St-Pierre, tech.
Vérifié par :	A. Cloutier, ing., PA LEED
Date :	2017-03-17
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		Vérifié par : A. Cloutier, ing., PA LEED	No réf. client : -
Titre : Simulation d'éclairage Entrée des camions et aire d'attente		Date : 2017-03-17	Échelle : Aucune
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Étude sectorielle No. 31

Agrandissement du terminal portuaire de Contrecœur
Inventaire des émissions atmosphériques de contaminants et de gaz à effet de serre

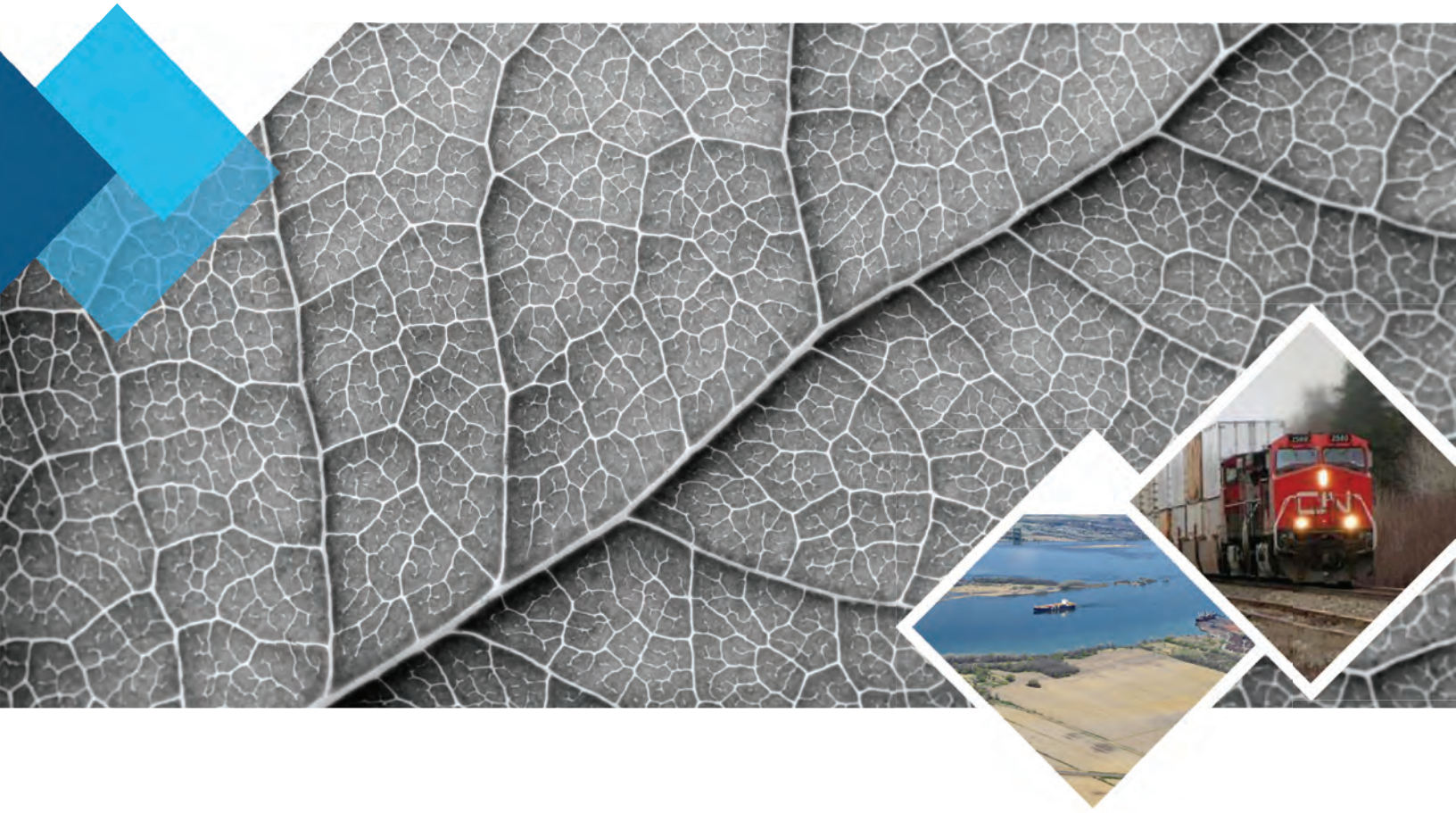


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Agrandissement du terminal portuaire de Contrecoeur

Inventaire des émissions atmosphériques de contaminants et de gaz à effet de serre

ADMINISTRATION PORTUAIRE DE MONTRÉAL



Environnement et géosciences

juillet| 2017

Rapport final
Réf. interne 609988-SLQA-RP01-01

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Agrandissement du terminal portuaire de Contrecœur

Inventaire des émissions atmosphériques de contaminants et de gaz à effet de serre

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V/Dossier n°: 2015642
N/Dossier n°: 609988
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2017-07

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SNC-Lavalin inc.
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Longueuil, le 20 juillet 2017

Monsieur Claude Deschambault
Directeur de l'environnement
ADMINISTRATION PORTUAIRE DE MONTRÉAL (APM)
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Objet : Agrandissement du terminal portuaire de Contrecœur
Inventaire des émissions atmosphériques et des gaz à effet de serre
V/Dossier n° : 2015642
N/Dossier n° : 609988
N/Document n° : 609988-SLQA-RP01-01

Monsieur,

Veuillez trouver ci-joint notre rapport concernant l'inventaire des émissions atmosphériques et des gaz à effet de serre effectué par l'unité d'exploitation Environnement et géosciences de SNC-Lavalin inc. (SNC-Lavalin).

Nous espérons le tout à votre entière satisfaction et vous prions d'agréer, Monsieur, l'expression de nos sentiments les meilleurs.

Jenny Vieira, ing.
Directrice adjointe, Qualité de l'air
Environnement et géosciences
Ingénierie des infrastructures

JV/sc

p. j.

AVIS AU LECTEUR

Le présent rapport a été préparé et les travaux qui y sont mentionnés ont été réalisés par SNC-Lavalin inc. (SNC-Lavalin), exclusivement à l'intention de l'**Administration portuaire de Montréal** (le Client), qui a été partie prenante à l'élaboration de l'énoncé des travaux et en comprend les limites. La méthodologie, les conclusions, les recommandations et les résultats cités au présent rapport sont fondés uniquement sur l'énoncé des travaux et assujettis aux exigences en matière de temps et de budget, telles que décrites dans l'offre de services et/ou dans le contrat en vertu duquel le présent rapport a été produit. L'utilisation de ce rapport, le recours à ce dernier ou toute décision fondée sur son contenu par un tiers est la responsabilité exclusive de ce dernier. SNC-Lavalin n'est aucunement responsable de tout dommage subi par un tiers du fait de l'utilisation de ce rapport ou de toute décision fondée sur son contenu.

Les conclusions, les recommandations et les résultats cités au présent rapport (i) ont été élaborés conformément au niveau de compétence normalement démontré par des professionnels exerçant des activités dans des conditions similaires de ce secteur, et (ii) sont déterminés selon le meilleur jugement de SNC-Lavalin en tenant compte de l'information disponible au moment de la préparation du présent rapport. Les services professionnels fournis au Client et les conclusions, les recommandations et les résultats cités au présent rapport ne font l'objet d'aucune autre garantie, explicite ou implicite. Les conclusions et les résultats cités au présent rapport sont valides uniquement à la date du rapport et peuvent être fondés, en partie, sur de l'information fournie par des tiers. En cas d'information inexacte, de la découverte de nouveaux renseignements ou de changements aux paramètres du projet, des modifications au présent rapport pourraient s'avérer nécessaires.

Le présent rapport doit être considéré dans son ensemble, et ses sections ou ses parties ne doivent pas être vues ou comprises hors contexte. Si des différences venaient à se glisser entre la version préliminaire (ébauche) et la version définitive de ce rapport, cette dernière prévaudrait. Rien dans ce rapport n'est mentionné avec l'intention de fournir ou de constituer un avis juridique.

ENGAGEMENT ENVERS LA QUALITÉ

Afin de démontrer son engagement envers l'importance de la qualité, sa priorité à satisfaire les exigences de ses clients et son engagement à l'amélioration continue, l'unité d'exploitation Environnement et géosciences de SNC-Lavalin inc. s'est dotée d'une politique qualité et d'un système de gestion de la qualité adaptés à ses activités.

Nous tenons en haute estime nos clients ainsi que l'environnement et les communautés au sein desquelles nous travaillons. Nous appliquons rigoureusement et améliorons continuellement notre système de gestion de la qualité afin de répondre et de surpasser les exigences de nos clients. Ainsi, nous reconnaissons que, la qualité de notre prestation est souvent jugée selon les indicateurs suivants :

- Des travaux de terrain réalisés en toute sécurité;
- Une cueillette d'information (inventaires, relevés, recherches) précise et complète;
- La qualité technique et linguistique des livrables soumis;
- Le respect des échéanciers;
- Le respect des budgets;
- Une facturation rapide, claire et précise;
- La compétence de notre équipe de travail.

Nous comprenons que la satisfaction de nos clients est indispensable à la réussite de nos affaires et nous voulons être perçus par eux comme un partenaire privilégié pour réaliser des projets durables.

Notre système de gestion de la qualité repose sur cette politique qui est revue annuellement lors de la revue de direction qualité. Tout notre personnel est sensibilisé à cette déclaration et comprend l'importance de son application dans les activités de l'entreprise.

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Intrants à l'outil PEIT

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Échéancier des travaux de construction

Annexe C

Taux d'émission

1 Introduction

Dans le cadre de l'Étude d'impact environnemental (ÉIE) pour le *Projet d'agrandissement du terminal portuaire de Contrecœur*, l'inventaire des émissions atmosphériques de contaminants et de gaz à effet de serre (GES) directement reliées au projet a été effectué pour chaque phase du projet, soit la construction et l'exploitation. L'inventaire comprend également les émissions des activités actuelles au port à Contrecœur. Les installations actuelles, lesquelles sont concentrées dans la partie est de la propriété foncière, comprennent un quai servant à la réception et à la manutention de vrac solide, principalement du minerai de fer et ses concentrés, ainsi que d'engrais dont la majorité sert à l'industrie et au marché local.

Le futur terminal permettrait d'accueillir un terminal à conteneurs d'une capacité annuelle maximale de 3,5 millions de conteneurs équivalent vingt pieds (EVP). Le déploiement complet de cet aménagement se réaliserait en 3 phases.

Le projet est situé sur le territoire de la municipalité de Contrecœur au Québec, à environ 40 kilomètres (km) en aval de Montréal, sur la rive sud du fleuve Saint-Laurent. L'aménagement du terminal pour la première phase du projet, soit un terminal portuaire à conteneurs d'une capacité annuelle de 1,15 million de conteneurs en EVP, comprend :

- deux postes à quai;
- une aire de manutention des conteneurs;
- une cour ferroviaire intermodale et une gare de triage;
- les installations de soutien;
- les accès ferroviaires et routiers.

L'inventaire des émissions atmosphériques de contaminants et de GES comprend, plus spécifiquement, les trois scénarios suivants :

1. Activités actuelles au terminal de vrac, années 2015 et 2025
2. Construction du nouveau terminal
3. Exploitation du nouveau terminal, Phase 1, année 2025, 1 150 000 EVP

Les sources considérées comprennent les bâtiments, les équipements de manutention de cargaison (EMC), les navires, les véhicules routiers, les trains ainsi que les divers équipements qui seront utilisés pour la construction du terminal.

Les émissions fugitives de matières particulaires liées au transport sur le site, aux activités de manutention de matériaux et à l'érosion éolienne ne sont pas incluses dans l'inventaire. Ces émissions ont été évaluées dans le cadre d'une étude de dispersion atmosphérique et sont présentées dans un rapport distinct préparé par SNC-Lavalin[1].

De plus, une évaluation sommaire a également été effectuée pour estimer les émissions de GES pour les phases 2 et 3 du projet d'agrandissement, soit à 2,3 M EVP et 3,45 M EVP, respectivement.

---

[1] Agrandissement du terminal portuaire de Contrecœur, Étude de dispersion atmosphérique, 2017.

Le choix des contaminants considérés dans la présente étude a été effectué en tenant compte des lignes directrices de l'Agence canadienne d'évaluation environnementale (ACEE)[2]:

› Principaux contaminants atmosphériques (PCA) :
  - Ammoniac – NH_3
  - Oxydes d'azote – NO_x
  - Oxydes de soufre – SO_x
  - Monoxyde de carbone – CO
  - Composés organiques volatils – COV
  - Particules totales – PMT
  - Particules fines – $PM_{2.5}$

Les particules respirables PM_{10} sont estimées comme étant équivalentes aux particules totales pour chaque source.

› Hydrocarbures aromatiques polycycliques (HAP) :
  - Acénaphthène
  - Acénaphtylène
  - Anthracène
  - Benz(a)anthracène
  - Benzo(ghi)pérylène
  - Benzo(a)pyrène
  - Benzo(b)fluoranthène
  - Benzo(k)fluoranthène
  - Chrysène
  - Fluoranthène
  - Fluorène
  - Indeno(1,2,3-cd)pyrène
  - Naphtalène
  - Phénanthrène
  - Pyrène

Les facteurs d'équivalence de toxicité pour les HAP du MDDELCC[3] sont utilisés afin de calculer les émissions d'HAP en équivalent benzo(a)pyrène.

› Autres contaminants ayant une norme ou critère du MDDELCC
  - Arsenic
  - Benzène
  - Chrome (composés de chrome hexavalent)
  - Chrome (composés de chrome trivalent)
  - Éthylbenzène
  - Formaldéhyde
  - Hexane
  - Isooctane

---

[2] Lignes directrices pour la préparation d'une étude d'impact environnemental, réalisée en vertu de la Loi canadienne sur l'évaluation environnementale (2012), Projet d'agrandissement du terminal portuaire de Contrecœur, Administration portuaire de Montréal. Agence canadienne d'évaluation environnementale, Mars 2016.

[3] Normes et critères québécois de qualité de l'atmosphère, Version 5. MDDELCC, 2016.

- Manganèse
- Mercure
- Nickel
- Plomb
- Styrène
- Toluène
- Xylène

- Gaz à effet de serre
  - Dioxyde de carbone – CO_2
  - Méthane – CH_4
  - Protoxyde d'azote – N_2O

Pour le calcul de l'équivalent en dioxyde de carbone (éq. CO_2), les potentiels de réchauffement planétaire (PRP) utilisés sont ceux exigés pour la déclaration des émissions de GES selon l'article 46 de la Loi canadienne sur la protection de l'environnement[4] établi par le Groupe d'experts intergouvernemental sur l'évolution du climat (GIEC) dans son quatrième rapport d'évaluation:

- CO_2 : 1
- CH_4 : 25
- N_2O : 298

La méthodologie utilisée pour l'estimation des émissions atmosphériques de contaminants et de GES est présentée à la section 2, les intrants et les hypothèses utilisées sont présentés à la section 3 et les émissions estimées pour chaque scénario sont présentées à la section 4. Les prévisions des émissions de GES pour les phases 2 et 3 du projet sont présentées à la section 5 et la conclusion de l'étude à la section 6.

[4] Potentiels de réchauffement planétaire, Environnement et Changement climatique Canada, page web : https://www.ec.gc.ca/ges-ghg/default.asp?lang=Fr&n=cad07259-1 (consulté le 8 mai, 2017)

2 Méthodologie

La méthodologie utilisée pour la réalisation de l'inventaire des émissions atmosphériques de contaminants et de GES se base sur l'outil d'inventaire portuaire PEIT (Port Emission Inventory Tool) de Transports Canada. L'outil PEIT a été développé en 2009 et mis à l'essai à deux ports canadiens. À ce moment, un protocole d'inventaire des émissions portuaires a également été développé qui identifiait les méthodes utilisées par l'outil PEIT pour le calcul des émissions. Le protocole ainsi que l'outil PEIT ont été mis à jour en 2012[5], et utilisés pour développer l'inventaire portuaire des ports canadiens[6,7]. Depuis, l'outil continue à être utilisé pour l'inventaire de plusieurs ports canadiens. L'outil PEIT a été récemment mis à jour à la version 4.0 et inclut des modifications importantes afin qu'il reste à jour avec les meilleures pratiques et méthodes d'estimation des émissions de sources portuaires[8]. L'outil PEIT utilise plusieurs bases de données et modèles de l'United States Environmental Protection Agency (US EPA), incluant NONROADS 2008, MOVES 2014a et des données d'émissions de locomotives publiées en 2009[9]. L'outil utilise également des données pour certaines catégories de navires identifiées dans des études réalisées par l'Organisation maritime internationale (OMI)[10,11].

Pour les contaminants autres que les PCA, les profils de spéciation du modèle PEIT[12] sont utilisés. Ils proviennent du modèle NMIM (National Mobile Inventory Model) de l'US EPA pour les véhicules routiers, les équipements de manutention de cargaison et les équipements de construction. Pour les navires, les profils de spéciation proviennent de l'inventaire national d'émissions de 2008 de l'US EPA[13], alors que pour les locomotives, ils proviennent de l'étude menée par le Southwest Research Institute (SwRI) pour le California Air Resources Board (CARB) en 2000[14].

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5 *Transport Canada Port Emissions Inventory Protocol,* SNC-Lavalin, 2012.
6 *East Coast/Great Lakes Ports 2010 Emissions Inventory Study. Final Report T8125-110138/002/XSB.* Ottawa: Transportation Development Centre, Transport Canada. SNC-Lavalin, 2014.
7 *West Coast Ports 2010 Emissions Inventory Study; T8125-101004/01/XSB.* Ottawa: Transportation Development Centre, Transport Canada. SNC-Lavalin, 2014.
8 *Transport Canada Port Emissions Inventory Tool Version 4.0 User Guide.* SNC-Lavalin, 2017.
9 *Emission Factors for Locomotives,* EPA 2009.
10 *Greenhouse Gas Study 2014.* London: International Maritime Organization. IMO, 2014.
11 *Prevention of Air Pollution from Ships.* OMI, 2016. Retrieved 05 23, 2016, from IMO: http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Air-Pollution.aspx
12 La version mise à jour de PEIT n'intègre pas les contaminants autres que les PCA et les GES; les profils de ces autres contaminants ont été transférés dans la version 4.0 de PEIT à partir de la version précédente de l'outil.
13 2008 National Emissions Inventory (NEI) Data, US EPA. Page web: https://www.epa.gov/air-emissions-inventories/2008-national-emissions-inventory-nei-data.
14 Diesel fuel effects on locomotive exhaust emissions, Steven G. Fritz, P.E. Final report, octobre 2000.

Les émissions générées par les activités portuaires sont comptabilisées par l'outil PEIT en tenant compte (1) de l'utilisation de l'équipement en heures, en kilomètres parcourus, ou en consommation de combustible et (2) du facteur d'émission qui lui tient compte des caractéristiques du combustible, du moteur et des mesures de contrôle des émissions, s'il y a lieu.

L'équation utilisée pour le calcul des émissions est la suivante :

Émissions = activité (heures ou km parcourus ou consommation de combustible) x facteur d'émission

L'inventaire tient compte des activités de cinq groupes de sources : les bâtiments, les navires, l'équipement de manutention de cargaison, les activités ferroviaires et les véhicules routiers à l'intérieur des limites terrestres et maritimes. Une description des méthodes de calcul utilisées par l'outil PEIT est présentée dans les sous-sections suivantes.

2.1 Émissions de GES

Les facteurs d'émission utilisés pour l'inventaire des GES (CO_2, CH_4, N_2O) proviennent du Rapport d'inventaire national 1990-2015 : Sources et puits de gaz à effet de serre au Canada[15] (RIN 1990-2015) d'Environnement et Changement climatique Canada. Ces facteurs se basent sur la consommation du combustible par type d'équipement, tel que présenté aux tableaux 2-1 et 2-2. Le calcul des émissions de GES tient compte des exigences du Règlement fédéral sur les combustibles renouvelables[16], soit en moyenne d'au moins 5 % de combustible renouvelable pour l'essence et une teneur de combustible renouvelable moyenne d'au moins 2 % pour le diesel.

[15] Rapport d'inventaire national 1990-2015 : Sources et puits de gaz à effet de serre au Canada, page web : https://www.ec.gc.ca/ges-ghg/default.asp?lang=Fr&n=662F9C56-1 (consulté le 22 avril 2016)

[16] Règlement fédéral sur les carburants renouvelables : Un aperçu, page web : https://www.ec.gc.ca/energie-energy/default.asp?lang=Fr&n=828C9342-1 (consulté le 8 mai 2017)

Tableau 2-1 Facteurs d'émission (g/L) de GES pour le diesel et l'essence

Type de combustible	Type de source	Type d'équipement	CO_2 (0 % renouvelable)	CO_2 (100 % renouvelable)	CH_4	N_2O
Diesel	Bâtiments	Tout	2 690	2 474	0,150	1,100
	EMC [1]	Tout	2 690	2 474	0,150	1,100
	Transport routier	Voitures (<1996)	2 690	2 474	0,068	0,210
		Voitures (>1995)	2 690	2 474	0,051	0,220
		Camionnette privée (<1996)	2 690	2 474	0,068	0,210
		Camionnette privée (>1996)	2 690	2 474	0,068	0,220
		Camions commerciaux et autobus (<1996)	2 690	2 474	0,140	0,082
		Camions commerciaux et autobus (>1995)	2 690	2 474	0,110	0,151
	Ferroviaire	Tout	2 690	2 474	0,150	1,100
Essence	Bâtiments	Tout	2 316	1 509	2,700	0,050
	EMC [1]	Tout	2 316	1 509	2,700	0,050
	Transport routier	Voitures (<1995)	2 316	1 509	0,320	0,660
		Voitures (1995–2003)	2 316	1 509	0,230	0,470
		Voitures (>2003)	2 316	1 509	0,14	0,022
		Camionnettes privées (<1995)	2 316	1 509	0,210	0,660
		Camionnettes privées (1995–2003)	2 316	1 509	0,240	0,580
		Camionnettes privées (>2003)	2 316	1 509	0,140	0,0220
		Camions commerciaux et autobus	2 316	1 509	0,068	0,200

Note 1: Équipements de manutention de cargaison.

Tableau 2-2 Facteurs d'émission de GES pour les combustibles marins, le gaz naturel et le propane (g/L)

Type de combustible	Type de source	CO_2	CH_4	N_2O
Mazout lourd	Navire	3 156	0,280	0,079
Mazout léger	Navire	2 753	0,260	0,073
Diesel marin	Navire	2 690	0,15	1,1
Mazout léger	Non maritime	2 753	0,026	0,031
Mazout lourd	Non maritime	3 156	0,057	0,064
Gaz naturel [1]	Bâtiments	1,887	0,000037	0,000035
	EMC [2]	1,9	0,009000	0,000060
	Navires	1,9	0,009000	0,000060
	Transport routier	1,9	0,009000	0,000060
Propane	Bâtiments	1 515	0,024	0,108
	EMC [2]	1 515	0,640	0,028
	Transport routier	1 515	0,640	0,028

Note 1 : Conditions standard pour la température et pression.
Note 2 : Équipements de manutention de cargaison.

Les intensités de GES pour la production d'électricité au Québec (en g GES/kWh produite) sont tirées du RIN 1990-2015 :

- CO_2 : 1,1 g/kWh
- CH_4 : 0,0 g/kWh
- N_2O : 0,0001 g/kWh

Les taux de consommation de combustible pour les navires sont présentés au tableau 2-3. Pour les locomotives, le taux de consommation de carburant est unique pour chaque compagnie ferroviaire. Selon l'association des chemins de fer du Canada, le taux spécifique de consommation du combustible pour les chemins de fer du CN et CP est de 4,9 L/1000 tonnes-km payantes[17]. Dans le cas des équipements de manutention de cargaison (incluant les équipements hors route pour la construction) et les véhicules routiers, les taux de consommation de combustible proviennent du modèle NONROAD 2008 et MOVES 2014a de l'US EPA, respectivement.

[17] Programme de surveillance des émissions des locomotives, Association des chemins de fer du Canada, 2014.

Tableau 2-3 Consommation spécifique de combustible (SFOC) pour moteurs de navires (en g/kWh) par classe de moteur, type de combustible et âge (OMI 2014)

Moteur	Âge du moteur	SFOC (g/kWh)
Principal Moteur à deux temps diesel	1970-1983	205
	1984-2000	185
	2001-2007	175
	2008+	175
Principal Moteur à quatre temps diesel	1970-1983	215
	1984-2000	195
	2001-2007	185
	2008+	185
Moteur auxiliaire Moteur à quatre temps diesel	1970-1983	225
	1984-2000	225
	2001-2007	225
	2008+	225
Turbine à gaz – Mazout lourd	Toutes les années	305
Turbine à gaz – Essence/diesel	Toutes les années	300
Chaudière à vapeur – Mazout lourd	Toutes les années	305
Chaudière à vapeur – Essence/diesel	Toutes les années	300
Principal et auxiliaire – GNL	Toutes les années	166

2.2 Émissions des contaminants atmosphériques (PCA)

Les sous-sections suivantes présentent les méthodes utilisées par l'outil PEIT pour l'estimation des contaminants atmosphériques. Dans le cas des SOx, les émissions sont estimées en tenant compte de la teneur en soufre du combustible utilisé par la source d'émission. Les teneurs en soufre utilisées par l'outil PEIT sont présentées au tableau 2-4.

Tableau 2-4 Teneurs en soufre du combustible utilisé par les différentes sources

Combustible	Teneur en souffre	Source
Gaz naturel - bâtiments	3 ppm	Valeur par défaut dans PEIT[1]
Diesel – EMC [2]	15 ppm	Environnement et Changement climatique Canada
Mazout lourd - Navires	1 000 ppm	Environnement et Changement climatique Canada
Diesel marin - Navires	15 ppm	Environnement et Changement climatique Canada
Diesel - Véhicules routiers	15 ppm	Environnement et Changement climatique Canada
Diesel - Locomotives	15 ppm	Environnement et Changement climatique Canada

Note 1 : Valeur provenant de Fortis BC.
Note 2 : Équipements de manutention de cargaison.

2.2.1 Navires

Les données de l'étude de l'OMI « Third IMO Greenhouse Gas Study 2014 »[18] sont utilisées pour l'estimation des émissions des navires, à l'exception des remorqueurs pour lesquels les taux d'émission du programme EPA SmartWay[19] sont utilisés.

L'équation pour le calcul des émissions des navires est la suivante :

$$E = P \times LF \times T \times EF_{énergie} \quad (1)$$

où E = émissions totales (g)

P = puissance nominale du moteur (kW)

LF = facteur de charge (fraction de la puissance nominale)

T = temps associé au mode d'opération du navire (h)

$EF_{énergie}$ = facteur d'émission (g/kWh)

Le total des émissions d'un navire correspond à la somme des émissions des moteurs principaux, des moteurs auxiliaires et des chaudières pour chaque mode d'opération du navire. Ce dernier est défini en fonction de la vitesse moyenne de croisière du navire, ce qui influe sur le choix du facteur de charge du moteur (tableau 2-5). Le moteur principal est considéré éteint lorsque le navire est à quai, alors que les moteurs auxiliaires et les chaudières sont considérés allumés en tout temps. Dans le cas des moteurs auxiliaires, la charge du moteur utilisée par l'outil PEIT se base sur la demande d'énergie selon le type et la taille du navire. Ces informations sont tirées de l'étude de l'OMI ainsi que des inventaires de navires effectués par Starcrest[20].

Le tableau 2-6 présente les facteurs d'émission pour les NO_x, CO et hydrocarbures. Ces taux proviennent de l'étude de l'OMI, exception faite du CO dont les facteurs d'émission proviennent plutôt d'inventaires portuaires et maritimes grandement répandus en Amérique du Nord (en comparaison, le taux de l'OMI est de 0,53 g/kWh pour tous les navires et combustibles). Les taux d'émission de NOx sont automatiquement ajustés par l'outil PEIT afin de tenir compte des limites prescrites dans l'annexe VI de l'OMI[21] selon l'année de fabrication du navire.

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[18] Third IMO Greenhouse Gas Study 2014, site web: http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Third%20Greenhouse%20Gas%20Study/GHG3%20Executive%20Summary%20and%20Report.pdf (consulté le 8 mai 2017)

[19] Barge Carrier Partner 2.0.15 Tool: Technical Documentation 2015 Data Year – United States Version. S.l.: US EPA Transportation and Climate Division, 2016.

[20] Long Beach Emissions Inventory 2013. Starcrest LLC, 2014.

[21] Prevention of Air Pollution from Ships, site web: http://www.imo.org/en/OurWork/environment/pollutionprevention/airpollution/pages/air-pollution.aspx

Tableau 2-5 Facteurs de charge par mode d'opération attribués par l'outil PEIT à partir de la vitesse moyenne de croisière

Vitesse du navire par rapport à la vitesse maximale de croisière	Fourchette du facteur de charge pour le moteur principal [1]	Facteur de charge attribué par l'outil PEIT
≥ 80 %	0,51 – 1,00	0,80
60 % ≤ x < 80 %	0,22 – 0,51	0,40
30 % ≤ x <60 %	0,027 – 0,22	0,25
≤ 30 %	0,00 – 0,027	0,10
0	0,0	0

Note 1 : Selon «Propellar Law» décrit dans plusieurs sources dont l'inventaire d'émissions de navires pour la Colombie-Britannique[22].

Tableau 2-6 Facteurs d'émission en g/kWh par type de moteur

Type de moteur	Combustible	NOx	CO	Hydrocarbures	Ammoniac
Moteur auxiliaire à quatre temps	Mazout lourd	14,0	1,1	0,4	0,001
Moteur auxiliaire à quatre temps	Mazout léger	13,2	1,1	0,4	0,001
Moteur auxiliaire à quatre temps	Diesel marin	13,2	1,1	0,4	0,001
Moteur principal à deux temps	Mazout lourd	18,1	1,4	0,6	0,021
Moteur principal à deux temps	Mazout léger	17,0	1,1	0,6	0,02
Moteur principal à deux temps	Diesel marin	17,0	1,1	0,6	0,02
Moteur principal à quatre temps	Mazout lourd	13,2	1,1	0,5	0,023
Moteur principal à quatre temps	Mazout léger	13,2	1,1	0,5	0,022
Moteur principal à quatre temps	Diesel marin	13,2	1,1	0,5	0,022
Chaudière	Mazout lourd	2,1	0,2	0,1	0,0004
Chaudière	Mazout léger	2,0	0,2	0,1	0,0004
Chaudière	Diesel marin	2,0	0,2	0,1	0,0004
Turbine à gaz	Mazout lourd	6,1	0,1	0,1	0,0004
Turbine à gaz	Mazout léger	5,9	0,1	0,1	0,0004
Turbine à gaz	Diesel marin	5,9	0,1	0,1	0,0004
Moteur principal et auxiliaire	GNL	1,3	1,3	0,5	0,01

[22] 2005-2006 BC Ocean-Going Vessel Emissions Inventory, The Chamber of Shipping, 25 janvier 2007.

Les émissions de SO_x et de particules totales varient selon le contenu en soufre du combustible. Les équations suivantes sont donc utilisées pour leurs estimations :

SO_x

$$EF_{SOx} = BSFC \times 2 \times 0{,}97753 \times TS \quad (2)$$

où EF_{SOx} = facteur d'émission de SOx (g/kWh)

BSFC = consommation spécifique de combustible (g/kWh)

TS = fraction de soufre dans le combustible

PMT (moteurs diesel)

$$EF_{PMT}\,(kg/tonnes) = 0{,}23 + BSFC \times 7 \times 0{,}02247 \times (TS - 0{,}0024) \quad (3)$$

PMT (chaudières)

$$EF_{PMT}\,(g/kWh) = 0{,}25 + 20{,}3 \times TS \quad (4)$$

Pour les navires à quai qui se brancheront sur le réseau électrique, l'outil PEIT considère les hypothèses suivantes :

- Les moteurs auxiliaires sont considérés en marche pendant une période de 3 heures pour représenter la période d'enclenchement et d'arrêt auprès de la source électrique;
- Les chaudières opèrent comme pour les navires non branchés à quai.

2.2.2 Équipements de manutention de cargaison (EMC)

Les émissions des équipements de manutention de cargaison sont calculées à l'aide de l'équation suivante :

$$E = P \times LF \times T \times EF_{cycle\text{-}opératoire} \quad (5)$$

où E = émissions totales (g)

P = puissance nominale du moteur (hp)

LF = facteur de charge (fraction de la puissance nominale)

T = temps d'utilisation du moteur (h)

$EF_{cycle\text{-}opératoire}$ = facteur d'émission basé sur un cycle d'usage défini (g/hph)

Les facteurs d'émission dans l'outil PEIT sont tirés du modèle NONROAD 2008 de l'US EPA. L'annexe C présente les facteurs d'émission et les charges utilisées par l'outil PEIT pour chaque source de l'inventaire.

2.2.3 Ferroviaire

Les émissions des locomotives sont calculées avec les équations 6, 7 et 8, ci-dessous.

$$F = TKP \times Index_Carb \quad (6)$$

$$Wk = F \times Index_Travail \quad (7)$$

$$E = EF_{cycle\ opératoire} \times Wk \quad (8)$$

où F = consommation de combustible (L)

TKP = tonne-km payantes

Index_Carb = taux spécifique de consommation du combustible (L/TKP)

Wk = travail effectué par la locomotive (hp-h)

Index_Travail = travail moyen généré par le combustible (bhp-h/L)

E = émissions totales (g)

$EF_{cycle\ opératoire}$ = facteur d'émission basé sur le cycle d'opération (g/hph)

Les émissions des locomotives de CN et CP sont calculées à l'aide des équations 6, 7 et 8. Dans le cas des locomotives du port, seules les équations 7 et 8 sont utilisées. Dans ce cas, la consommation du combustible doit être connue.

Les tableaux 2-7 et 2-8 présentent les taux moyens d'utilisation de combustible des locomotives ainsi que les facteurs d'émission tirés de l'US EPA[23].

Tableau 2-7 Valeurs pour l'Index_Travail des locomotives

Type de locomotive	Index_Travail en bhp-h/litre
Ligne de service – grand	5,50
Ligne de service – petit	4,81
Manœuvres-triage	4,02
Groupes électrogènes diesel [1]	4,02
Manœuvres[1]	4,02

Note 1: Utilise le taux pour le type manœuvres-triage

[23] Emission factors for Locomotives; Office of Transportation and Air Quality, 2009.

Tableau 2-8 Facteurs d'émission moyens de l'US EPA selon le cycle opératoire

Type	Niveau EPA[1]	Facteur d'émission en g/bhp-h				
		PM_T	COV	NOx	CO	NH_3
Ligne de service	Hors niveau	0,32	0,48	13	1,28	0,014
Ligne de service	0	0,32	0,48	8,6	1,28	0,014
Ligne de service	0+	0,2	0,3	7,2	1,28	0,014
Ligne de service	1	0,32	0,47	6,7	1,28	0,014
Ligne de service	1+	0,2	0,29	6,7	1,28	0,014
Ligne de service	2	0,18	0,26	4,95	1,28	0,014
Ligne de service	2+	0,08	0,13	4,95	1,28	0,014
Ligne de service	3	0,08	0,13	4,95	1,28	0,014
Ligne de service	4	0,015	0,04	1	1,28	0,014
Manœuvres-triage	Hors niveau	0,44	1,01	17,4	1,83	0,014
Manœuvres-triage	0	0,44	1,01	12,6	1,83	0,014
Manœuvres-triage	0+	0,23	0,57	10,6	1,83	0,014
Manœuvres-triage	1	0,43	1,01	9,9	1,83	0,014
Manœuvres-triage	1+	0,23	0,57	9,9	1,83	0,014
Manœuvres-triage	2	0,19	0,51	7,3	1,83	0,014
Manœuvres-triage	2+	0,11	0,26	7,3	1,83	0,014
Manœuvres-triage	3	0,08	0,26	4,5	1,83	0,014
Manœuvres-triage	4	0,015	0,08	1	1,83	0,014

Note 1 : Niveaux Tier de l'US EPA

2.2.4 Transport routier

Les émissions des véhicules routiers sont calculées selon l'équation suivante :

$$E = T \times EF \quad (9)$$

où E = émissions totales (g)

T = temps d'opération du véhicule (h)

EF = facteur d'émission (g/h)

Les facteurs d'émission applicables proviennent du modèle MOVES 2014a de l'US EPA. L'annexe C présente les facteurs d'émission et les charges utilisées par l'outil PEIT pour chaque source.

2.2.5 Bâtiments

Les sources considérées pour les bâtiments incluent l'électricité utilisée ainsi que les chaudières pour le chauffage. Les taux d'émission des chaudières proviennent du modèle NONROADS de l'US EPA.

2.3 Émissions des autres contaminants atmosphériques

Pour les contaminants autres que les PCA, les profils de spéciation sont utilisés pour le calcul des contaminants. Les profils de spéciation sont des fractions par contaminant qui sont multipliées aux concentrations de COV totaux ou de particules afin d'obtenir la concentration du contaminant en question.

3 Intrants et hypothèses

Cette section présente les informations reçues de l'APM concernant l'exploitation du site (1) en 2015; (2) lors de la construction du nouveau terminal; (3) en 2025 dans les conditions actuelles; (4) en 2025 avec le nouveau terminal en exploitation (phase 1); (5) avec le nouveau terminal en exploitation (phases 2 et 3). Le tableau 3-1 présente la source de ces informations et les hypothèses considérées pour chaque scénario. Plus de détails sur les intrants utilisés pour le calcul des émissions par l'outil PEIT sont présentés à l'annexe A à l'exception du scénario actuel afin de garder les informations des locataires du port confidentielles

Tableau 3-1 Source des intrants et hypothèses

Scénario	Source des intrants	Hypothèses
Actuel - 2015	Locataires du port à Contrecœur Données sur les navires provenant de la capitainerie du port	• Navires : les remorqueurs opèrent 2 heures par navire à un facteur de charge de 0,5. • Équipements de manutention de cargaison : les facteurs de charge utilisés sont les facteurs moyens par type d'équipement du modèle NONROAD. • Véhicules routiers : dans le cas des camions lourds non opérés par les terminaux, le profil d'âge par défaut du modèle MOVES 2014a est utilisé. • Ferroviaire : pour les locomotives de manœuvre, la consommation de combustible est estimée en utilisant un régime moyen d'opération et taux de consommation de combustible de locomotives de manœuvre de l'US EPA.
Construction	Administration portuaire de Montréal	• Équipements de manutention de cargaison : les facteurs de charge utilisés sont les facteurs moyens par type d'équipement du modèle NONROAD; les facteurs d'émission utilisés sont ceux pour les équipements de niveau Tier 3. • Dragage : le temps d'opération des remorqueurs pendant un quart de travail est estimé à 50 % : ceux-ci font quatre voyages par jour pour transporter le chaland avec les sédiments pour déchargement.
Actuel - prévision 2025	Identique au scénario actuel (2015)	• Les activités et opérations sont identiques à celles de 2015. • Navires : ajout de 10 ans à l'âge des navires. • Équipements de manutention de cargaison : les facteurs de charge utilisés sont les facteurs moyens par type d'équipement du modèle NONROAD; l'âge des équipements en 2015 est utilisé comme base pour déterminer l'âge auquel le renouvellement de la flotte se fait en utilisant comme base l'âge de l'équipement le plus ancien. • Véhicules routiers : dans le cas des camions lourds non opérés par les terminaux, le profil d'âge est estimé comme suit : 1/3 2015, 1/3 2016 et 1/3 2017 (2017 étant la limite de l'outil PEIT) pour l'estimation des émissions. • Véhicules routiers : dans le cas des camionnettes du site, l'âge en 2015 est utilisé comme base pour déterminer l'âge auquel le renouvellement de la flotte se fait en utilisant comme base l'âge de la camionnette la plus âgée. • Ferroviaire : aucune modification.

Tableau 3-1 Source des intrants et hypothèses (suite)

Scénario	Source des intrants	Hypothèses
Exploitation Phase 1 (2025)	Administration portuaire de Montréal	• Navires : deux remorqueurs opèrent 2 heures par navire à un facteur de charge de 0,5; un modèle existant au port est considéré pour l'un des remorqueurs (2011), alors qu'un modèle neuf est considéré pour le 2e remorqueur (les facteurs d'émission pour un modèle de 2016 sont les plus récents pour les remorqueurs de catégorie 1); la distribution de l'âge de la moitié des navires à conteneurs a été établie à l'aide de la distribution de l'âge des navires à conteneurs fréquentant le port de Montréal en 2015 en ajoutant 10 ans à la flotte de navires (soit 5 % des navires de niveau Tier 0, 54 % des navires de niveau Tier 1, 34 % des navires de niveau Tier 2 et 7 % des navires de niveau Tier 3)[1]; l'autre moitié fréquentant le port en 2025 seront des navires hybrides GNL (hypothèse de l'APM); en l'absence d'informations sur l'opération des navires hybrides à l'approche et au quai quant à l'utilisation du carburant, les émissions de ces navires sont estimées selon les facteurs d'émission de navires au diesel de niveau Tier 2. • Électrification à quai : 25 % des navires sont considérés comme étant branchés aux infrastructures électriques lorsqu'ils sont à quai. • Équipements de manutention de cargaison : les facteurs de charge utilisés sont les facteurs moyens par type d'équipement du modèle NONROAD; le facteur de charge des grues électriques utilisé est le même que celui des grues au diesel (0,43); les conteneurs réfrigérés dans la cour à conteneurs sont utilisés à 65 % du temps et consomment de l'électricité (facteur de charge moyen de 0,5). • Véhicules routiers : dans le cas des camions lourds non opérés par les terminaux, le profil d'âge est estimé comme suit : 1/3 2015, 1/3 2016 et 1/3 2017 (2017 étant la limite de l'outil PEIT) pour l'estimation des émissions; dans le cas des camionnettes hybrides, l'utilisation en heures est estimée à 53 040 heures par année (fourni par l'APM) et l'estimation de la consommation de combustible et les taux d'émission des PCA proviennent du modèle MOVES 2014a. • Ferroviaire : pour les locomotives de manœuvres, la consommation de combustible est estimée en utilisant un régime moyen d'opération de locomotives de manœuvres de l'US EPA et le taux de consommation de combustible du manufacturier.
Prévisions (Phases 2 et 3)	Se base sur le scénario de la Phase 1	• Les nombres de navires, d'équipements de manutention de cargaison, de camions et de trains sont tous multipliés par 2 ou 3 selon la phase. • L'âge des navires est ajusté en ajoutant 10 ans au profil de 2025 pour la phase 2 et 20 ans pour la phase 3.

Note 1 : Les niveaux Tier sont reliés aux standards des émissions de NOx (Tier 0 pour les navires construits avant 2000, Tier 1 pour les navires construits de 2000 à 2010, Tier 2 pour les navires construits de 2011-2015 et Tier 3 pour les navires construits à partir de 2016)

Pour le scénario d'exploitation phase 1, l'année identifiée pour les équipements de manutention de cargaison et pour les camionnettes dans l'outil PEIT est 2015, afin de tenir compte des standards d'émissions plus récents. Ces standards sont tout de même conservateurs considérant que les émissions et la consommation de combustible des équipements en 2025 seront probablement moindres.

De plus, afin de vérifier un pire cas d'émissions des navires, un scénario d'exploitation additionnel a été évalué où aucun navire ne serait de type hybride au GNL et aucune électrification à quai ne

serait considérée. Pour ce scénario, la distribution de l'âge de tous les navires à conteneurs a été établie à l'aide de la distribution de l'âge des navires à conteneurs fréquentant le port de Montréal en 2015 en ajoutant 10 ans à la flotte de navires.

4 Émissions totales des contaminants atmosphériques et des GES

Les émissions des contaminants atmosphériques et de GES sont présentées de façon plus détaillée pour le scénario exploitation (par groupe et type de source) et plus grossièrement pour le scénario actuel afin de garder les informations des locataires actuels du port confidentielles. Les tableaux 4-1 et 4-2 présentent les émissions pour le scénario actuel (2015 et 2025) alors que le tableau 4-3 présente les émissions pour le scénario exploitation Phase 1.

Tableau 4-1 Scénario actuel 2015 – Émissions de contaminants (PCA) et de GES, en tonnes

Groupe de sources	NO_x	SO_x	CO	COV	PM_T	$PM_{2.5}$	NH_3	CO_2	CH_4	N_2O	éq. CO_2
Bâtiments	0,04	0,00	0,07	0,01	0,01	0,01	0,01	99,9	0,00	0,00	101
EMC [1]	3,36	0,01	13,1	0,69	0,26	0,25	0,01	692	0,09	0,24	765
Navires	35,8	1,03	3,94	1,44	0,60	0,55	0,04	2 347	0,21	0,06	2 370
Transport routier	2,52	0,01	1,01	0,21	0,30	0,16	0,01	752	0,03	0,06	770
Ferroviaire	0,53	0,001	0,06	0,02	0,01	0,01	0,001	77,9	0,004	0,03	86,6
TOTAUX	**42,2**	**1,05**	**18,2**	**2,37**	**1,18**	**0,98**	**0,07**	**3 968**	**0,34**	**0,39**	**4 093**

Note 1 : Équipements de manutention de cargaison.

Les émissions de GES en éq. CO_2 estimées pour les activités au port à Contrecœur en 2015 sont de 4 093 tonnes, dont 58 % sont attribuées aux navires. En 2025, en considérant les activités équivalentes à celles effectuées en 2015, ces émissions se voient diminuer à 3 968 tonnes en éq. CO_2 par l'utilisation d'équipements et de navires plus récents, tel que précisé au tableau 3-1. En ce sens, les émissions des contaminants, et notamment les NO_x et le CO, diminuent également puisque ce scénario suppose un certain renouvellement de la flotte selon les hypothèses listées au tableau 3-1.

Tableau 4-2 Scénario actuel 2025 – Émissions de contaminants (PCA) et de GES, en tonnes

Groupe de sources	NO_x	SO_x	CO	COV	PM_T	$PM_{2.5}$	NH_3	CO_2	CH_4	N_2O	éq. CO_2
Bâtiments	0,04	0,00	0,07	0,01	0,01	0,01	0,01	99,9	0,00	0,00	101
EMC [1]	2,58	0,01	2,58	0,24	0,22	0,21	0,01	692	0,09	0,24	765
Navires	21,0	1,01	3,89	1,42	0,59	0,54	0,04	2 303	0,21	0,06	2 325
Transport routier	0,45	0,01	0,32	0,04	0,12	0,02	0,01	674	0,03	0,05	690
Ferroviaire	0,53	0,001	0,06	0,02	0,01	0,01	0,001	77,9	0,004	0,03	86,6
TOTAUX	**24,6**	**1,02**	**6,93**	**1,74**	**0,95**	**0,80**	**0,07**	**3 846**	**0,33**	**0,38**	**3 968**

Note 1: Équipements de manutention de cargaison.

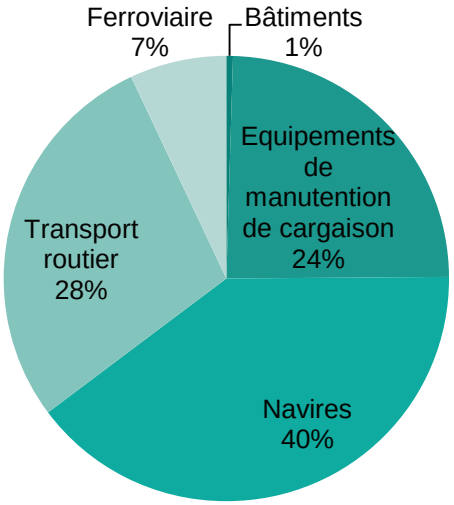
Tableau 4-3 Scénario exploitation Phase 1 – Émissions de contaminants (PCA) et de GES en 2025, en tonnes

Groupe de sources	Type de source	NO_x	SO_x	CO	COV	PM_T	$PM_{2.5}$	NH_3	CO_2	CH_4	N_2O	éq. CO_2
Bâtiments	Électricité	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,10	0,00	0,00	1,13
	Chaudières (GN)	0,05	0,00	0,10	0,01	0,01	0,01	0,008	142	0,00	0,00	142
EMC [2]	Chariots élévateur (D)	0,11	0,00	0,24	0,05	0,00	0,00	0,004	272	0,02	0,10	303
	Mini-génératrices (D)[1]	1,27	0,00	0,66	0,13	0,09	0,09	0,003	167	0,01	0,06	186
	Chariots gerbeur (D)	0,47	0,01	0,14	0,22	0,02	0,02	0,01	887	0,05	0,33	986
	Camions de cour (D)	2,76	0,05	1,16	1,29	0,11	0,11	0,09	5 214	0,29	1,94	5 800
	Camions de cour (E)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	8,19	0,00	0,00	8,41
	Grues (E)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	55,4	0,00	0,01	56,9
	Alimentation pour les conteneurs réfrigérés (E)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	8,47	0,00	0,00	8,70
Navires	Alimentation à quai (E)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,82	0,00	0,00	1,86
	Navires à conteneurs (ML)	133	6,53	13,9	5,52	2,99	2,75	0,096	11 159	0,99	0,28	11 268
	Remorqueurs (DM)	4,33	0,01	1,90	0,59	0,19	0,17	0,026	723	0,07	0,02	730
Transport routier	Camions lourds (D)	6,10	0,07	2,06	0,67	1,62	0,32	0,141	7 902	0,29	0,47	8 050
	Camionnettes (HD)	0,30	0,00	0,48	0,03	0,04	0,01	0,02	443	0,02	0,03	451
Ferroviaire	Locomotives du CN (D)	3,39	0,00	0,57	0,15	0,10	0,10	0,006	216	0,01	0,08	241
	Locomotives multi-génératrices (D)	16,8	0,02	2,26	0,91	0,48	0,47	0,21	1 680	0,09	0,63	1 869
TOTAUX – Futur terminal		**168**	**6,69**	**23,4**	**9,58**	**5,66**	**4,04**	**0,60**	**28 880**	**1,84**	**3,95**	**30 103**
Sources actuelles – prévision 2025		24,6	1,02	6,93	1,74	0,95	0,80	0,07	3 846	0,33	0,38	3 968
TOTAUX – Futur terminal et sources actuelles		**192**	**7,71**	**30,4**	**11,3**	**6,61**	**4,84**	**0,67**	**32 725**	**2,18**	**4,33**	**34 071**

GN : gaz naturel; D : diesel; ML : mazout lourd; DM : diesel marin; HD: hybride-diesel; E: électrique
Note 1: mini-génératrices pour conteneurs réfrigérés au niveau des camions et wagons de trains
Note 2: Équipements de manutention de cargaison.

Les émissions de GES générées par l'exploitation du nouveau terminal en 2025 s'élèvent à 30 103 tonnes en éq. CO_2. La figure 4-1 présente la répartition de ces émissions par type de source.

Figure 4-1 Répartition des émissions de GES par source, scénario exploitation – Phase 1



Les émissions des 156 navires à conteneurs, comprenant les activités connexes (remorqueurs et électrification à quai) qui visiteront le port en 2025 représentent 40 % des émissions de GES en éq. CO_2, suivi par 28 % pour le transport routier et 24 % pour les équipements de manutention de cargaison. Parmi les équipements de manutention de cargaison, ce sont les camions de cour au diesel qui génèrent la majorité des émissions (79 %), alors que le même nombre de camions de cour électriques génère moins de 1 % des émissions en éq. CO_2. En fait, les émissions de GES totales lors de l'exploitation Phase 1 pourraient être réduites de presque 6 000 tonnes avec l'utilisation de camions de cour électriques exclusivement. Les navires sont la source d'émissions la plus significative dans le cas des contaminants atmosphériques, représentant plus de 80 % des émissions de NO_x et de SO_x.

Le tableau 4-4 présente les émissions générées en considérant un pire cas où aucun navire n'est considéré de type hybride au GNL et aucune électrification à quai n'est considérée.

Tableau 4-4 Navires à conteneurs au diesel et aucune électrification à quai – Émissions de contaminants (PCA) et de GES en 2025, en tonnes

	NO_x	SO_x	CO	COV	PM_T	$PM_{2.5}$	NH_3	CO_2	CH_4	N_2O	éq. CO_2
Émissions totales	184	7,44	25,3	10,3	5,96	4,32	0,61	30 158	1,96	3,98	31 394
Écart[1] par rapport au scénario exploitation Phase 1[2]	16,3	0,75	1,87	0,68	0,31	0,28	0,002	1 279	0,11	0,03	1 291

Note 1 : l'écart est égal aux émissions totales présentées dans ce tableau moins celles estimées pour le scénario exploitation Phase 1.

Note 2 : Scénario qui considère 50 % des navires comme étant des hybrides au GNL (diesel-GNL) et 50 % des navires au diesel. À quai, le scénario considère 25 % de tous les navires étant branchés électriquement.

Si l'on considère un pire scénario quant aux navires, qui considère tous les navires opérant au diesel selon la distribution de la flotte de navires à conteneurs fréquentant le port de Montréal en 2015 extrapolée par 10 ans et aucune électrification à quai, le total des émissions de GES en éq. CO_2 est de 1 291 tonnes de plus que le scénario avec 50 % des navires comme étant des hybrides au GNL (diesel-GNL) et 25 % de tous les navires étant branchés électriquement (scénario exploitation Phase 1).

Pour le scénario de construction du terminal, les émissions sont présentées par activité. Le tableau 4-5 présente les émissions totales estimées pour la construction du nouveau terminal à Contrecœur, sur la période de 4 années alors que le tableau 4-6 présente ces émissions par année de construction. Ces émissions ont été réparties par année de construction en se référant à l'échéancier préliminaire des travaux fourni par l'APM présenté à l'annexe B.

Un total de 27 188 tonnes en éq. CO_2 a été estimé pour la construction, soit entre 6 200 et 7 600 tonnes par année, tel que présenté au tableau 4-6. L'activité générant le plus d'émissions de GES est le dragage suivi par la construction de la cour de conteneurs. Trois options ont été considérées pour le dragage des sédiments :

Option 1. Dragage et mise en pile des sédiments sur la zone 4 sur le site
Option 2. Dragage et disposition des sédiments hors site
Option 3. Dragage et mise en pile des sédiments sur la zone 2 sur le site

La figure 4-2 présente les deux zones potentielles pour l'empilement sur le site. Dans le cas de l'option 2 où les sédiments seraient transportés hors site, un site dans un rayon de 20 km est considéré pour le calcul des émissions des camions. Le scénario émettant le plus de GES a été retenu dans l'inventaire des émissions associées à la construction du nouveau terminal (tableaux 4-5 et 4-6), soit l'option 1 où les sédiments seraient disposés sur la zone 4 du site. Ce scénario comprend plusieurs équipements pour le transport et l'aménagement des aires d'assèchement des déblais.

La source d'émissions la plus significative pour l'option 1 est l'ensemble de camions hors route utilisés pour le transport des sols pour l'aménagement des aires d'assèchement des déblais et pour la mise en pile sur le site à la zone 4. Advenant le cas où l'option 3 serait retenue par le promoteur, soit l'empilement des sédiments à la zone 2, les émissions de GES estimées pour la construction

seraient réduites de plus de 3 300 tonnes en éq. CO_2 (tableau 4-7) ou d'environ 1 100 tonnes par année (années 2, 3 et 4 de la construction).

Tableau 4-5 Construction – Émissions totales de contaminants (PCA) et de GES sur la période de construction (4 années) du nouveau terminal, en tonnes[1]

Activité	NO_x	SO_x	CO	COV	PM_T	$PM_{2.5}$	NH_3	CO_2	CH_4	N_2O	éq. CO_2
Préparation de site	0,85	0,01	0,43	0,38	0,04	0,03	0,03	2 104	0,12	0,77	2 336
Cours de conteneurs	2,95	0,05	1,39	0,93	0,32	0,12	0,08	6 219	0,32	1,82	6 770
Cour intermodale	0,78	0,01	0,40	0,35	0,04	0,03	0,02	1 926	0,11	0,70	2 137
Dragage – option 1	15,1	0,06	4,58	2,22	0,43	0,40	0,12	7 646	0,47	2,38	8 366
Quai de 2 postes d'amarrage	1,68	0,03	0,68	0,61	0,13	0,06	0,05	3 679	0,20	1,20	4 042
Aire de contrôle des camions	0,19	0,00	0,10	0,06	0,02	0,01	0,01	387	0,02	0,10	418
Infrastructures ferroviaires	1,45	0,02	0,58	0,36	0,06	0,04	0,03	2 115	0,12	0,74	2 340
Bâtiments	0,17	0,00	0,08	0,08	0,01	0,01	0,01	425	0,02	0,15	471
Drainage de la surface	0,11	0,00	0,05	0,05	0,00	0,00	0,00	277	0,02	0,10	308
TOTAUX	**23,3**	**0,18**	**8,30**	**5,04**	**1,06**	**0,70**	**0,34**	**24 778**	**1,38**	**7,97**	**27 188**

Note 1 : considère l'option 1 pour le dragage

Tableau 4-6 Construction – Émissions de GES par année, en tonnes[1]

	Année 1	Année 2	Année 3	Année 4
Préparation de site	✓			
Cours de conteneurs	✓	✓	✓	✓
Cour intermodale			✓	✓
Dragage – option 1		✓	✓	✓
Quai de 2 postes d'amarrage	✓	✓		
Aire de contrôle des camions			✓	
Infrastructures ferroviaires			✓	✓
Bâtiments	✓	✓	✓	
Drainage de la surface			✓	
éq. CO_2 (tonnes)	**6 206**	**6 659**	**7 603**	**6 720**

Note 1 : considère l'option 1 pour le dragage, c'est-à-dire la gestion des sédiments sur le site de l'APM à la zone 4

Tableau 4-7 Construction – Dragage options 1, 2 et 3 – Émissions totales (4 années) de contaminants (PCA) et GES, en tonnes

Activité	NO_x	SO_x	CO	COV	PM_T	$PM_{2.5}$	NH_3	CO_2	CH_4	N_2O	éq. CO_2
Dragage – option 1 (gestion des sédiments zone 4)	15,1	0,06	4,58	2,22	0,43	0,40	0,12	7 646	0,47	2,38	8 366
Dragage – option 2 (disposition des sédiments hors site)	16,7	0,07	4,66	1,53	1,18	0,50	0,13	7 567	0,38	0,75	7 801
Dragage – option 3 (gestion des sédiments zone 2)	13,9	0,04	3,99	1,66	0,38	0,35	0,09	4 635	0,31	1,27	5 020

320 000 5 076 000 321 000 5 077 000 322 000

5 075 000 320 000 5 074 000 321 000 323 000 5 077 000 324 000

Chenal maritime du Saint-Laurent

Fleuve Saint-Laurent

Aire à draguer
Élévation à atteindre :
-6,58 m (géodésique)
-11,0 m (zéro des cartes)

Aire à remblayer
Élévation à atteindre :
9,5 m (géodésique)

Écran sonore

Mur écran

Installations actuelles

Zone 2

Zone 4A

Zone 4B

Prolongement potentiel du mur écran

Fossé Noir

Ruisseau 2

Ruisseau 1

Route Marie-Victorin

Montée Lapierre

132

N

Composantes du projet

- Aire du projet
- Aire à draguer
- Aire à remblayer
- Zone d'entreposage des déblais de dragage
- Mur écran
- Prolongement potentiel du mur écran
- Écran sonore

Infrastructures existantes

- Chemin de fer du CN
- Autre chemin de fer
- Réseau routier
- Chenal maritime du Saint-Laurent

Territoire de l'APM

PORT MONTRÉAL

SNC·LAVALIN

ADMINISTRATION PORTUAIRE DE MONTRÉAL
Projet d'agrandissement du terminal portuaire de Contrecœur

Figure 4-2
Aires à draguer et à remblayer
et zones d'entreposage des déblais de dragage

Sources :
CanVec, 1/50 000, RNCan, 2017
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
Composantes du projet, APM, février 2017 et Alphard, avril 2017

Projet : 639223

0 100 200 m
1/10 000
Projection MTM, fuseau 8, NAD83

F01	2017/07/19	Final	A. Chouinard	M. Brennan Jacot
Rév.	aaaa/mm/jj	Description	Préparé	Vérifié

Format 11x17

S:\PROJ\639223_APM_EIE_Contrecoeur\4.7_CadDaoSig\GEOMATIQUE\interne\diffusion\produits\609988-01-GES\snc609988_ges_f4-2_deblai_tab_170719_F01.mxd

Le tableau 4-8 résume les émissions de GES estimées pour chacun des scénarios étudiés.

Tableau 4-8 Émissions de GES par scénario, en tonnes

Scénario	CO_2	CH_4	N_2O	Éq. CO_2
Actuel - 2015	3 968	0,34	0,39	4 093
Actuel – prévision 2025	3 846	0,33	0,38	3 968
Construction[1] – **total sur 4 ans**	24 778	1,38	7,97	27 188
Exploitation Phase 1 – **seul**	28 880	1,84	3,95	30 103
Exploitation Phase 1 - **incluant les sources actuelles en 2025**	32 725	2,18	4,33	34 071

Note 1 : considère l'option 1 pour le dragage

Les tableaux 4-9, 4-10 et 4-11 résument les émissions estimées pour les PCA, les HAP (total présenté en équivalent benzo(a)pyrène) et les autres contaminants d'intérêt.

Tableau 4-9 Émissions des PCA par scénario, en tonnes

Scénario	NO_x	SO_x	CO	COV	PM_T	$PM_{2.5}$	NH_3
Actuel 2015	42,2	1,05	18,2	2,37	1,18	0,98	0,07
Actuel – prévision 2025	24,6	1,02	6,93	1,74	0,95	0,80	0,07
Construction[1] – **total sur 4 ans**	23,3	0,18	8,30	5,04	1,06	0,70	0,34
Exploitation Phase 1 – **seul**	168	6,69	23,4	9,58	5,66	4,04	0,60
Exploitation Phase 1 - **incluant les sources actuelles en 2025**	193	7,71	30,4	11,3	6,61	4,84	0,67

Note 1 : considère l'option 1 pour le dragage

Tableau 4-10 Émissions des HAP par scénario, en kilogrammes

Scénario	Acénaphthène	Acénaphtylène	Anthracène	Benz(a)anthracène	Benzo(ghi)périylène	Benzo(a)pyrène	Benzo(b)fluoranthène	Benzo(k)fluoranthène	Chrysène	Fluoranthène	Fluorène	Indeno(1,2,3-cd)pyrène	Naphtalène	Phénanthrène	Pyrène	Éq. benzo(a)pyrène
Actuel - 2015	0,05	0,10	0,03	0,02	0,01	0,01	0,01	0,01	0,01	0,03	0,07	0,01	1,98	0,13	0,04	0,01
Actuel – prévision 2025	0,04	0,09	0,03	0,01	0,01	0,005	0,007	0,005	0,004	0,03	0,06	0,01	1,71	0,11	0,03	0,01
Construction[1] – **total sur 4 ans**	0,05	0,06	0,02	0,02	0,01	0,01	0,01	0,01	0,01	0,02	0,06	0,004	1,00	0,13	0,03	0,01
Exploitation Phase 1 – **seul**	0,11	0,46	0,17	0,11	0,03	0,03	0,04	0,03	0,03	0,14	0,28	0,02	6,81	0,75	0,22	0,07
Exploitation Phase 1 - **incluant les sources actuelles en 2025**	0,15	0,56	0,19	0,12	0,04	0,04	0,05	0,04	0,04	0,16	0,34	0,03	8,52	0,86	0,25	0,08

Note 1 : considère l'option 1 pour le dragage

Tableau 4-11 Émissions des autres contaminants atmosphériques par scénario, en kilogrammes

Scénario	Arsenic	Benzène	Chrome (composés de chrome hexavalent)	Chrome (composés de chrome trivalent)	Éthylbenzène	Formaldéhyde	Hexane	Isooctane	Manganèse	Mercure	Nickel	Plomb	Styrène	Toluène	Xylène
Actuel - 2015	0,04	43,7	0,02	0,05	12,1	155	11,0	9,68	0,04	0,00003	1,16	0,19	2,82	40,7	39,1
Actuel – prévision 2025	0,04	20,8	0,02	0,05	3,12	138	5,74	1,15	0,04	0,00005	1,14	0,14	2,10	8,65	8,80
Construction[1] – **total sur 4 ans**	0,03	92,9	0,01	0,02	13,6	571	11,0	3,14	0,58	0,0007	1,23	0,21	4,14	60,0	44,7
Exploitation Phase 1 – **seul**	0,25	78,8	0,15	0,29	17,6	610	29,3	3,97	0,42	0,0004	7,71	0,76	11,1	55,7	50,8
Exploitation Phase 1 - **incluant les sources actuelles**	0,29	99,6	0,17	0,33	20,7	748	35,0	5,12	0,47	0,0005	8,85	0,90	13,2	64,3	59,6

Note 1 : considère l'option 1 pour le dragage

5 Émissions de GES – Prévisions Phase 2 et Phase 3

Le site de Contrecœur permettrait d'accueillir à terme un terminal à conteneurs d'une capacité annuelle maximale de 3,5 millions de conteneurs équivalent vingt pieds (EVP). Le terminal exploité à 1,15 M EVP annuellement représente la Phase 1 du projet. Les projets subséquents seraient répartis en deux phases additionnelles, soit les Phases 2 et 3 selon le tableau 5-1.

Tableau 5-1 Phases du projet de terminal à conteneurs à Contrecœur

Scénario	Année[1]	EVP
Phase 1	2025	1,15 M
Phase 2	2035	2,30 M
Phase 3	2045	3,45 M

Note 1 : Les années indiquées sont approximatives.

Une évaluation sommaire a été effectuée selon les hypothèses identifiées au tableau 3-1 afin de déterminer les émissions futures de GES lors de la mise en exploitation des Phases 2 et 3. Le tableau 5-2 présente les estimations totales pour chaque phase du projet.

Tableau 5-2 Émissions de GES en éq. CO_2 par phase, en tonnes

Scénario	éq. CO_2 – par phase	éq. CO_2 – total
Phase 1	30 103	30 103
Phase 2	29 959	60 062[1]
Phase 3	29 959	90 022[2]

Note 1 : Phase 1 + Phase 2
Note 2 : Phase 1 + Phase 2 + Phase 3

Les émissions de GES estimées pour les phases 2 et 3 sont conservatrices considérant que ces scénarios font l'hypothèse que tous les équipements de manutention de cargaison, navires, camions et trains seraient doublés et triplés par rapport à la Phase 1, alors que ce ne sera pas le cas nécessairement. De plus, les taux de consommation de combustible futurs seront probablement moindres dans l'optique où les moteurs seront probablement plus performants dans le futur. La différence observée entre les émissions des phases 2 et 3 par rapport à la phase 1 est attribuée à l'utilisation de flottes d'équipements de manutention de cargaison, de navires et de camions moins âgés, tel qu'indiqué au tableau 3-1.

6 Conclusion

Le modèle d'inventaire des émissions portuaires de Transports Canada, PEIT, a été utilisé pour faire l'estimation des émissions portuaires pour les différents scénarios à l'étude. Ce modèle incorpore les méthodes reconnues pour l'estimation des émissions portuaires.

La réalisation du projet implique une augmentation des émissions de contaminants atmosphériques et de GES. Dans le cas des contaminants atmosphériques, l'étude de dispersion atmosphérique déterminera l'impact du projet sur ceux-ci. Dans le cas des GES, lors de l'exploitation de la Phase 1 du projet à pleine capacité, une augmentation des émissions de l'ordre de 30 000 tonnes en éq. CO_2 est attendue en 2025, représentant 0,04 % des émissions de GES en éq. CO_2 au Québec. Ces émissions seront réduites par rapport au scénario de référence avec l'utilisation de grues électriques au futur terminal et pourraient être réduites davantage, soit de l'ordre de 6 000 tonnes, dans le cas où tous les camions de cour (qui acheminent les conteneurs des grues portiques vers la cour des conteneurs et de la cour des conteneurs vers la cour intermodale) seraient électriques. Cette option n'a pas été présentée dans le cadre de cette évaluation, mais sera considérée sur une base technico-économique au moment de l'achat du matériel.

L'administration portuaire publiera annuellement les émissions de GES émises par les opérations du port à Contrecœur en plus d'effectuer les déclarations tel que requises par la réglementation applicable.

Annexe A

Intrants à l’outil PEIT

Phase 1 - Scénario 2025

Tableau A-1: Bâtiments

Type de combustible	Type d'équipement	Consommation annuelle	Unités
Électricité	Énergie pour le bâtiment administratif	1 000 000	kWh
Gaz naturel	Chaudières (bâtiment entretien, aires de repas et bureaux de l'APM)	75 000	m^3

Note 1: Dans le cas des chaudières, l'outil PEIT considère qu'ils sont âgés de 15 ans. Puisque l'année identifiée dans l'outil est 2017 (l'année la plus récente), les facteurs d'émissions utilisés par PEIT sont ceux de 2002.

Tableau A-2: Navires opérant dans le port

Type de navire	Nombre	Puissance du moteur		Type de moteur principal et âge		Type de combustible	Consommation annuelle[1] (tonnes)
		Moteur principal (kW)	Moteur auxiliaire (kW)	Type	Age		
Remorqueur	2	3730	340	4-temps	2011/2017	Diesel marin	227

[1] Estimation selon le temps d'opération par navire, un facteur de charge de 0,5 et les facteurs au tableau 2-3 – se référer au tableau 3-1 pour les hypothèses.

Tableau A-3: Escales de navires au port

Distance du terminal à la limite maritime portuaire	14 miles nautiques
Vitesse moyenne dans les limites maritimes portuaires	6 noeuds marins
Consommation électrique pour l'électrification à quai[1]	1,650 MWh

Type de navire	**Niveau EPA**	**Nombre**[2]	**Tonnage de port en lourd**	**Temps total à quai (heures)**	**Électrification à quai?**[2]
Conteneur avec moteur 2-temps	Pre- Tier (avant 2000)	3	37 500	48	Non
Conteneur avec moteur 2-temps	Tier 1 (2000-2010)	31	37 500	48	Non
Conteneur avec moteur 2-temps	Tier 2 (2011-2015)	79	37 500	48	Non
Conteneur avec moteur 2-temps	Tier 3 (2016 +)	4	37 500	48	Non
Conteneur avec moteur 2-temps	Pre- Tier (avant 2000)	1	37 500	48	Oui
Conteneur avec moteur 2-temps	Tier 1 (2000-2010)	11	37 500	48	Oui
Conteneur avec moteur 2-temps	Tier 2 (2011-2015)	26	37 500	48	Oui
Conteneur avec moteur 2-temps	Tier 3 (2016 +)	1	37 500	48	Oui

Note 1 : Estimation basée sur une demande en énergie par le moteur auxiliaire de 940 kW.
Note 2 : Selon les hypothèses listées au tableau 3-1.

Tableau A-4: Équipements de manutention de cargaison

Type de combustible	Consommation annuelle	Unités
Électricité[1]	65 367 522	kWh
Diesel[2]	2 434 992	litres

Type d'équipement	Année	Nombre	Type de combustible	Puissance du moteur (kW)	Heures d'utilisation annuelle (par unité)
Grues de quai	2015	8	Électricité	1250	3224
Grues portiques (navires)	2015	32	Électricité	500	4641
Grues portiques (train)	2015	5	Électricité	500	2070
Chariots élévateurs	2015	3	Diesel	60	5840
Camions de cour	2015	18	Diesel	160	4299
Camions de cour	2015	18	Électricité	160	4299
Chariots gerbeur	2015	2	Diesel	250	5840
Conteneurs réfrigérés branchés dans la cour	2015	270	Électricité	10	5694
Mini-génératrices pour conteneurs réfrigérés - transport camions et trains	2010[3]	100	Diesel	10	500

Note 1 : Pour les grues, l'estimation considère un facteur de charge moyen selon l'équipement correspondant au diesel, soit, 0,43 pour les grues électriques, 0,59 pour les camions de cour et 0,5 pour le branchement des conteneurs réfrigérés dans la cour.
Note 2 : Estimation provenant de PEIT selon le modèle NONROADS.
Note 3 : Considère que ces génératrices non-appartenant au terminal peuvent être plus vieux; en l'absence de données, 15 ans est considéré en moyenne (par rapport à 2025).

Tableau A-5: Véhicules routiers n’appartenant pas au port (camionnage)

Type de véhicule	Type de combustible	Nombre annuel	Temps moyen sur le terminal (min)	Temps moyen en déplacement sur le terminal (min)	Temps moyen avec le moteur au ralenti sur le terminal (min)	Distance de parcours hors terminal sur la propriété de l’APM (km)
Camion de transport	Diesel	316250	41	26	15	1,15

Tableau A-6: Véhicules routiers appartenant au port

Type de véhicule	Année du véhicule	Nombre de véhicules similaires	Type de combustible	Consommation annuelle (litres)
Camionnette	2015	12	Diesel-hybride	165 000[1]

Note 1: Estimation de la consommation basée sur 53 040 heures d’utilisation par année. Un taux de consommation de diesel réduit (50 %) est considéré pour tenir compte du moteur hybride.

Tableau A-7: Locomotives d’un chemin de fer national

Fournisseur	Nombre de visites par année	Tonnage moyen (tonnes)	Distance parcouru sur le territoire portuaire (km)
CN	475	5023	3.45

Tableau A-8: Locomotives appartenant au port

Nombre	Type	Niveau Tier EPA	Type de combustible	Consommation annuelle[1] (litres)
2	Multi-génératrices, modèle RP20BD	2	Diesel	625 680

Note 1 : Estimation basée sur 5 688 heures d'opération par année par locomotive et un taux de consommation[1] calculé en fonction du régime moyen d'opération de locomotives de manœuvres de l'US EPA

[1] Selon les informations tirées du document : Fuel consumption and exhaust emissions from a 1 125 kW multiple genset switcher locomotive, ASME Internal Combustion Engine Division 2006 Fall Technical Conference, Novembre 5-8, 2006, Sacramento, California, USA.

Construction

Tableau A-9: Mobilisation et préparation du site

Activité durant la construction	Durée de l'activité	Type d'équipement	Type de carburant (essence ou diesel)	Puissance du moteur (hp)	# d'unités (nombre max utilisés en même temps)	Nombre de km parcourus par quart de travail	Nombre d'heures d'opération par quart de travail
Circulation des véhicules, de l'équipement et de la machinerie	30 jours	Pelles mécaniques (350D)	Diesel	268	2	5	10
		camions semi-remorque	Diesel	475	4	100	10
		Bouteur (1150M)	Diesel	138	1	30	10
		Rouleau compacteur	Diesel	100	2	30	10
		Pick up	Diesel	440	2	30	3
		Camions hors routes	Diesel	325	4	100	10
Déboisement et enlèvement du couvert végétal; Terrassement	120 jours	Bouteur (1150M)	Diesel	138	1	30	10
		Pelles mécaniques avec équipement pour déboisement	Diesel	268	1	5	10
		Camions hors routes	Diesel	325	4	100	10
		Pick up	Diesel	440	2	30	3
		Camion à eau	Diesel	440	1	100	10
Nivellement, remblayage et compaction	120 jours	Rouleau compacteur	Diesel	100	2	30	10
		Bouteur (1150M)	Diesel	138	2	5	10
		Camions hors routes	Diesel	325	6	100	10
		Pelles mécaniques (350D)	Diesel	268	2	5	10
		Pick up	Diesel	440	2	30	3
		Niveleuse	Diesel	234	1	30	10
Consommation totale en diesel (estimation à partir de NONROADS 2008, MOVES 2014a) : 783 319 L							

Tableau A-10: Cours de conteneurs

Activité durant la construction	Durée de l'activité	Type d'équipement	Type de carburant (essence ou diesel)	Puissance du moteur (hp)	# d'unités (nombre max utilisés en même temps)	Nombre de km parcourus par quart de travail	Nombre d'heures d'opération par quart de travail
Excavation et mise en place des fondations, drainage et infrastructures souterraines	280 jours	Rouleau compacteur	Diesel	100	2	30	10
		Bouteur	Diesel	138	2	5	10
		Camions hors routes	Diesel	325	8	100	10
		Pelles mécaniques (350D)	Diesel	268	4	5	10
		Pick up	Diesel	440	2	30	3
		Boom truck	Diesel	100	1	30	10
		Camions 12 roues	Diesel	475	6	30	10
		Camions semi-remorque (Varennes)	Diesel	475	44	50	10
		Camion à eau	Diesel	440	1	100	10
BCR et Pavage	140 jours	Camions semi-remorque (Varennes)	Diesel	475	5	50	10
		Niveleuse	Diesel	234	1	30	10
		Paveuse	Diesel	225	1	15	10
		Rouleau compacteur	Diesel	100	2	30	10
		Pick up	Diesel	440	2	30	3
		Camions 12 roues	Diesel	475	20	30	10
Piste de roulement RMG	240 jours	Pelle mécanique	Diesel	268	1	5	10
		Camions 12 roues	Diesel	475	3	30	10
		Boom truck	Diesel	100	1	30	10
		Équipement pour la mise en place de la voie ferrée	Diesel	250	1	5	10
		Pick up	Diesel	440	1	30	3
		Rouleau compacteur	Diesel	100	2	30	10
Consommation totale en diesel (estimation à partir de NONROADS 2008, MOVES 2014a) : 2 315 772 L							

Tableau A-11: Cours intermodale

Activité durant la construction	Durée de l'activité	Type d'équipement	Type de carburant (essence ou diesel)	Puissance du moteur (hp)	# d'unités (nombre max utilisés en même temps)	Nombre de km parcourus par quart de travail	Nombre d'heures d'opération par quart de travail
Excavation et mise en place des fondations, drainage et infrastructures souterraines	150 jours	Rouleau compacteur	Diesel	100	1	30	10
		Bouteur	Diesel	138	1	5	10
		Camions hors routes	Diesel	325	6	100	10
		Pelles mécaniques (350D)	Diesel	268	2	5	10
		Pick up	Diesel	440	2	30	3
		Camion à eau	Diesel	440	1	100	10
Installations des voies ferrées et traverses à niveau	150 jours	Grues	Diesel	160	1	2	10
		Équipement pour la mise en place de la voie ferrée	Diesel	250	1	5	10
		Pick up	Diesel	440	2	30	3
Construction des voies de roulement pour RMG	150 jours	Pelle mécanique	Diesel	268	2	5	10
		Camions 12 roues	Diesel	475	3	30	10
		Équipement pour la mise en place de la voie ferrée	Diesel	250	1	5	10
		Pick up	Diesel	440	2	30	3
		Rouleau compacteur	Diesel	100	2	30	10
Consommation totale en diesel (estimation à partir de NONROADS 2008, MOVES 2014a) : 717 200 L							

Tableau A-12: Dragage – Option 1

Activité durant la construction	Durée de l'activité	Type d'équipement	Type de carburant (essence ou diesel)	Puissance du moteur (hp)	# d'unités (nombre max utilisés en même temps)	Nombre de km parcourus par quart de travail	Nombre d'heures d'opération par quart de travail
Aménagement des aires d'assèchement des déblais de dragage et digues	33 semaines	Rouleau compacteur	Diesel	100	1	60	12
		Bouteur	Diesel	138	2	5	12
		Camions hors routes	Diesel	500	4	149	12
		Pelles mécaniques (350D)	Diesel	268	4	5	12
		Pick up	Diesel	440	3	30	3
		Camion à eau	Diesel	440	1	100	10
Dragage des sédiments	33 semaines	Drague (515 m.cu /hre)	Diesel	208	2	0	12
		Chaland		0	2		12
		Remorqueur (pour déplacer le chaland)	Diesel	1,500	2	40	12
		Pelles mécaniques (350D)	Diesel	268	3	5	12
Transport et mise en pile sur le site zone 4	33 semaines	Camions hors routes	Diesel	500	5	149	12
		Bouteur	Diesel	138	2	5	12
		Camion à eau	Diesel	440	1	50	10
Consommation totale en diesel incluant le diesel marin (estimation à partir de NONROADS 2008, MOVES 2014a et les facteurs au tableau 2-3 (remorqueur) : 2 846 036 L							

Tableau A-13: Dragage – Option 2

Activité durant la construction	Durée de l'activité	Type d'équipement	Type de carburant (essence ou diesel)	Puissance du moteur (hp)	# d'unités (nombre max utilisés en même temps)	Nombre de km parcourus par quart de travail	Nombre d'heures d'opération par quart de travail
Dragage des sédiments	33 semaines	Drague (515 m.cu /hre)	Diesel	208	2	0	12
		Chaland		0	2		12
		Remorqueur (pour déplacer le chaland)	Diesel	1,500	2	40	12
		Pelles mécaniques (350D)	Diesel	268	3	5	12
Transport et disposition hors site	33 semaines	Camions semi-remorque	Diesel	475	28	420	12
		Bouteur	Diesel	138	2	5	12
		Camion à eau	Diesel	440	1	50	10
Consommation totale en diesel incluant le diesel marin (estimation à partir de NONROADS 2008, MOVES 2014a et les facteurs au tableau 2-3 (remorqueur) : 2 816 806 L							

Tableau A-14: Dragage – Option 3

Activité durant la construction	Durée de l'activité	Type d'équipement	Type de carburant (essence ou diesel)	Puissance du moteur (hp)	# d'unités (nombre max utilisés en même temps)	Nombre de km parcourus par quart de travail	Nombre d'heures d'opération par quart de travail
Aménagement des aires d'assèchement des déblais de dragage et digues	2 mois	Rouleau compacteur	Diesel	100	1	30	12
		Bouteur	Diesel	138	2	5	12
		Camions hors routes	Diesel	325	2	72	12
		Pelles mécaniques (350D)	Diesel	268	4	5	12
		Pick up	Diesel	440	2	30	3
		Camion à eau	Diesel	440	1	100	10
Dragage des sédiments	33 semaines	Drague (515 m.cu /hre)	Diesel	208	2	0	12
		Chaland		0	2		12
		Remorqueur (pour déplacer le chaland)	Diesel	1,500	2	40	12
		Pelles mécaniques (350D)	Diesel	268	3	5	12
Transport et mise en pile sur le site zone 2	33 semaines	Camions hors routes	Diesel	325	6	72	12
		Bouteur	Diesel	138	2	5	12
		Camion à eau	Diesel	440	1	50	10
Consommation totale en diesel incluant le diesel marin (estimation à partir de NONROADS 2008, MOVES 2014a et les facteurs au tableau 2-3 (remorqueur) : 1 724 868 L							

Tableau A-15: Quai

Activité durant la construction	Durée de l'activité	Type d'équipement	Type de carburant (essence ou diesel)	Puissance du moteur (hp)	# d'unités (nombre max utilisés en même temps)	Nombre de km parcourus par quart de travail	Nombre d'heures d'opération par quart de travail
Palplanche	53 semaines	Vibrofonceuse ou forage percussion	Diesel	575	1	2	10
		Remorqueur (pour déplacer la barge)	Diesel	1,500	1	40	2
		Pick up	Diesel	440	2	30	3
		Grues	Diesel	160	3	2	10
		Camion remorque	Diesel	440	1	10	5
		Foreuse	Diesel	200	2	5	10
		Bétonnière	Diesel	440	2	5	1
Remblayage derrière l'enceinte du mur	53 semaines	Pelles mécaniques (350D)	Diesel	268	2	5	10
		camions semi-remorque	Diesel	475	10	100	10
		Bouteur (1150M)	Diesel	138	1	30	10
		Rouleau compacteur	Diesel	100	1	30	10
		Pick up	Diesel	440	2	30	3
		Camions hors routes	Diesel	325	4	100	10
Installation de tirants d'ancrage	53 sem-aines	Pelles mécaniques (250D)	Diesel	177	1	5	10
		Pick up	Diesel	440	2	30	3
Pieux rails avant et arrière	168 jours	Foreuse	Diesel	200	2	5	10
		Bétonnière	Diesel	440	2	5	1
		Pick up	Diesel	440	2	30	3
Mise en place des infrastructures de support des grues (fondations, rails)	1 mois	Boom truck	Diesel	100	1	30	10
		Skytrack	Diesel	75	2	30	10
		Pelles mécaniques (250D)	Diesel	177	1	5	10
		Pick up	Diesel	440	2	30	3
Mise en place de grues-portiques électriques (Montage)	1 mois	Grues	Diesel	160	1	2	5
		Pick up	Diesel	440	2	30	3
Consommation totale en diesel (estimation à partir de NONROADS 2008, MOVES 2014a) : 1 369 913 L							

Tableau A-16: Aire de contrôle des camions

Activité durant la construction	Durée de l'activité	Type d'équipement	Type de carburant (essence ou diesel)	Puissance du moteur (hp)	# d'unités (nombre max utilisés en même temps)	Nombre de km parcourus par quart de travail	Nombre d'heures d'opération par quart de travail
Excavation drainage et infrastructures souterraines	20 jours	Rouleau compacteur	Diesel	100	1	30	10
		Bouteur	Diesel	138	2	5	10
		Camions hors routes	Diesel	325	6	100	10
		Pelles mécaniques (350D)	Diesel	268	2	5	10
		Pick up	Diesel	440	2	30	3
		Camion à eau	Diesel	440	1	100	10
Mise en place des fondations et Pavage	30 jours	Camions semi-remorque (Varennes)	Diesel	475	5	500	10
		Nivelleuse	Diesel	234	1	30	10
		Paveuse	Diesel	225	1	15	10
		Rouleau compacteur	Diesel	100	2	30	10
		Pick up	Diesel	440	2	30	3
Installation des équipements	90 jours	Boom truck	Diesel	100	1	30	5
		Camion de service	Diesel	440	2	30	3
		Pick up	Diesel	440	2	30	3
Consommation totale en diesel (estimation à partir de NONROADS 2008, MOVES 2014a) : 143 962 L							

Tableau A-17: Infrastructures routières et ferroviaires

Activité durant la construction	Durée de l'activité	Type d'équipement	Type de carburant (essence ou diesel)	Puissance du moteur (hp)	# d'unités (nombre max utilisés en même temps)	Nombre de km parcourus par quart de travail	Nombre d'heures d'opération par quart de travail
Construction d'un viaduc routier	15 mois	Boom truck	Diesel	100	1	30	10
		Skytrack	Diesel	75	2	30	10
		Grues et foreuse pour pieux (1 mois)	Diesel	160	1	2	5
		Camion à eau	Diesel	440	1	100	10
		Pelle mécanique	Diesel	268	2	5	10
		Camions 12 roues	Diesel	475	3	30	10
		Rouleau compacteur	Diesel	100	2	30	10
Raccordement de la voie ferrée actuelle à la cour intermodale	260 jours	Grues	Diesel	160	1	2	10
		Équipement pour la mise en place de la voie ferrée	Diesel	250	1	5	10
		Pick up	Diesel	440	1	30	3
		Pelle mécanique	Diesel	268	2	5	10
		Camions 12 roues	Diesel	475	3	30	10
		Rouleau compacteur	Diesel	100	2	30	10
Consommation totale en diesel (estimation à partir de NONROADS 2008, MOVES 2014a) : 787 582 L							

Tableau A-18: Bâtiments et support

Activité durant la construction	Durée de l'activité	Type d'équipement	Type de carburant (essence ou diesel)	Puissance du moteur (hp)	# d'unités (nombre max utilisés en même temps)	Nombre de km parcourus par quart de travail	Nombre d'heures d'opération par quart de travail
Excavation et fondations	60 jours	Camion 12 roues	Diesel	475	1	20	10
		Pelles mécaniques (250D)	Diesel	177	2	5	10
		Pick up	Diesel	300	2	30	3
		Foreuse	Diesel	200	1	5	10
		Bétonnière	Diesel	440	2	5	1
Construction des structures des bâtiments	160 jours	Grues	Diesel	160	4	2	10
Mise en place des services (alimentation électrique, eau, égouts, etc.)	80 jours	Rouleau compacteur	Diesel	100	1	30	10
		Camion 12 roues	Diesel	475	1	20	10
		Pelles mécaniques (250D)	Diesel	177	1	5	10
		Pick up	Diesel	300	2	30	3
Consommation totale en diesel (estimation à partir de NONROADS 2008, MOVES 2014a) : 158 139 L							

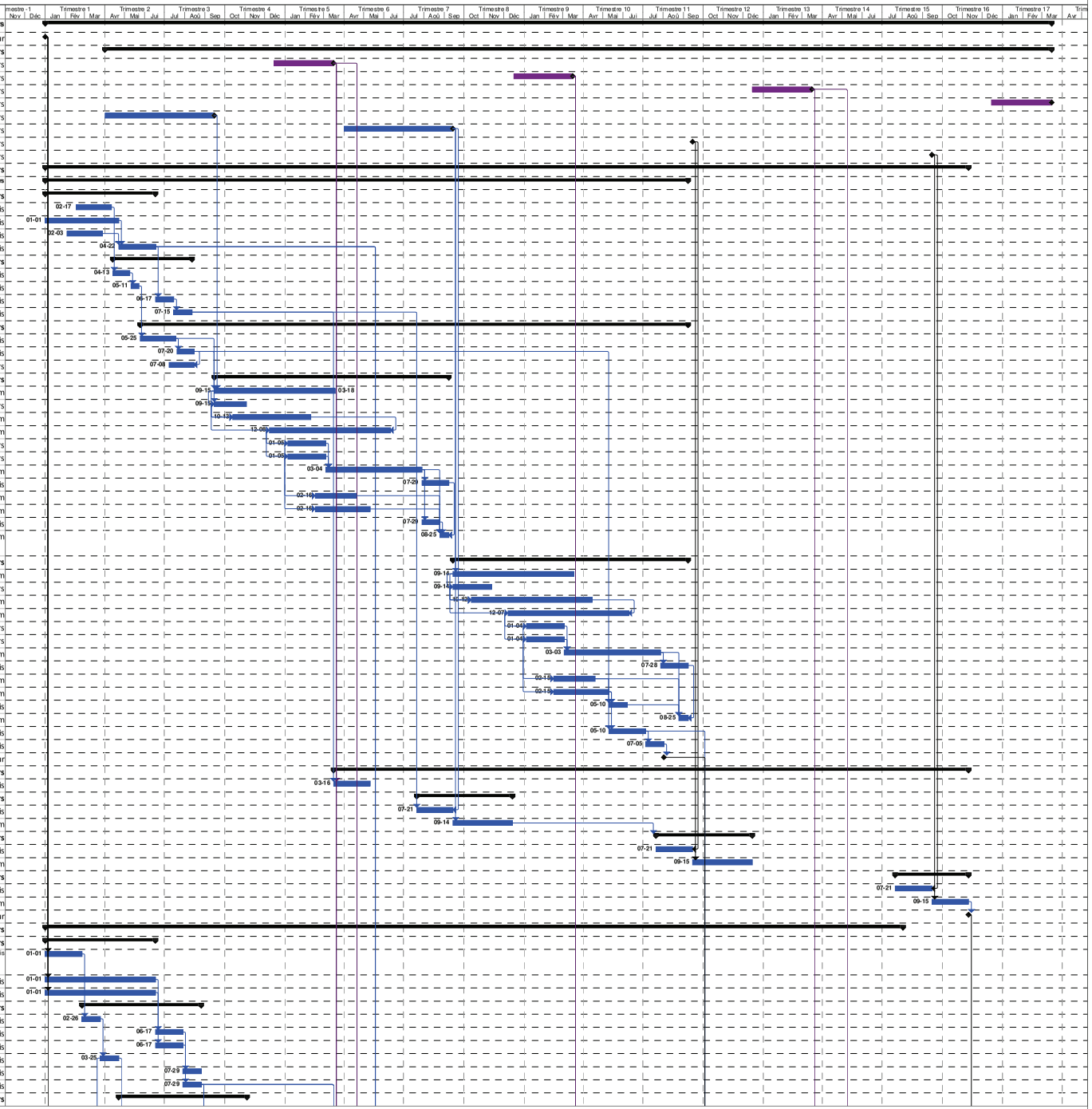
Tableau A-19: Drainage de la surface

Activité durant la construction	Durée de l'activité	Type d'équipement	Type de carburant (essence ou diesel)	Puissance du moteur (hp)	# d'unités (nombre max utilisés en même temps)	Nombre de km parcourus par quart de travail	Nombre d'heures d'opération par quart de travail
Profilage des fossés et mise en place du système de drainage	90 jours	Camion 12 roues	Diesel	475	2	20	10
		Pelles mécaniques (250D)	Diesel	177	1	5	10
		Pick up	Diesel	300	2	30	3
		Camion à eau	Diesel	440	1	100	10
Ruisseau 1 et Ruisseau 2	90 jours	Camion 12 roues	Diesel	475	2	20	10
		Pelles mécaniques (250D)	Diesel	177	1	5	10
		Pick up	Diesel	300	2	30	3
Détournement du Fossé noir	90 jours	Camion 12 roues	Diesel	475	2	20	10
		Pelles mécaniques (250D)	Diesel	177	1	5	10
		Pick up	Diesel	300	2	30	3
Consommation totale en diesel (estimation à partir de NONROADS 2008, MOVES 2014a) : 103 147 L							

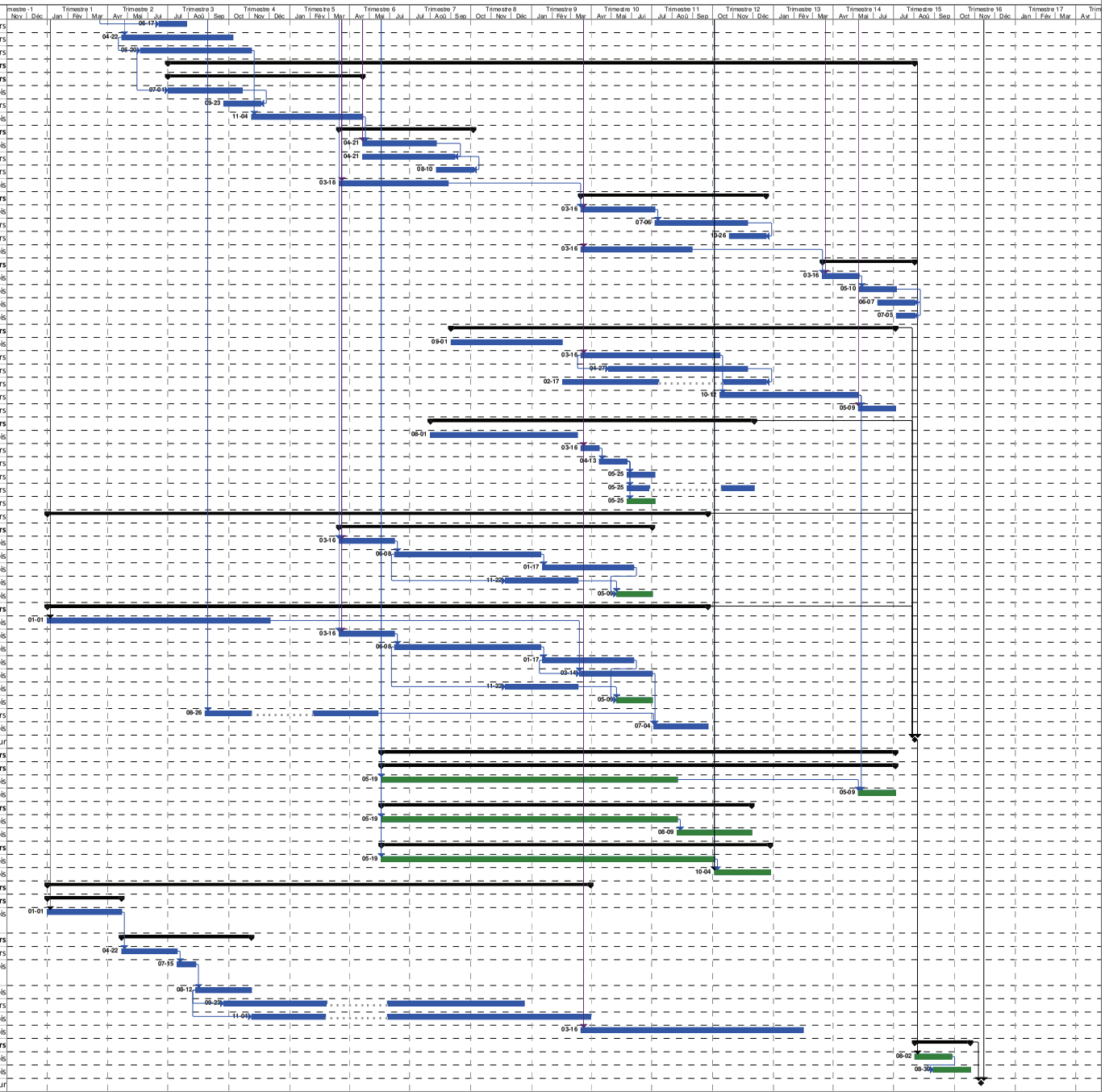
Annexe B

Échéancier des travaux de construction

N°	Task Name	Durée
0	**TERMINAL CONTRECOEUR**	**1100 jours**
1	**DÉBUT DU PROJET**	0 jour
2	**CONTRAINTES**	**1035 jours**
3	Période hivernale - Aucune excavation permise (Année 1)	65 jours
4	Période hivernale - Aucune excavation permise (Année 2)	64 jours
5	Période hivernale - Aucune excavation permise (Année 3)	65 jours
6	Période hivernale - Aucune excavation permise (Année 4)	66 jours
7	Aucun Dragage possible - Clause environmentale (Année 1)	119 jours
8	Aucun Dragage possible - Clause environmentale (Année 2)	119 jours
9	Aucun Dragage possible - Clause environmentale (Année 3)	119 jours
10	Aucun Dragage possible - Clause environmentale (Année 4)	120 jours
11	**TRAVAUX MARITIMES**	**1009 jours**
12	**QUAI**	702 jours
13	**Plans et Devis Techniques**	**120 jours**
14	Préparation des plans et devis techniques pour pieux	2 mois
15	Préparation des plans et devis techniques pour les palplanches du quai	4 mois
16	Préparation des plans et devis techniques pour le dragage	2 mois
17	Préparation des documents de construction travaux maritimes	2 mois
18	**Approvisionnement**	**87 jours**
19	Période de soumission - Palplanche et pieux	1 mois
20	Attribution du contrat - Palplanche et pieux	0,5 mois
21	Période de soumission travaux maritimes	1 mois
22	Attribution du contrat Travaux Maritimes	1 mois
23	**Fourniture et construction - Quai**	**599 jours**
24	Fourniture et livraison des palplanches et pieux	2 mois
25	Mobilisation travaux - berge	1 mois
26	Fournir et placer matériaux de remblayage - berge	28 jours
27	**PREMIÈRE PARTIE DU QUAI (Année 1)**	**257 jours**
28	Installation des palplanches	26,5 sm
29	Installation des pieux du mur d'ancrage	35 jours
30	Installation des tirants horizontaux	17 sm
31	Remblayage derrière mur de palplanche	26,5 sm
32	Installation des pieux pour rail de grue - Arrière	42 jours
33	Installation des pieux pour rail de grue - Avant	42 jours
34	Bétonnage de la Poutre de liaison	21 sm
35	Bétonnage puits pour alimentation électrique des navires, câbles, etc.	1,5 mois
36	Bétonnage du rail de grue - Arrière	9 sm
37	Bétonnage de rail de grue - Avant et ancrage sismique	12 sm
38	Installation des services du quai	1 mois
39	Remblayage jusqu'au niveau final	2 sm
40	**DEUXIÈME PARTIE DU QUAI (Année 2)**	**257 jours**
41	Installation des palplanches	26,5 sm
42	Installation des pieux du mur d'ancrage	43 jours
43	Installation des tirants horizontaux	26,5 sm
44	Remblayage derrière mur de palplanche	26,5 sm
45	Installation des pieux pour rail de grue - Arrière	42 jours
46	Installation des pieux pour rail de grue - Avant	42 jours
47	Bétonnage de la Poutre de liaison	21 sm
48	Bétonnage puits pour alimentation électrique des navires, câbles, etc.	1,5 mois
49	Bétonnage du rail de grue - Arrière	9 sm
50	Bétonnage de rail de grue - Avant et ancrage sismique	12 sm
51	Installation des services du quai	1 mois
52	Remblayage jusqu'au niveau final	2 sm
53	Installation des rails de grues	2 mois
54	Installation des défenses, Bollards, Échelles, arrêts pour grues Etc.	1 mois
55	Achèvement substantiel - Travaux de quai	0 jour
56	**DRAGUAGE ET DISPOSITION DES SÉDIMENTS**	**695 jours**
57	Préparation de l'aire de disposition du matériel de dragage	2 mois
58	**PREMIÈRE PARTIE DU DRAGAGE (Année 2)**	**105 jours**
59	Mobilisation des équipements de dragage	2 mois
60	Dragage du bassin	13 sm
61	**DEUXIÈME PARTIE DU DRAGAGE (Année 3)**	**105 jours**
62	Mobilisation des équipements de dragage	2 mois
63	Dragage du bassin	13 sm
64	**TROISIÈME PARTIE DU DRAGAGE (Année 4)**	**80 jours**
65	Mobilisation des équipements de dragage	2 mois
66	Dragage du bassin	8 sm
67	Achèvement substantiel - Dragage	0 jour
68	**TRAVAUX DE TERRASSEMENT ET DE BÂTIMENTS**	**937 jours**
69	**Plans et devis Techniques**	**120 jours**
70	Préparation des plans et devis technique : Préparation du site et consolidation des sols	2 mois
71	Préparation des plans et devis technique Travaux de terrassement	6 mois
72	Préparation des plans et devis - Bâtiments	6 mois
73	**Approvisionnement**	**130 jours**
74	Période de soumission -Préparation du site	1 mois
75	Période de soumission - Travaux terrassement	1,5 mois
76	Période de soumission - Bâtiments	1,5 mois
77	Attribution du contrat - Préparation du site	1 mois
78	Attribution du contrat - Travaux terrassement	1 mois
79	Attribution du contrat - Bâtiments	1 mois
80	**Préparation du site (Année 1)**	**140 jours**



N°	Task Name	Durée
81	Construction des voies de circulations	30 jours
82	Déboisement, Terrassement	120 jours
83	Nivellement et remblayage - matériel d'emprunt	120 jours
84	**TRAVAUX DE TERRASSEMENT (Années 1 à 4)**	**807 jours**
85	**PREMIÈRE PARTIE TRAVAUX CIVILS (Année 1)**	**210 jours**
86	Excavation, réseaux souterrains (Eau, Égoût, Etc), fondations	4 mois
87	Pavage et marquage de chaussées	40 jours
88	Consolidation des sols (Zone 2e année)	6 mois
89	**DEUXIÈME PARTIE TRAVAUX CIVILS (Année 2)**	**146 jours**
90	Excavation, réseaux souterrains (Eau, Égoût, Etc), fondations	4 mois
91	Piste de roulement - RMG	100 jours
92	Pavage et marquage de chaussées	40 jours
93	Consolidation des sols (Zone 3e année)	6 mois
94	**TROISIÈME PARTIE TRAVAUX CIVILS (Année 3)**	**200 jours**
95	Excavation, réseaux souterrains (Eau, Égoût, Etc), fondations	4 mois
96	Piste de roulement - RMG	100 jours
97	Pavage et marquage de chaussées	40 jours
98	Consolidation des sols (Zone 4e année)	6 mois
99	**QUATRIÈME PARTIE TRAVAUX CIVILS (Année 4)**	**100 jours**
100	Excavation, réseaux souterrains (Eau, Égoût, Etc), fondations	2 mois
101	Piste de roulement - RMG	2 mois
102	Pavage et marquage de chaussées	2 mois
103	Différents travaux sur le site(clôture, barrières)	1 mois
104	**TRAVAUX INTERMODAL (Années 2, 3, 4)**	**480 jours**
105	Préachat des matériaux ferroviaires (Année 2)	6 mois
106	Réseaux souterrains (Eau, Égoût, Etc) (Année 3)	150 jours
107	Fondations (Année 3)	150 jours
108	Installations des voies ferrées (Année 3)	150 jours
109	Piste de roulement - RMG (Année 3-4)	150 jours
110	Pavage et marquage de la chaussée (Année 4)	40 jours
111	**TRAVAUX PORTAIL D'ACCÈS (Années 2-3)**	**351 jours**
112	Préachat des équipements (Année 2)	8 mois
113	Profilage et Drainage (Année 3)	20 jours
114	Structures de béton (Année 3)	30 jours
115	Pavage et marquage de la chaussée (Année 3)	30 jours
116	Installation des équipements et essais (Année 3)	60 jours
117	Système sécurité du locataire (Équipements, barrières, etc.) (Année 3)	30 jours
118	**TRAVAUX BÂTIMENTS (Années 1 à 3)**	**714 jours**
119	**Atelier d'entretien, salle du personnel, bureau administratif (année 1, 2, 3)**	**340 jours**
120	Fondation	3 mois
121	Structure	8 mois
122	Construction intérieure	5 mois
123	Services publiques pour bâtiments	4 mois
124	Système spécifique au locataire	2 mois
125	**Sous-station électrique (Années 1, 2, 3)**	**714 jours**
126	Préachat équipement longue livraison	12 mois
127	Fondation	3 mois
128	Structure	8 mois
129	Construction intérieure	5 mois
130	Installation des équipements électriques	4 mois
131	Services publiques pour bâtiments	4 mois
132	Système spécifique au locataire	2 mois
133	Réseau électrique primaire	120 jours
134	Raccordement au réseau de HQ	3 mois
135	**FIN DES TRAVAUX TERRASSEMENT ET BÂTIMENT**	0 jour
136	**APPROVISIONNEMENT DES ÉQUIPEMENTS**	**556 jours**
137	**RMG: Commande, fabrication, assemblage et mise en service**	**556 jours**
138	Commande, fabrication, assemblage et transport	16 mois
139	Assemblage sur le site et mise en service	2 mois
140	**ASC : Commande, fabrication, assemblage et mise en service**	**400 jours**
141	Commande, fabrication, assemblage et transport	16 mois
142	Assemblage sur le site et Mise en service	4 mois
143	**STS: Commande, fabrication, assemblage et mise en service**	**420 jours**
144	Commande, fabrication, assemblage et transport	18 mois
145	Assemblage sur le site et Mise en service	3 mois
146	**TRAVAUX POUR LES ACCÈS AU TERMINAL**	**587 jours**
147	**Documents de Construction**	**80 jours**
148	Préparation des documents Conceptions-Construction plans & devis techniques	4 mois
149	**Appel d'offre**	**140 jours**
150	Période de Soumission pour Conception-Construction	60 jours
151	Attribution du contrat pour la Conception-construction des travaux de terrassement	1 mois
152	Approbation des plans et de la conception	3 mois
153	**Desserte ferroviaire vers réseau principal**	260 jours
154	**Viaduc Route 132**	15 mois
155	**TRAVAUX COMPENSATOIRE ENVIRONNEMENT**	12 mois
156	**MISE EN SERVICE DU TERMINAL**	**60 jours**
157	Test au chantier et et résoudre les problèmes d'intégration	2 mois
158	Formation pour les locataires	2 mois
159	**DÉBUT DES OPÉRATIONS**	0 jour



Annexe C

Taux d’émission – Équipements de manutention de la cargaison, véhicules et chaudières

Tableau C-1 : Facteurs d’émission des équipements de manutention de cargaison – Scénario Phase 1 - 2025

Type d’équipement	Puissance du moteur (hp)	Puissance du moteur (kW)	Hydrocarbures totales (g/hph)	CO (g/hph)	NOx (g/hph)	PMT (g/hph)	$PM_{2.5}$ (g/hph)	NH_3 (g/hph)	Facteur de charge (ratio)
Chariots élévateurs	81	60	0,130	0,615	0,280	0,009	0,009	0,011	0,21
Camions de cour	215	160	0,132	0,118	0,281	0,011	0,011	0,009	0,59
Chariots gerbeur	336	250	0,131	0,082	0,280	0,010	0,010	0,009	0,43
Mini-génératrices pour conteneurs réfrigérés	13	10	0,446	2,312	4,457	0,323	0,313	0,010	0,43

Tableau C-2 : Facteurs d’émission des équipements de construction – Scénario Construction

Type d’équipement	Puissance du moteur (hp)	Puissance du moteur (kW)	Hydrocarbures totales (g/hph)	CO (g/hph)	NOx (g/hph)	PMT (g/hph)	$PM_{2.5}$ (g/hph)	NH_3 (g/hph)	Facteur de charge (ratio)
Vibrofonceuse ou forage percussion	575	429	0,131	0,082	0,280	0,010	0,010	0,009	0,43
Grues	160	119	0,131	0,094	0,281	0,010	0,010	0,009	0,43
Foreuse	200	149	0,131	0,073	0,281	0,010	0,010	0,009	0,43
Pelle mécanique	268	200	0,131	0,117	0,281	0,011	0,011	0,009	0,59
Pelle mécanique	177	132	0,131	0,117	0,281	0,011	0,011	0,009	0,59
Rouleau compacteur	100	75	0,131	0,383	0,281	0,011	0,011	0,010	0,59
Bouteur	138	103	0,131	0,137	0,281	0,011	0,010	0,009	0,59
Camions hors route	325	242	0,131	0,136	0,281	0,011	0,010	0,009	0,59
Bétonnière	440	328	0,131	0,136	0,281	0,011	0,010	0,009	0,59
Boom truck	100	75	0,132	0,386	0,281	0,011	0,011	0,010	0,59
Skytrack	75	56	0,132	0,395	3,015	0,024	0,023	0,010	0,59
Niveleuse	234	175	0,131	0,116	0,281	0,011	0,010	0,009	0,59
Paveuse	225	168	0,131	0,117	0,281	0,011	0,011	0,009	0,59
Équipement pour la mise en place de la voie ferrée	250	187	0,131	0,073	0,281	0,010	0,010	0,009	0,43
Camions hors route (dragage)	500	373	0,131	0,138	0,281	0,011	0,011	0,009	0,59
Drague (pelle)	208	155	0,131	0,117	0,281	0,011	0,011	0,009	0,59

Tableau C-3 : Facteurs d'émission des véhicules – Scénario Phase 1 - 2025

Type	Vitesse (km/h)[1]	Hydrocarbures totales (g/h)	CO (g/h)	NOx (g/h)	PMT tot (g/h)	$PM_{2.5}$ tot (g/h)	NH_3 (g/h)
Camion de transport	Moteur au ralenti	2,12	5,66	15,99	4,50	0,84	0,39
Camion de transport	11	2,88	11,80	37,48	9,13	1,94	0,81
Camionnette hybride	30	1,19	19,39	12,05	1,80	0,38	0,59

Note 1 : La vitesse est considérée comme étant un maximum de 11 km/h sur le site pour les camions de transport et un maximum de 30 km/h pour les camionnettes.

Tableau C-4 : Facteurs d'émission des véhicules – Scénario Construction

Type	Vitesse (km/h)[1]	Hydrocarbures totales (g/h)	CO (g/h)	NOx (g/h)	PM10 tot (g/h)	$PM_{2.5}$ tot (g/h)	NH_3 (g/h)
Camion lourd (camions semi-remorque/ 12 roues)	Moteur au ralenti	2,18	5,84	17,25	4,53	0,87	0,39
Camion à eau	Moteur au ralenti	0,92	6,62	8,01	1,03	0,26	0,29
Pick-up	Moteur au ralenti	2,16	5,75	14,85	2,50	0,52	0,39
Camion lourd (camions semi-remorque/ 12 roues)	30	2,97	12,20	40,79	9,22	2,02	0,81
Camion à eau	30	1,45	19,39	15,87	1,85	0,42	0,67
Pick-up	30	3,01	11,02	25,14	5,59	1,06	0,74

Note 1 : La vitesse est considérée comme étant un maximum de 30 km/h sur le site pendant la construction.

Tableau C-5 : Facteurs d'émission des chaudières – Scénario Phase 1 - 2025

Équipement	Hydrocarbures totales (g/hph)	CO (g/hph)	NOx (g/hph)	PMT (g/hph)	$PM_{2.5}$ tot (g/hph)	NH_3 (g/hph)
Chaudière au gaz naturel	0,0124	0,0947	0,0564	0,00857	0,00857	0,00756
Chaudière au gaz naturel – faible dégagement de NOx	0,0124	0,0947	0,0361	0,00857	0,00857	0,00756



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00	13/06/2017	Note technique préliminaire
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1.0 INTRODUCTION

1.1 MISE EN CONTEXTE

Dans le cadre de l'aménagement projeté du terminal de conteneurs à Contrecœur, SNC-Lavalin a été mandaté par l'Administration portuaire de Montréal (APM) afin de mettre à jour les études d'impacts sur la circulation dans le secteur. Une première étude d'impacts sur la circulation a été effectuée par SNC-Lavalin en 2011 pour l'axe de la montée Lapierre, et une deuxième étude a été réalisée par CIMA+ en 2014 qui vise la montée de la Pomme-d'Or.

Le projet de l'APM à Contrecœur consiste en l'aménagement de nouveaux postes à quais pour le transbordement des conteneurs sur les rives du fleuve Saint-Laurent. La construction reliée au projet s'étalonnera sur une période de 4 ans. Par la suite, le terminal de conteneurs avec une capacité de 1,15 M «*Équivalent Vingt Pieds* » (EVP) sera mis en opération. Les deux scénarios analysés dans le cadre de cette étude se résument ainsi :

- **Phase de construction (pendant 4 ans) :** comprend les travaux de dragage et de terrassement pendant 4 ans, ayant environ 350 camions/jour (travaux dragage de mi-septembre à décembre) et environ 150 camions/jour (travaux terrassement d'avril à décembre) ;
- **Phase d'opération (après la phase de construction) :** environ 1 200 camions/jour et 2 000 camions/jour pour les jours plus fréquentés. La capacité du terminal de conteneurs sera de 1,15 M (EVP), en période de pleine exploitation.

La présente étude permet d'identifier les impacts sur la circulation des itinéraires d'entrées et de sorties des camions générés sur le réseau routier pendant les travaux de construction et durant les opérations du futur terminal de conteneurs. Plus précisément, l'étude vise à déterminer les niveaux de service du secteur à l'étude durant la phase de construction sur la montée Lapierre, et la phase des opérations sur la montée de la Pomme-d'Or. Des mesures de bonifications proposées dans les études antérieures seront validées et mises à jour afin d'optimiser les conditions de circulation futures.

1.2 SECTEUR À L'ÉTUDE

Le secteur à l'étude se situe principalement sur deux axes soient la montée de la Pomme-d'Or et la Montée Lapierre.

La portion de la **montée Lapierre** qui est considérée dans l'analyse se retrouve entre la Route 132 et les bretelles d'accès à l'A-30. Les quatre (4) intersections incluses sont les suivantes :

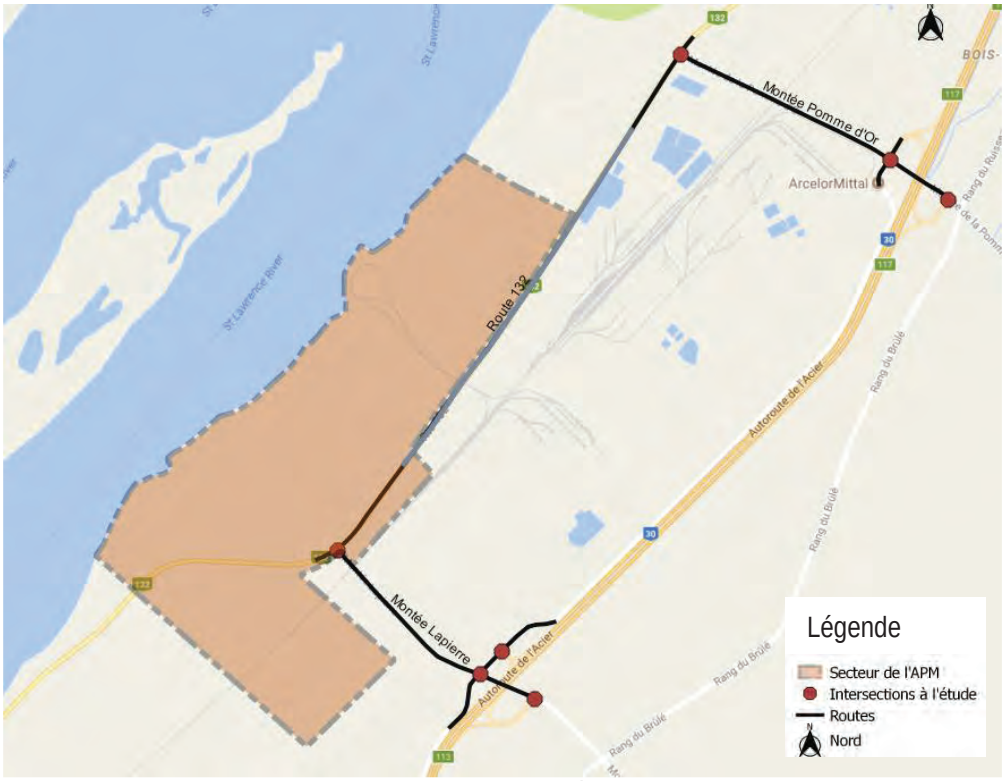
- Montée Lapierre / Route 132;
- Montée Lapierre / Route des Aciéries;
- Route des Aciéries / bretelles A-30 Ouest;
- Montée Lapierre / bretelles A-30 est.

La portion de la **montée Pomme-d'Or** qui est considérée dans l'analyse se retrouve entre la Route 132 et les bretelles d'accès à l'A-30. Les trois (3) intersections incluses sont les suivantes :

- Montée de la Pomme-d'Or / Route 132;
- Montée de la Pomme-d'Or / Route des Aciéries / bretelles A-30 Ouest;
- Montée de la Pomme-d'Or / bretelles A-30 est.

La figure 1-1 ci-dessous montre le secteur à l'étude considéré dans les analyses.

Figure 1-1 : Localisation du secteur à l'étude



Source : Google Maps, consulté le 11 mai 2017

2.0 MÉTHODOLOGIE

La démarche préconisée pour réaliser le mandat comprend les étapes suivantes :

Collecte de données

Une prise de connaissance de la documentation et des données en lien avec l'étude est faite. Ces données sont :

- Comptages véhiculaires par classe et par 15 minutes pour une journée représentative de semaine (6h 00 à 9h 00, 11h 00 à 13h 00 et 15h 00 à 18h 00) aux carrefours suivants :

  Secteur de la montée Lapierre :

  - Route Marie – Victorin (Route 132) ;
  - Bretelle de l'Autoroute 30 Ouest (Route des Aciéries) ;
  - Route des Aciéries ;
  - Bretelle de l'Autoroute 30 Est.

  Secteur de la montée de la Pomme-d'Or :

  - Route Marie – Victorin (Route 132) ;
  - Bretelles d'entrée et de sortie de l'A30 Ouest ;
  - Bretelles d'entrée et de sortie de l'A30 Est ;
- Relevés sur les caractéristiques du réseau routier, de la signalisation, des photographies des lieux et des conditions actuelles de circulation.

Caractérisation de la situation actuelle

- Identification de l'utilisation du sol;
- Identification du réseau routier tel que la hiérarchie des voies, la géométrie des rues, la vitesse affichée, le nombre et l'affectation des voies, la gestion des intersections, etc.;
- Validation, ajustement et calibration des débits de circulation provenant des comptages des périodes de pointe du matin, du midi et de l'après-midi d'une journée représentative de la semaine.
- Modélisation et simulation des conditions de circulation des carrefours à l'étude à l'aide du logiciel Synchro/SimTraffic pour les heures de pointe du matin, du midi et de l'après-midi d'une journée typique de semaine;
- Analyse et présentation des principaux résultats des impacts selon les indicateurs de performance suivants : retards, ratio débit/capacité, niveau de service, file d'attente, etc.

Génération des déplacements

- Détermination des débits horaires des camions générés par le terminal de conteneurs pour une journée typique par type de camion pour :
    - La période de construction;
    - La mise en opération du site.

Conditions futures de circulation et impacts

- Validation, ajustement et calibration des débits de circulation suite à l'ajout de la génération des déplacements produite par la phase de construction et la phase des opérations du projet du terminal de conteneurs aux heures de pointe du matin, du midi et de l'après-midi d'une journée représentative de la semaine pour la situation projetée;
- Modélisation et simulation des conditions de circulation à l'aide du logiciel Synchro/SimTraffic pour les heures de pointe du matin, du midi et de l'après-midi d'une journée typique de semaine;
- Analyses et présentation des principaux résultats des impacts selon les indicateurs de performance suivant : retards, ratio débit/capacité, niveau de service, files d'attente, etc. ;
- Détermination des impacts du camionnage sur le réseau routier et les installations actuelles.

Améliorations potentielles et infrastructures requises

- Validation de mesures de bonification proposée dans les études antérieures afin d'améliorer la fonctionnalité du réseau : modification de la géométrie routière (largeur de voies, assignation des voies, marquage, etc.);
- Modification de la gestion de la circulation et de la signalisation (modification de la gestion, interdiction de virage, etc.);

3.0 CARACTÉRISATION DE LA SITUATION ACTUELLE

3.1 CARACTÉRISATION DU TERRITOIRE ET DU RÉSEAU ROUTIER

3.1.1 Utilisation du sol

Le secteur à l'étude se situe dans une zone qui est principalement agricole et industrielle.

Au nord de l'intersection de la montée Lapierre / Route 132 se retrouvent l'expansion projetée et les terminaux actuels du port. La montée Lapierre se situe dans une zone agricole avec la présence d'une ferme près de la Route 132 et un accès pour la compagnie Harsco Minéraux près de l'A-30.

L'axe de la montée de la Pomme-d'Or se situe dans une zone industrielle au nord et une zone agricole au sud. Plusieurs accès sont aménagés de part et d'autre de la chaussée.

3.1.2 Géométrie et signalisation du réseau routier

Le secteur à l'étude présente sept (7) carrefours situés sur deux (2) Routes soient la montée de la Pomme-d'Or et la montée Lapierre. La vitesse affichée sur la montée Lapierre est de 80 km/h. Sur la montée de la Pomme-d'Or, la vitesse affichée est de 80 km/h sauf dans la zone des carrefours des bretelles d'autoroute où elle est de 70 km/h. La vitesse affichée sur les bretelles varie entre 45 et 55 km/h.

Les montées Lapierre et de la Pomme-d'Or sont composées d'une voie de circulation par direction avec élargissement à deux voies par direction à proximité des bretelles d'autoroute. Un passage à niveau du CN se situe à mi-chemin entre la Route 132 et l'A-30 sur les deux axes. Selon « *l'Étude d'impact sur la circulation sur le site du port de Montréal à Contrecœur* » de CIMA+ (2014), il y a un seul passage par jour durant la nuit.

Les carrefours sur la montée Lapierre / Route 132 sont gérés de la façon suivante :

- Route 132 : Panneau d'arrêt sur la montée Lapierre;
- Bretelles A-30 Ouest : Panneaux arrêt sur les bretelles;
- Bretelle A-30 est : Panneau arrêt sur la bretelle.

Les carrefours sur la montée de la Pomme-d'Or sont gérés de la façon suivante :

- Route 132 : Panneau d'arrêt sur la montée Lapierre;
- Route des Aciéries / bretelle A-30 Ouest : Feux de circulation, deux (2) phases avec détections sur toutes les approches, cycle de 70 secs ;
- Bretelles A-30 est : Panneau arrêt sur la bretelle.

Le réseau de camionnage du secteur se situe principalement sur les montées Lapierre et de la Pômme-d'Or.

Il est à noter que les véhicules lourds sont interdits sur la Route 132 à l'ouest de la montée Lapierre, et ce sur 1,3 km (sauf livraison).

3.2 DÉBITS DE CIRCULATION

3.2.1 Débits véhiculaires

Les débits actuels de circulation ont été obtenus à partir des comptages de SNC-Lavalin présentés à l'**annexe A**.

Les comptages ont été effectués le 9 et 10 mai 2017 pour les périodes suivantes :

- Matin (AM) : 6h 00 à 9h 00 ;
- Midi : 11h 00 à 13h 00 ;
- L'après-midi (PM) : 15h 00 à 18h 00.

Les comptages incluent la classification des véhicules légers, des camions lourds et des articulés. Les carrefours comptés sont les suivantes :

Secteur de la montée Lapierre :

- Route Marie – Victorin (Route 132) ;
- Bretelle de l'Autoroute 30 Ouest (Route des Aciéries) ;
- Route des Aciéries ;
- Bretelle de l'Autoroute 30 Est.

Secteur de la montée de la Pomme-d'Or :

- Route Marie – Victorin (Route 132) ;
- Bretelles d'entrée et de sortie de l'A30 Ouest ;
- Bretelles d'entrée et de sortie de l'A30 Est ;

Les débits aux heures de pointe du matin, du midi et de l'après-midi de la situation actuelle sont présentés aux figures 3-1, 3-2 et 3-3. Les heures de pointe du secteur à l'étude sont les suivantes :

- Heure de pointe du matin : 7h 00 à 8h 00;
- Heure de pointe du midi : 11h 00 à 12h 00 (Montée Lapierre) et de 12h 00 à 13h 00 (montée de la Pomme-d'Or) ;
- Heure de pointe de l'après-midi : 15h 45 à 16h 45.

Les débits de piétons et cyclistes sont actuellement négligeables.

3.2.2 Débits de véhicules lourds

La proportion des véhicules lourds est composée de véhicules lourds et articulés. Les comptages présentés à l'**annexe A** présentent le nombre de camions et les pourcentages des véhicules légers, véhicules lourds et les véhicules articulés.

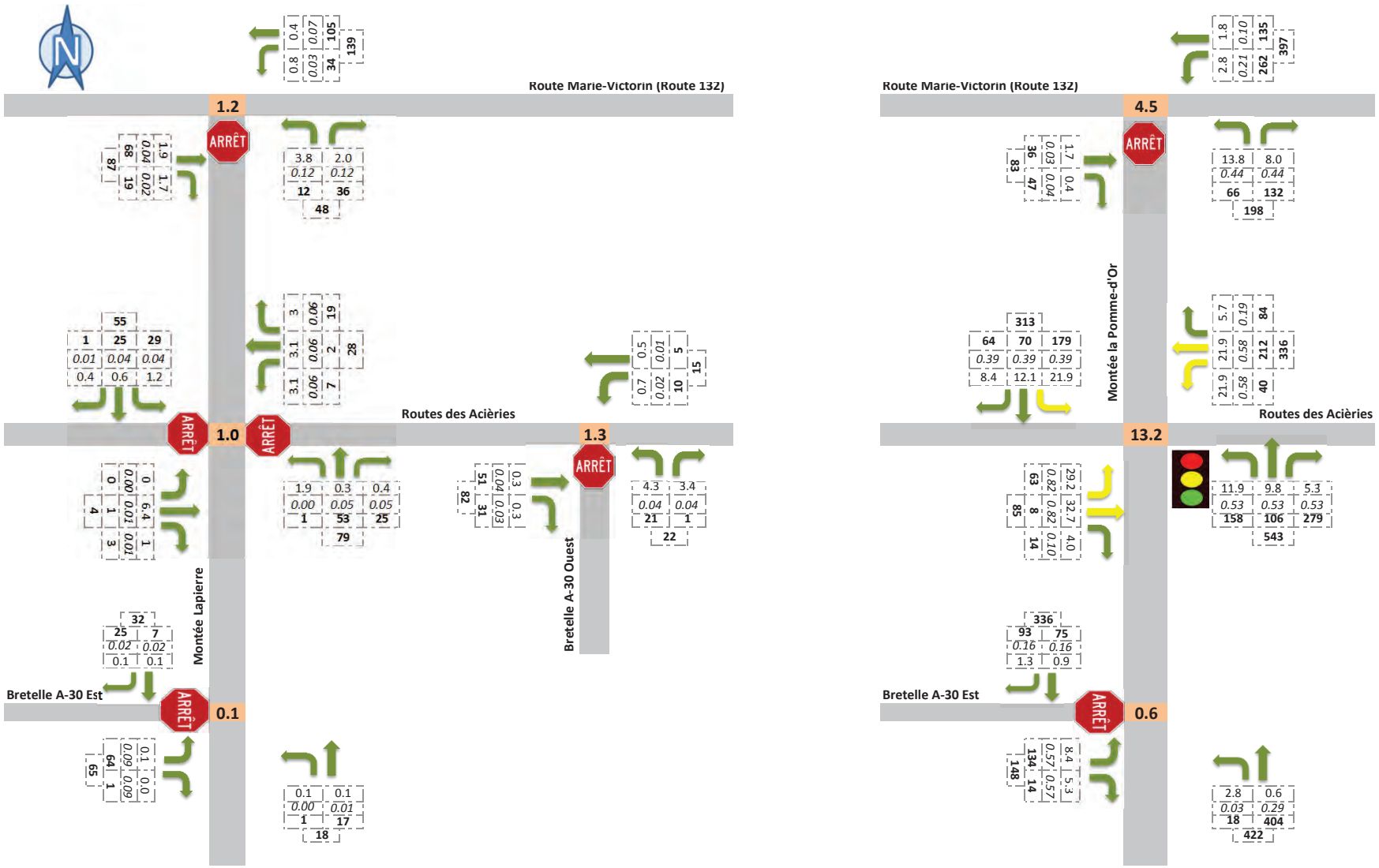
Durant les trois heures de pointe, le pourcentage de véhicules lourds sur la montée Lapierre varie entre 23 et 47 %. Sur la montée de la Pomme-d'Or, le pourcentage de véhicules lourds varie entre 8 et 15 %.

Les débits sur les bretelles de l'autoroute 30 sont composés d'entre 4% et 56 % de véhicules lourds.

3.3 CONDITIONS ACTUELLES DE CIRCULATION

Les analyses de circulation ont permis de dresser un portrait des conditions actuelles de la circulation aux heures de pointe du matin (AM), midi et de l'après-midi (PM) selon les aménagements présents dans le secteur à l'étude. Les figures 3-1, 3-2 et 3-3 présentent les résultats des simulations de circulation des carrefours pendant les trois heures de pointe. Les résultats détaillés des simulations sont présentés à l'**annexe C** et sont discutés sommairement dans la section qui suit.

Les résultats de simulation démontrent qu'il n'y a aucune problématique à noter sur l'ensemble du réseau à l'étude, et ce, pour les trois heures de pointe. Dans l'ensemble, tous les mouvements sont à des niveaux de service A à C et il n'y a pas de retard ni de file d'attente significative.



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Étude de circulation Contrecoeur

Conditions actuelles de circulation à l'heure de pointe du matin (AM)

Juillet 2017

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Figure 3-1

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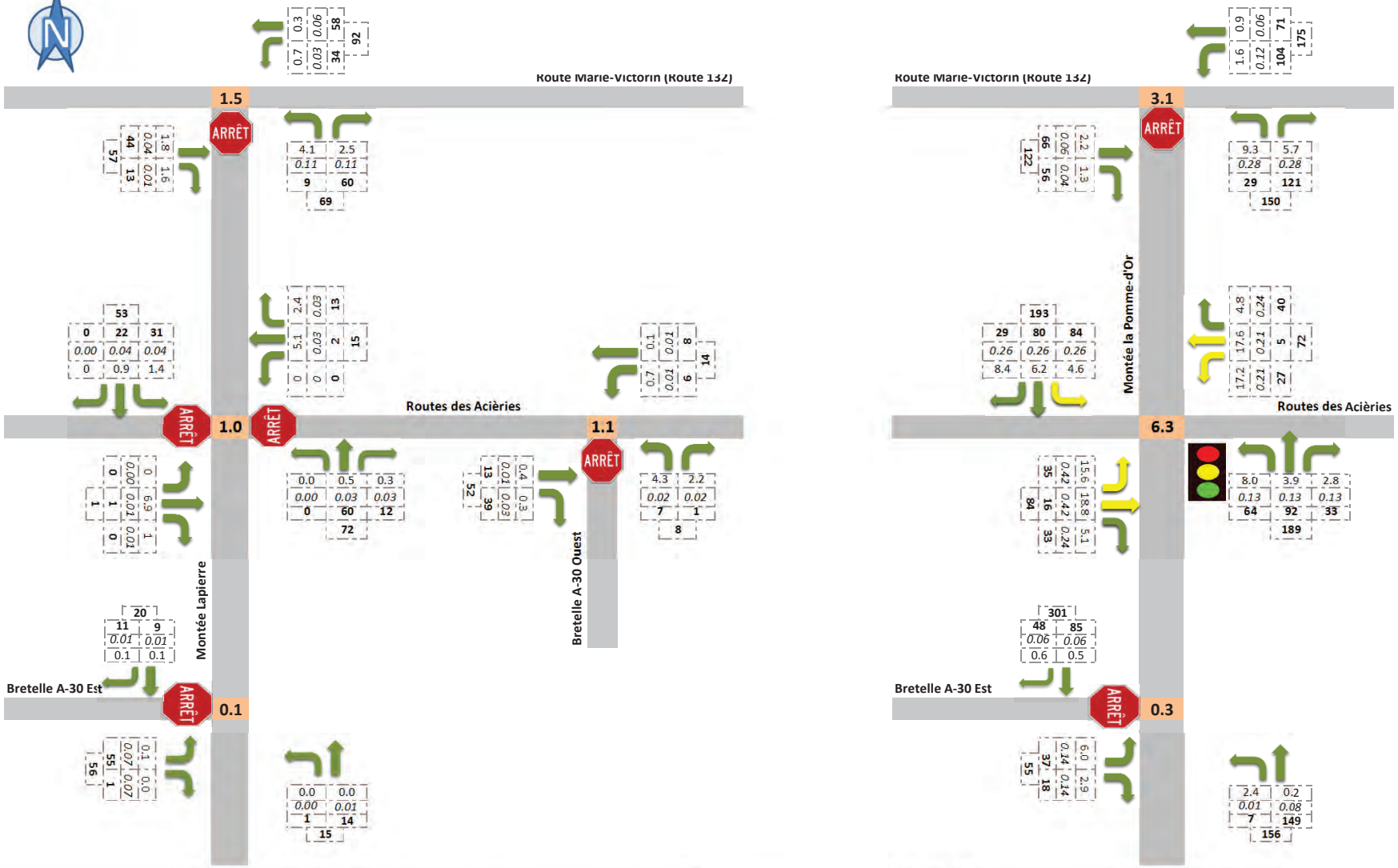
LÉGENDE

Niveau de service

A-B
C-D
E
F

Retard moyen par véhicule (s)
Débit / Capacité
Débit par mouvement (véh / heure)
Débit à l'approche (véh / heure)

Retard moyen par véhicule (s) pour l'ensemble de l'intersection



Étude de circulation Contrecoeur

Conditions actuelles de circulation à l'heure de pointe du midi

Juillet 2017

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N/Réf : 647111

Figure 3-2

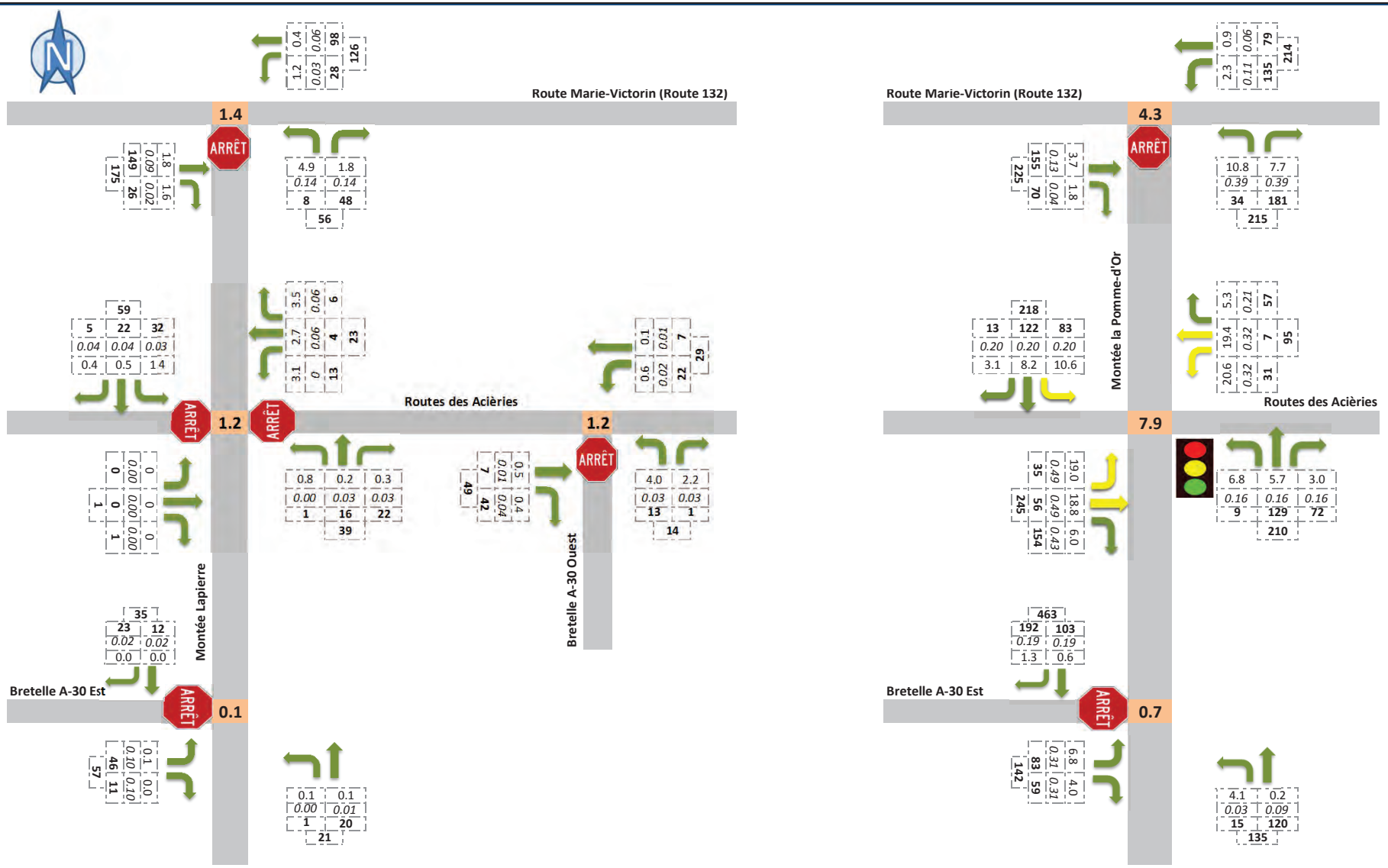
LÉGENDE

Niveau de service

A-B
C-D
E
F

Retard moyen par véhicule (s)
Débit / Capacité
Débit par mouvement (véh / heure)
Débit à l'approche (véh / heure)

Retard moyen par véhicule (s) pour l'ensemble de l'intersection



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Étude de circulation Contrecoeur

Conditions actuelles de circulation à l'heure de pointe de l'après-midi (PM)

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N/Réf : 647111

Figure 3-3

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LEGENDE

Niveau de service

A-B
C-D
E
F

Retard moyen par véhicule (s)
Débit / Capacité
Débit par mouvement (véh / heure)
Débit à l'approche (véh / heure)

Retard moyen par véhicule (s) pour l'ensemble de l'intersection

4.0 CARACTÉRISATION DE LA SITUATION PROJETÉE - CONSTRUCTION

Afin d'identifier la génération de véhicules lourds durant les travaux de construction, plusieurs hypothèses ont été prises selon les informations fournies par l'APM par rapport aux débits de véhicules lourds attendus pendant la période des travaux dans le secteur de la montée Lapierre.

Il est à noter que dans l'étude antérieure de SNC-Lavalin de 2012, la montée Lapierre était utilisée durant les opérations des deux phases de réalisation : construction d'un premier terminal de conteneurs ayant une capacité de 470 000 EVP (Phase 1) et finalisation du site complet avec une capacité de 1.14 M EVP (Phase 2). Les débits générés étaient donc plus élevés que ceux analysés dans cette étude.

4.1 GÉNÉRATION ET CARACTÉRISATION DES DÉPLACEMENTS - CONSTRUCTION

La montée Lapierre sera empruntée par les véhicules lourds durant les travaux de dragage et de terrassement. La montée Lapierre servira de lien entre l'autoroute 30 et le site du port.

Les travaux de dragage seront effectués pendant 11 semaines par année de mi-septembre à décembre sur une période de 3 ans. Les travaux de terrassement se dérouleront d'avril à décembre sur une période de 4 ans. La période critique se trouve donc entre mi-septembre et décembre, quand les deux types de travaux se feront en même temps.

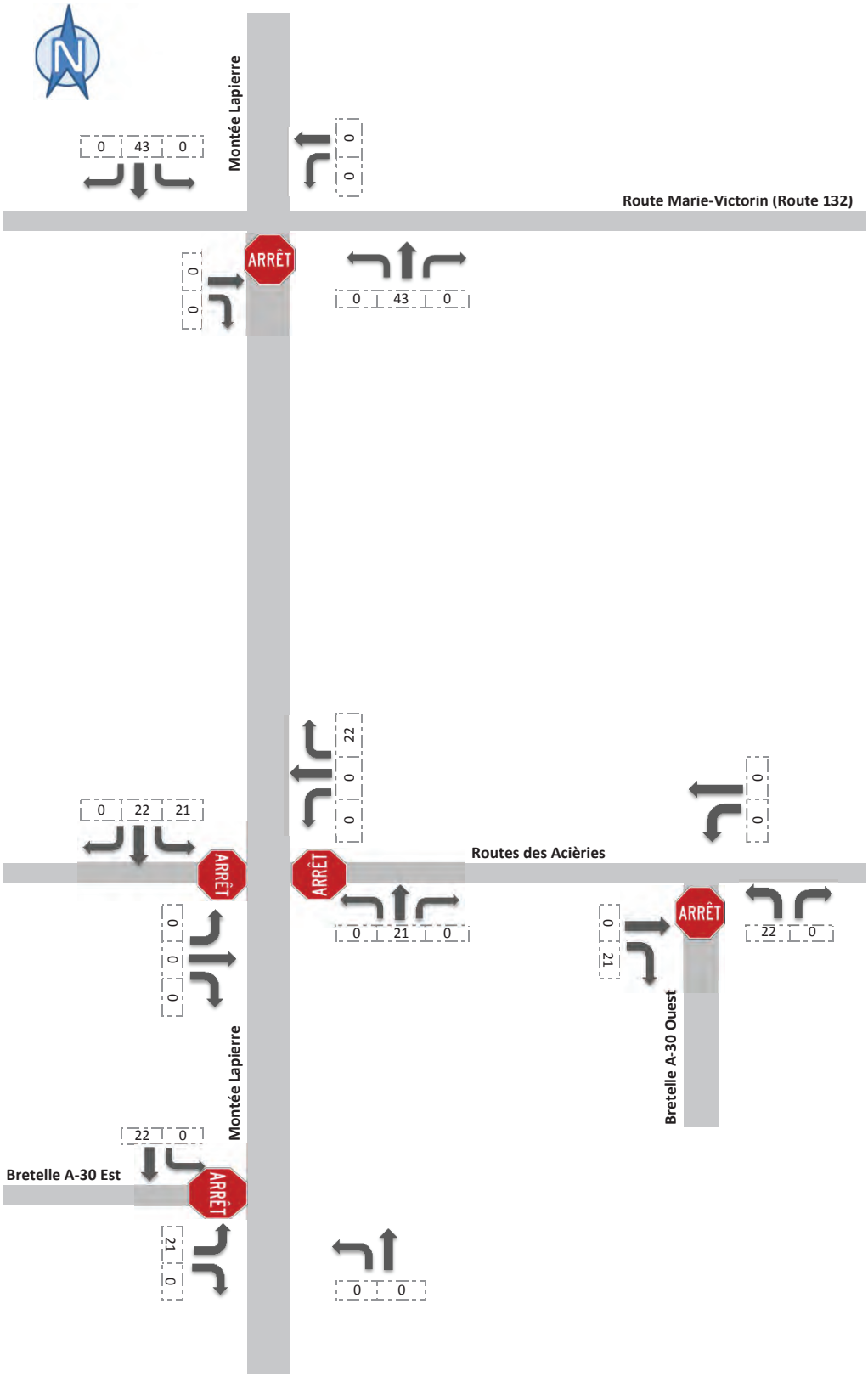
Le tableau 4-1 présente la génération des déplacements de camions produits durant la phase de travaux de construction selon les données fournies par l'APM.

Tableau 4-1 : Déplacements journaliers de véhicules lourds pendant la phase de construction

CONSTRUCTION	GÉNÉRATION	UNITÉ
Terrassement *(avril – décembre)*	150	Véhicules lourds / jour
Dragage *(mi-septembre – décembre)*	350	Véhicules lourds / jour
Dragage et terrassement *(mi-septembre – décembre)*	500	Véhicules lourds / jour

Durant la période entre mi-septembre et décembre, il y aura 500 véhicules lourds / jour générés par le site. En considérant une journée ouvrable de 12 heures avec un taux constant de camionnage, la génération horaire considérée pour chaque heure de pointe est de **43 véhicules lourds / heure**. Ceci représente **43 mouvements entrant au site et 43 mouvements sortant du site**.

La figure 4-1 présente les débits de véhicules lourds générés du site Contrecœur durant les heures de pointe.



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Étude de circulation Contrecoeur

Génération de véhicules lourds sur la Montée Lapierre - Construction

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Figure 4-1

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4.2 DÉBITS VÉHICULAIRES - CONSTRUCTION

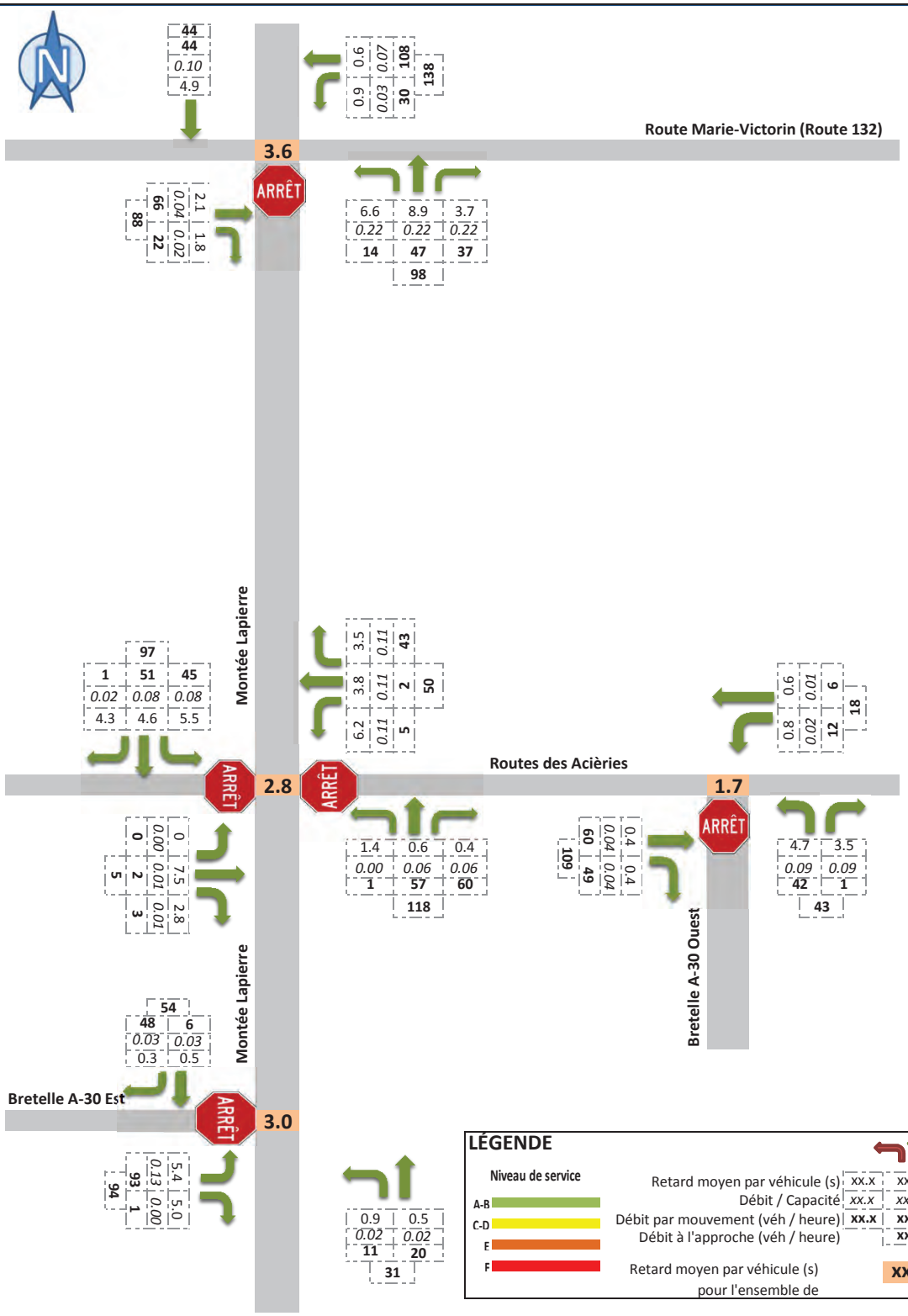
Les débits véhiculaires retenus pour les analyses et simulations des conditions projetées de circulation sont ceux mentionnés aux figures 4-2, 4-3 et 4-4. Les débits tiennent compte de la génération de véhicules lourds liée à la phase de construction. Les débits futurs sont composés des débits actuels auxquels se sont ajoutés les débits générés par le projet.

4.3 CONDITIONS PROJETÉES DE CIRCULATION - CONSTRUCTION

Les analyses de circulation ont permis de dresser un portrait des conditions projetées de la circulation durant la phase de construction aux heures de pointe du matin (AM), midi et de l'après-midi (PM) selon les aménagements présents dans le secteur à l'étude. Les figures 4-2 à 4-4 présentent les résultats des simulations de circulation des carrefours pendant les trois heures de pointe. Les résultats détaillés des simulations sont présentés à l'**annexe D** et sont discutés sommairement dans la section qui suit.

Les résultats de simulation démontrent qu'il n'y a aucune problématique à noter sur l'ensemble du réseau à l'étude, et ce, pour les trois heures de pointe. Dans l'ensemble, tous les mouvements sont à des niveaux de service A à B et il n'y a pas de retard ni de file d'attente significative.

Les aménagements existants sont donc suffisants pour accommoder le débit de véhicules lourds généré par la phase de construction.



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Étude de circulation Contrecoeur

Conditions projetées de circulation sur la montée Lapierre à l'heure de pointe du matin (AM) - Construction

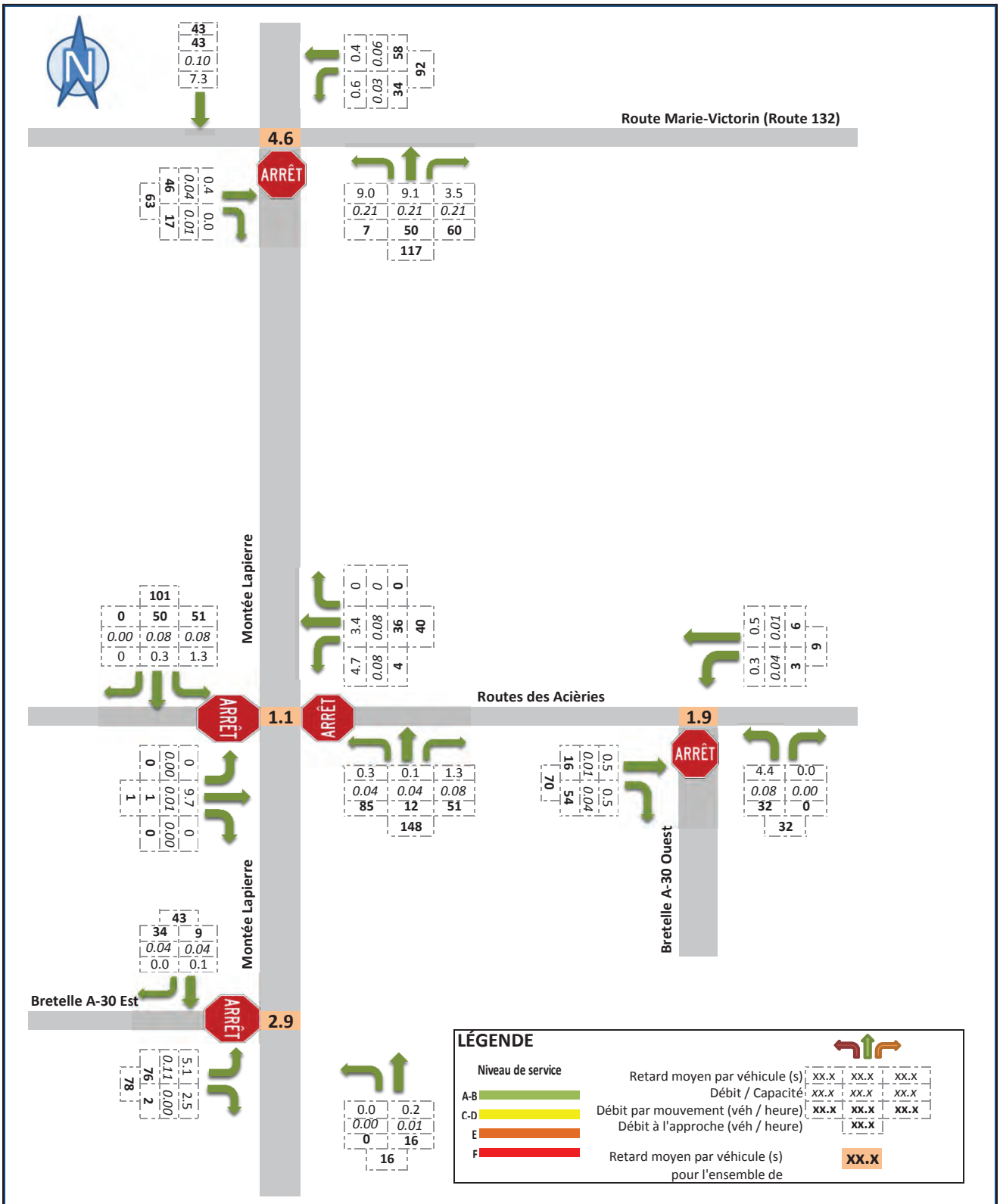
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Figure 4-2

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Étude de circulation Contrecoeur

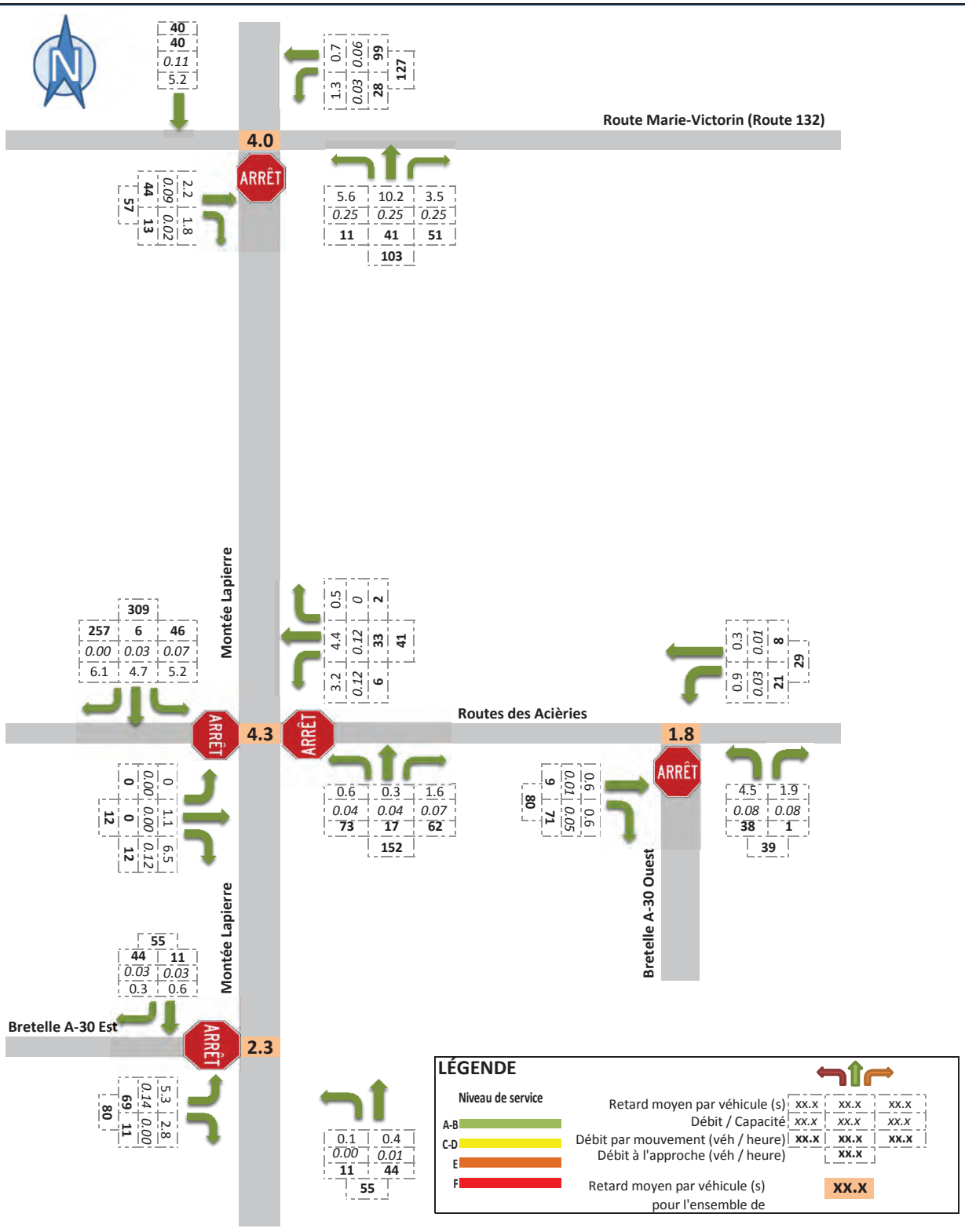
Conditions projetées de circulation sur la montée Lapierre à l'heure de pointe du midi - Construction

Juillet 2017

Réf. APM : 2018698

N/Réf : 647111

Figure 4-3



Port de Montréal
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Étude de circulation Contrecoeur

Conditions projetées de circulation à l'heure de pointe de l'après-midi (PM) - Construction

Juillet 2017
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Figure 4-4

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5.0 CARACTÉRISATION DE LA SITUATION PROJETÉE - OPÉRATIONS

Afin d'identifier la génération de véhicules lourds durant la phase des opérations du port, plusieurs hypothèses ont été prises selon les informations fournies par l'APM par rapport aux débits de véhicules lourds attendus dans le secteur de la montée de la Pomme-d'Or. Les véhicules lourds accèderont aux installations terrestres du terminal de conteneurs à partir de l'autoroute 30 et de la Route 132. Le transit entre l'autoroute 30 et la Route 132 se fera par la montée de la Pomme-d'Or, accessible par la sortie 117 de l'autoroute 30.

5.1 GÉNÉRATION ET CARACTÉRISATION DES DÉPLACEMENTS - OPÉRATIONS

La montée de la Pomme-d'Or sera empruntée par les véhicules lourds durant la mise en opération du terminal de conteneurs à Contrecœur. La génération des déplacements des véhicules lourds pendant l'opération du port variera selon le niveau d'utilisation du terminal de conteneurs. Selon les informations fournies par l'APM, il y aura en moyenne 1 200 véhicules lourds par jour affecté au port à pleine capacité. Ce nombre pourra atteindre 2 000 véhicules lourds pour des journées plus achalandées.

La période critique se trouve donc durant les journées plus achalandées qui présentent une génération de véhicules lourds plus élevée.

Le tableau 5-1 présente la génération des déplacements de véhicules lourds durant les opérations du port selon les données fournies par l'APM.

Tableau 5-1 : Déplacements journaliers de véhicules lourds- Opérations

NIVEAUX D'OPÉRATION	GÉNÉRATION (VÉHICULES LOURDS / JOUR)	MOUVEMENTS
Moyenne	1 200	1 200 entrants 1 200 sortants
Maximum	2 000	2 000 entrants 2 000 sortants

Les activités de camionnage se dérouleront de 6 h à 18 h, mais principalement avant 15 h, les jours de semaine seulement. En période de pleine exploitation du terminal de conteneurs, un maximum de 2 000 véhicules lourds / jour seront générés. La répartition horaire du débit journalier a été faite selon la répartition du comptage provenant de l'APM pour l'accès du Port de Montréal sur Notre-Dame étant donnée la similitude des opérations des conteneurs. Le tableau 5-2 présente les débits de véhicules lourds anticipés par période d'analyse pour le site à Contrecœur.

Tableau 5-2 : Déplacements horaires de véhicules lourds - Opérations

MOUVEMENT	AM (1 HEURE)	MIDI (1 HEURE)	PM (1 HEURE)
Entrants	281	207	34
Sortants	169	233	132

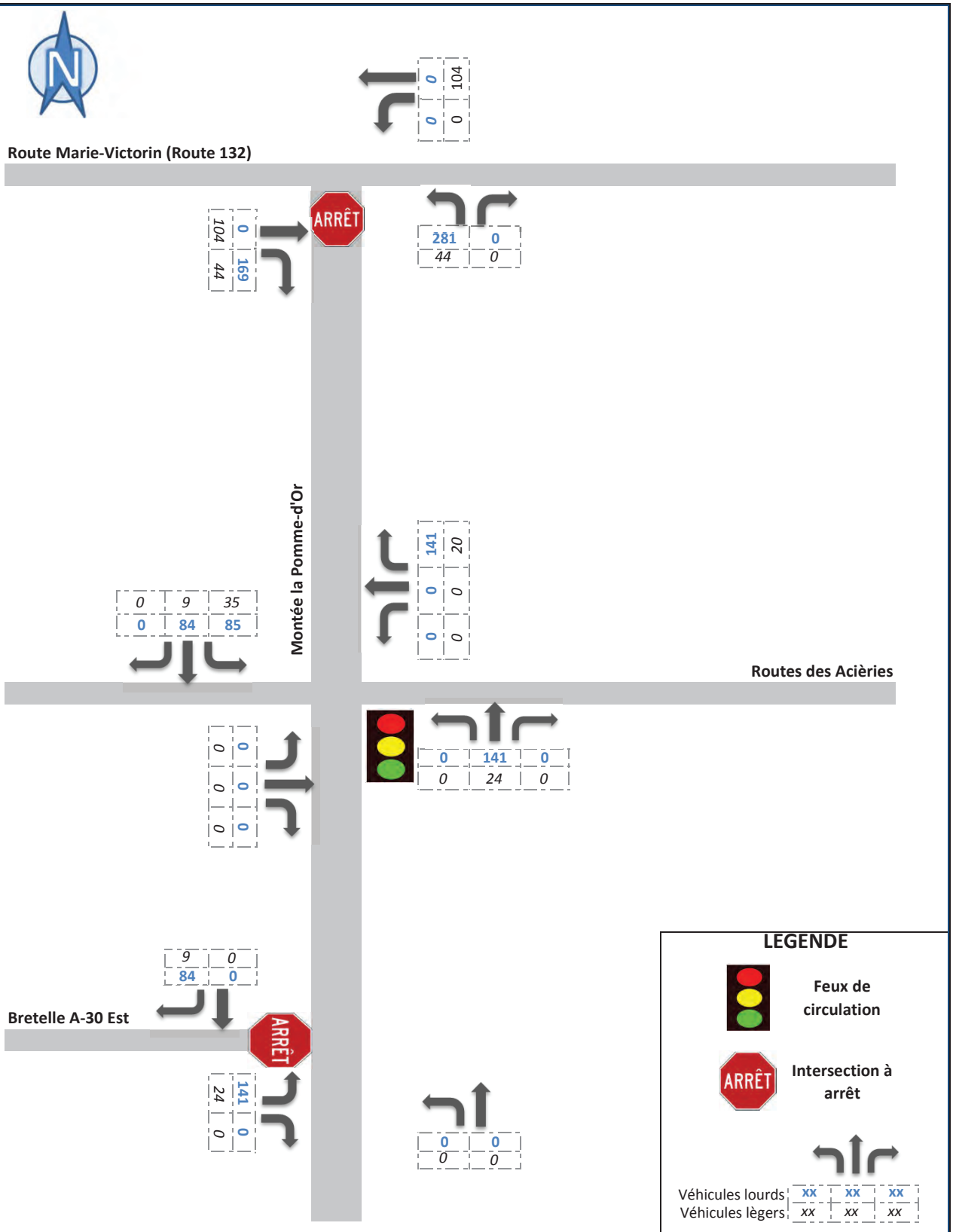
La mise en opération du port va aussi générer des déplacements reliés aux travailleurs. Environ 500 travailleurs seront affectés au site sur trois plages horaires de travail selon les données de l'APM. Afin d'analyser la situation critique, il a été estimé que l'arrivée et le départ des employés correspondent aux heures de pointe de la journée. Dans cette optique, le tableau 5-3 présente les débits des employés anticipés par période d'analyse.

Tableau 5-3 : Déplacements horaires des employés - Opérations

MOUVEMENT	AM (1 HEURE)	MIDI (1 HEURE)	PM (1 HEURE)
Entrants	166	166	166
Sortants	166	166	166

Finalement, les débits actuels ont été ajustés pour un horizon de 10 ans selon un taux de croissance annuel de 1,5%. La croissance a été calculée à partir des enquêtes Origine-Destination (EOD) 2008 et 2013 de l'RMT (Réseau de Transport Métropolitain).

Les figures 5-1, 5-2 et 5-3 présentent les débits de véhicules lourds générés du site Contrecœur durant les heures de pointe du matin (AM), du midi et de l'après-midi (PM).



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Étude de circulation Contrecoeur

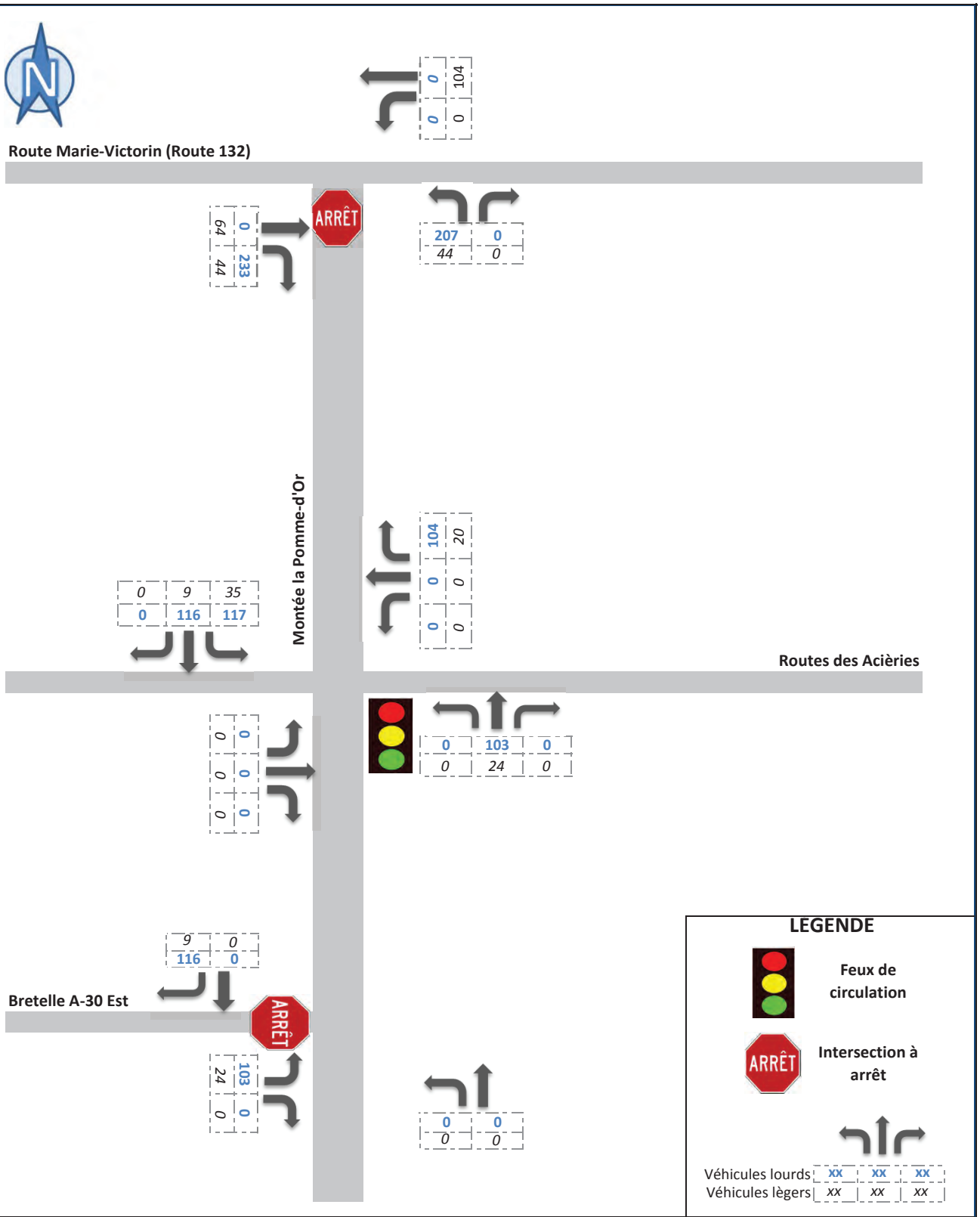
Génération de véhicules lourds sur la montée de la Pomme-d'Or à l'heure de pointe du matin (AM) - Opérations

Juillet 2017

Réf. APM : 2018698

N/Réf : 647111

Figure 5-1



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Étude de circulation Contrecoeur

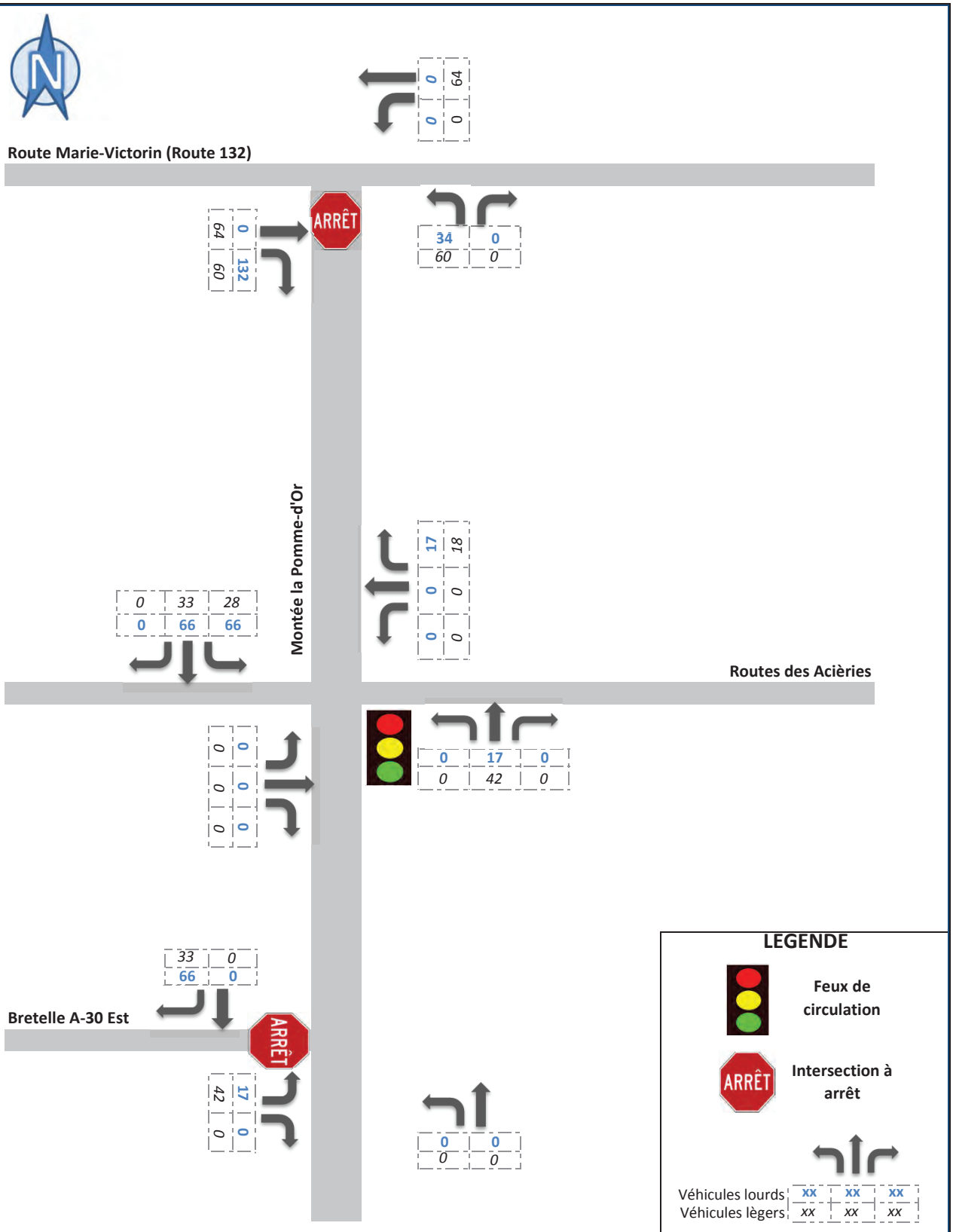
Génération de véhicules lourds sur la montée de la Pomme-d'Or à l'heure de pointe du midi - Opérations

Juillet 2017

Réf. APM : 2018698

N/Réf : 647111

Figure 5-2



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Étude de circulation Contrecoeur

Génération de véhicules lourds sur la montée de la Pomme-d'Or à l'heure de pointe de l'après-midi (PM) - Opérations

Juillet 2017

Réf. APM : 2018698

N/Réf : 647111

Figure 5-3

5.2 DÉBITS VÉHICULAIRES - OPÉRATIONS

Les débits véhiculaires retenus pour les analyses et simulations des conditions projetées de circulation sont ceux mentionnés aux figures 5-4, 5-5 et 5-6. Les débits tiennent compte de la génération de camions liée aux opérations du port, de l'arrivée et le départ des employés et une croissance de 10 ans (2028). Les débits futurs sont composés des débits actuels ajustés et projetés auxquels se sont ajoutés les débits générés par le projet du port à Contrecœur.

5.3 INTERVENTIONS REQUISES SUR LE RÉSEAU ROUTIER - OPÉRATIONS

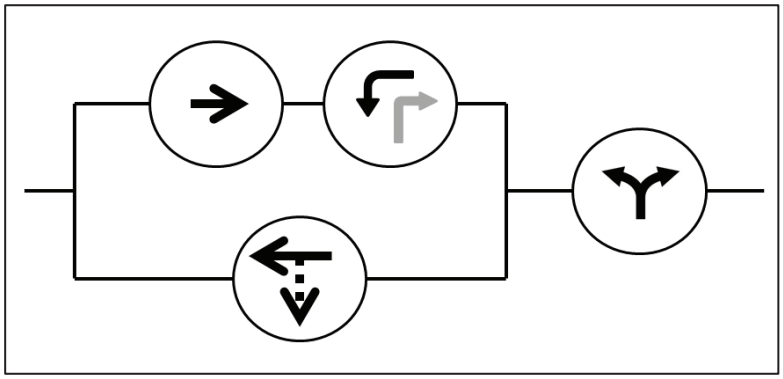
Certaines modifications au réseau routier à l'étude seront nécessaires pour desservir la demande future du secteur suite à l'aménagement du terminal de conteneurs à Contrecœur. Ces modifications accommoderont les conditions futures de la circulation.

Les modifications géométriques proposées dans « l'Étude d'impacts sur la circulation sur le site du port de Montréal à Contrecœur » de Cima+ de 2014 sont les suivantes :

Carrefour montée de la Pomme-d'Or / Route Marie – Victorin

- Implantation d'un feu de circulation avec détection sur l'approche sud et sur la voie de virage à gauche de l'approche est (Figure 5-4) ;

Figure 5-4 Programmation des feux de circulation proposée au carrefour montée de la Pomme-d'Or / Route Marie-Victorin

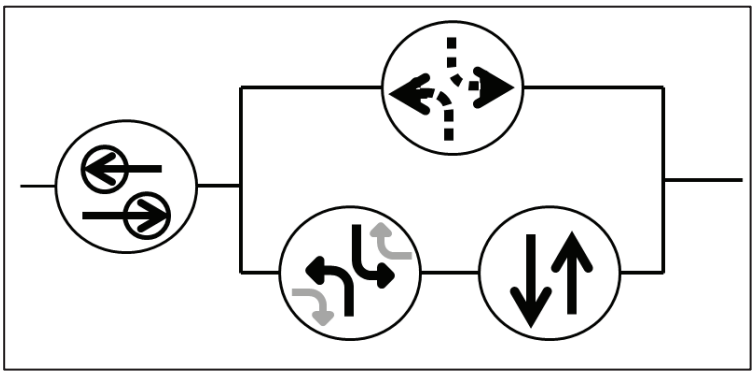


- Élargissement de la chaussée pour l'ajout d'une voie de virage à droite exclusive à l'approche sud et une voie additionnelle en direction sud (sur environ 100 m);
- Aménagement d'un îlot de virage à droite à l'approche Ouest qui entre sur la montée de la Pomme-d'Or en gain de voie.

Carrefour montée de la Pomme-d'Or / Route des Aciéries

- Assignation des voies sur la montée de la Pomme-d'Or
  - Approche nord : Voie de virage à gauche exclusive et voie partagée tout droit et virage à droite;
  - Approche sud : Une voie partagée de virage à gauche et tout droit et une voie partagée de tout droit et virage à droite.
- Ajout d'une phase protégée de virage à gauche dans la programmation actuelle du feu de circulation avec modification des têtes de feux (Figure 5-5);

Figure 5-5 Programmation des feux de circulation proposée au carrefour montée de la Pomme-d'Or / Route des Aciéries

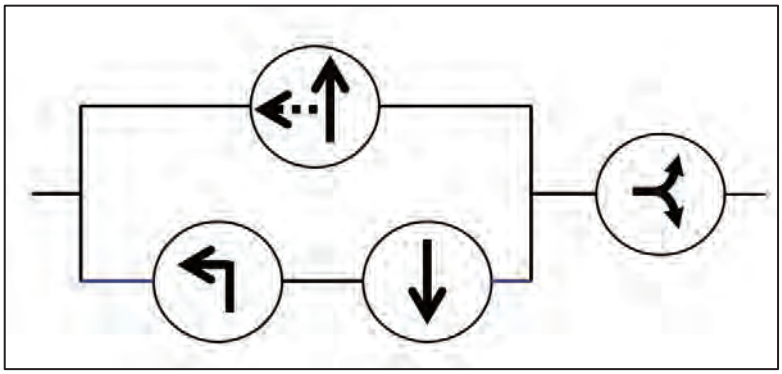


- Modification de la détection : Détection sur les approches est et ouest ainsi que dans la voie exclusive de virage à gauche à l'approche nord.

Carrefour montée de la Pomme-d'Or / A-30 est

- Réaménagement des voies de circulation : Voie de virage à gauche exclusive à l'approche sud;
- Implantation d'un feu de circulation avec détection sur la bretelle et dans la voie de virage à gauche exclusive (Figure 5-6).

Figure 5-6 : Programmation des feux de circulation proposée au carrefour montée de la Pomme-d'Or / bretelle A-30 est



Les analyses de justification de feux de circulation selon les normes du MTMDET sont présentées à l'**annexe F**. La justification des voies de virage est également présentée à l'**annexe H.**

5.4 CONDITIONS PROJETÉES DE CIRCULATION - OPÉRATIONS

Les analyses de circulation ont permis de dresser un portrait des conditions projetées de la circulation durant l'opération du port aux heures de pointe du matin (AM), midi et de l'après-midi (PM) selon les aménagements précisés dans la section précédente. Les figures 5-7 à 5-9 présentent les résultats des simulations de circulation des carrefours pendant les trois heures de pointe. Les résultats détaillés des simulations sont présentés à l'**annexe E** et sont discutés sommairement dans la section qui suit.

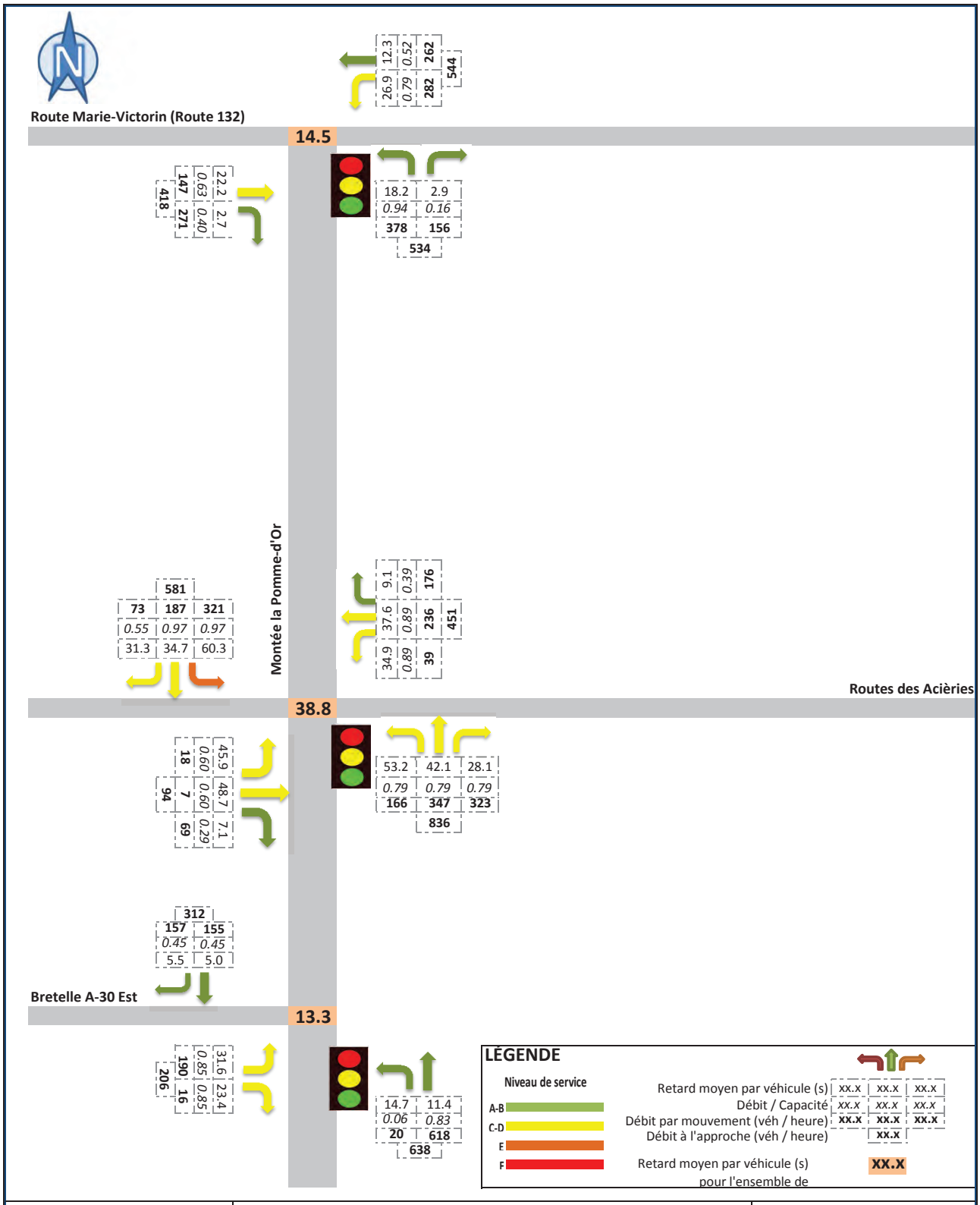
Il est à noter que les simulations effectuées représentent le scénario critique, c'est-à-dire la période de pleine exploitation du port durant une journée plus achalandée avec la génération de jusqu'à 2 000 camions / jour. De façon générale, la génération sera moindre avec environ 1 200 véhicules lourds / jour prévus.

Durant l'heure de pointe du matin, les conditions de circulation pour chacun des mouvements aux carrefours sont satisfaisantes sur la majorité des carrefours avec des niveaux de services qui varient entre A et C sauf le virage à gauche de l'approche nord du carrefour montée de la Pomme-d'Or / Route des Acières / bretelle A-30 ouest qui présente un retard de 60 sec (niveau de service E). La file d'attente moyenne à l'approche nord de ce carrefour est de 60 m et peut remonter à 270 m à son maximum. À l'approche sud, la file d'attente moyenne est de 85 m et peut remonter à 240 m à son maximum. Il n'y a pas de file d'attente importante dans les bretelles de l'autoroute ni aux autres carrefours.

Durant l'heure de pointe du midi, les conditions de circulation pour chacun des mouvements aux carrefours sont satisfaisantes sur la majorité des carrefours avec des niveaux de services qui varient entre A et C au long de la montée de la Pomme-d'Or.

Durant l'heure de pointe de l'après-midi, les conditions de circulation pour chacun des mouvements aux carrefours sont satisfaisantes avec des niveaux de services qui oscillent entre niveaux de service A, et C au long de la Pomme-d'Or.

Les interventions proposées dans «Étude d'impacts sur la circulation sur le site du port de Montréal à Contrecœur» de Cima+ de 2014 sont donc suffisantes pour accommoder les débits additionnels sur le réseau routier suite à la mise en opération du port. Il est à noter que les impacts ressortis dans cette étude sont pour la période critique et ne seront pas ressentis tous les jours. Les impacts moyens seront approximativement 40% moindres que la situation maximale.



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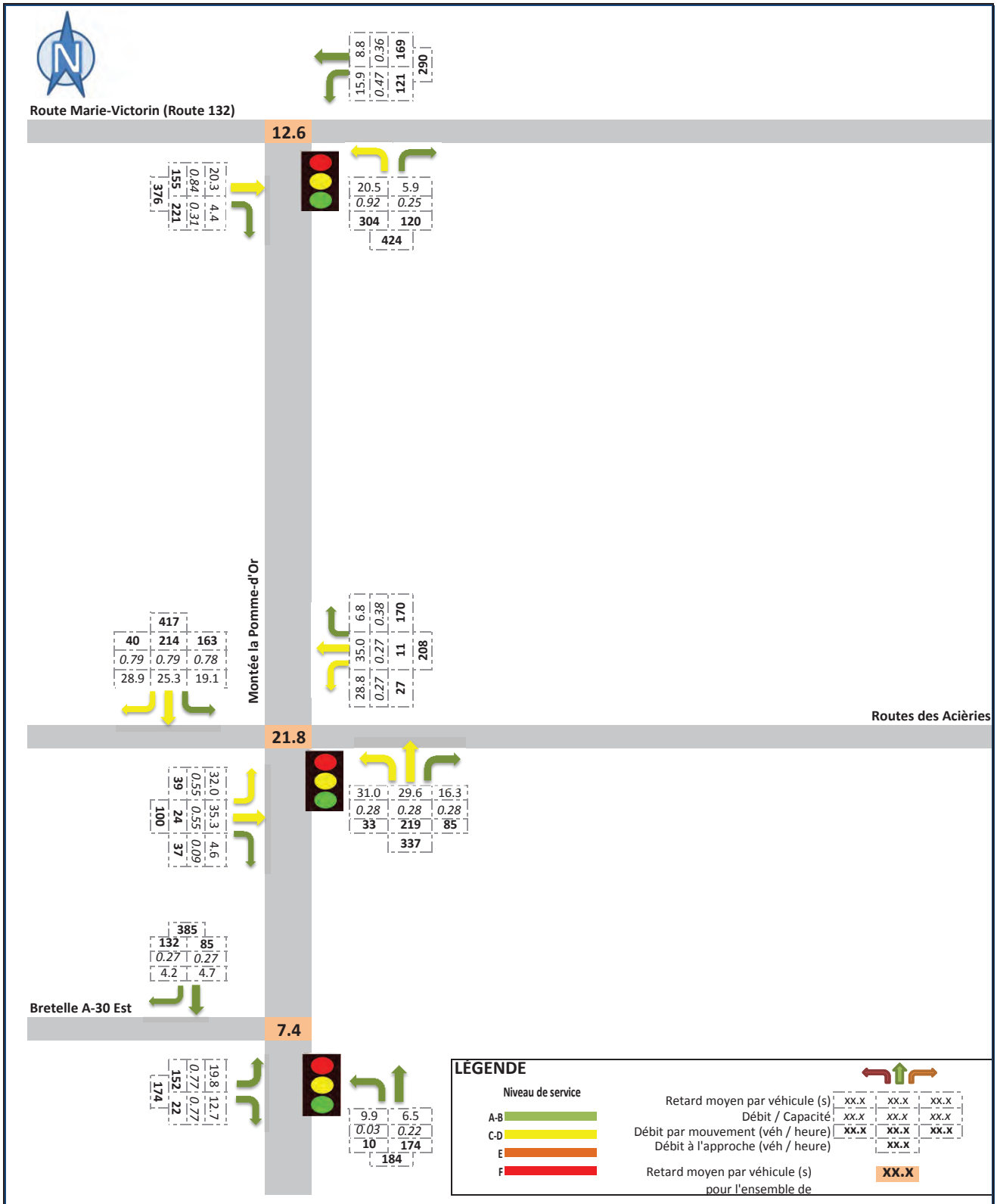
Étude de circulation Contrecoeur

Conditions projetées de circulation sur la montée de la Pomme-d'Or à l'heure de pointe du matin (AM) - Opérations

Juillet 2017
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Figure 5-7

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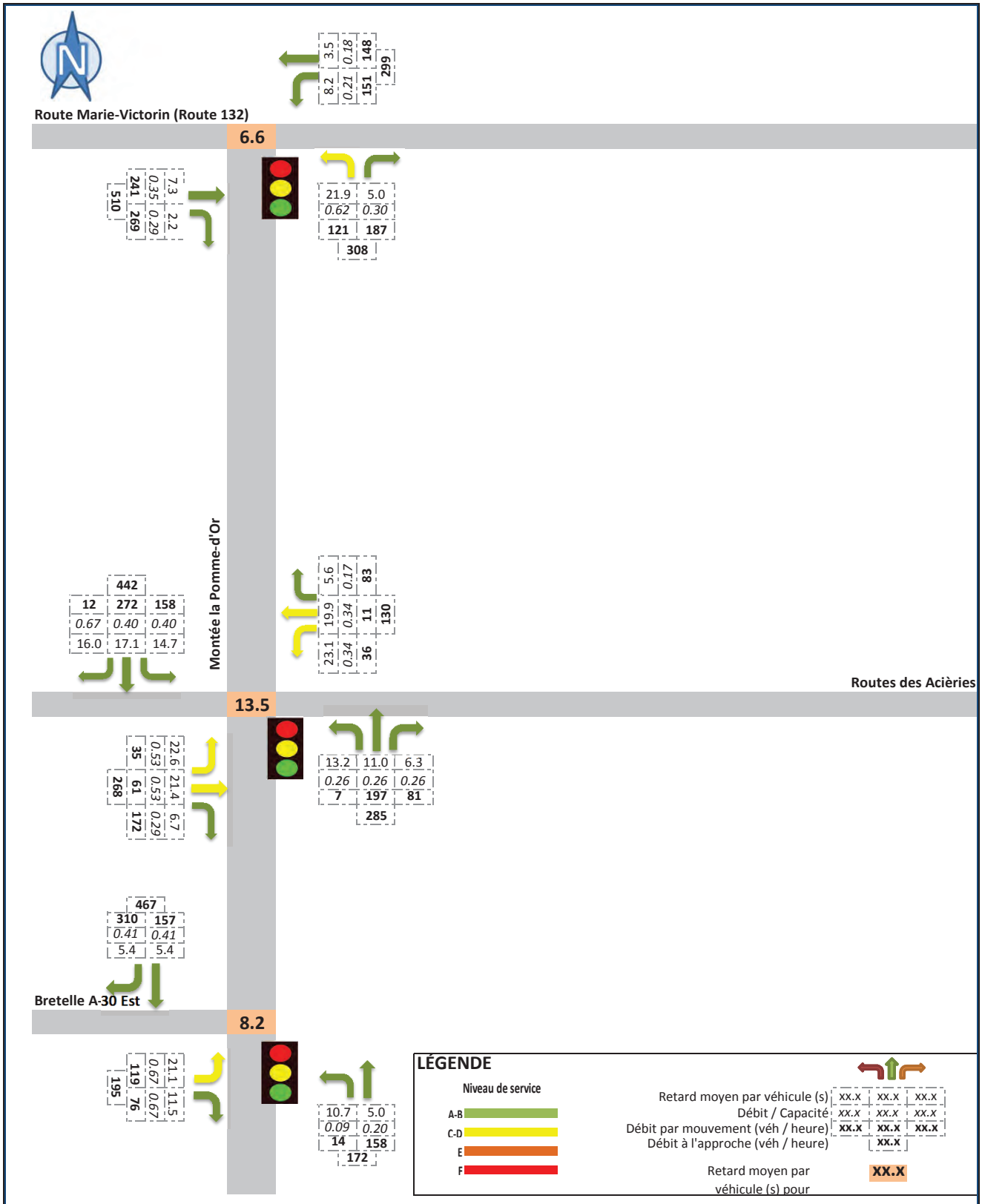
Étude de circulation Contrecoeur

Conditions projetées de circulation sur la montée de la Pomme-d'Or à l'heure de pointe midi - Opérations

Juillet 2017
Réf. APM : 2018698
N/Réf : 647111

Figure 5-8

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Etude de circulation Contrecoeur

Conditions projetées de circulation sur la montée de la Pomme-d'Or à l'heure de pointe de l'après-midi (PM) - Opérations

Juillet 2017
Réf. APM : 2018698
N/Réf : 647111

Figure 5-9

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6.0 RECOMMANDATIONS

L'implantation du projet d'aménagement d'un terminal de conteneurs à Contrecœur crée de nouveaux déplacements véhiculaires sur les montées Lapierre et de la Pomme-d'Or entre la Route Marie-Victorin (Route 132) et l'échangeur de l'autoroute 30.

Deux phases de réalisation ont été retenues pour l'étude, soient la phase de construction et la phase opération. La phase de construction génère 43 véhicules lourds entrants et 43 véhicules lourds sortants du site du port pendant chaque heure de pointe. La phase opération génère 450 véhicules lourds pendant l'heure de pointe du matin (AM), 440 véhicules lourds pendant l'heure de pointe du midi et 166 véhicules lourds pendant l'heure de pointe de l'après-midi. L'arrivée et le départ des travailleurs génèrent aussi 500 déplacements entrants et sortants pendant les heures de pointe (166 travailleurs par heure de pointe).

Durant la phase de construction, les véhicules lourds circulant sur la montée Lapierre entre l'autoroute 30 et l'accès du port au nord de la Route 132 ne causent aucun impact négatif sur les conditions actuelles de circulation. Les niveaux de service moyens pour chaque mouvement demeurent entre A et B. Les aménagements existants sont donc suffisants pour accommoder le débit de véhicules lourds généré par la phase de construction.

Il est à noter que dans l'étude antérieure de SNC-Lavalin de 2012, la montée Lapierre était utilisée durant les opérations des deux phases de réalisation : construction d'un premier terminal de conteneurs ayant une capacité de 470 000 EVP (Phase 1) et finalisation du site complet avec une capacité de 1.14 M EVP (Phase 2). Les débits générés étaient donc plus élevés que ceux analysés dans cette étude.

Durant les opérations du nouveau terminal de conteneurs, des interventions sont requises afin de garantir des bonnes conditions de circulation. Les modifications proposées dans « l'*Étude d'impact sur la circulation sur le site du port de Montréal à Contrecœur* » de Cima+ de 2014 ont été évaluées afin de valider leur capacité à répondre à la croissance de la demande future. Ces modifications se résument ainsi :

- Carrefour montée de la Pomme-d'Or / Route Marie – Victorin
  - Implantation d'un feu de circulation avec détection sur l'approche sud et sur la voie de virage à gauche de l'approche est ;
  - Élargissement de la chaussée pour l'ajout d'une voie de virage à droite exclusive à l'approche sud et une voie additionnelle en direction sud (sur environ 100 m);

- Aménagement d'un îlot de virages à droite à l'approche Ouest qui entre sur la montée de la Pomme-d'Or en gain de voie.

- Carrefour montée de la Pomme-d'Or / Route des Acières
  - Assignation des voies sur la montée de la Pomme-d'Or
    - Approche nord : Voie de virage à gauche exclusive et voie partagée tout droit et virage à droite;
    - Approche sud : Une voie partagée de virage à gauche et tout droit et une voie partagée de tout droit et virage à droite.
  - Ajout d'une phase protégée de virage à gauche dans la programmation actuelle du feu de circulation avec modification des têtes de feux;
  - Modification de la détection : Détection sur les approches est et ouest ainsi que dans la voie exclusive de virage à gauche à l'approche nord.

- Carrefour montée de la Pomme-d'Or / A-30 Est
  - Réaménagement des voies de circulation : Voie de virage à gauche exclusive à l'approche sud;
  - Implantation d'un feu de circulation avec détection sur la bretelle et dans la voie de virage à gauche exclusive.

Les interventions proposées dans «Étude d'impacts sur la circulation sur le site du port de Montréal à Contrecœur» de Cima+ de 2014 sont donc suffisantes pour accommoder les débits additionnels sur le réseau routier suite à la mise en opération du port.

ANNEXE A :

COMPTAGES VÉHICULAIRES

Compilation Data Traffic

Titre: 0317-55-4

Comptage

Ville ou Arrondissement: Contrecoeur

Intersection: Entrée privé _ Marie-Victorin

Approche Nord	Entrée privé
Approche Est	Marie-Victorin
Approche Sud	Montée Lapierre
Approche Ouest	Marie-Victorin

Classification

Automobiles, Piétons et Cyclistes

Camions, Autobus

Articulés



Date: 10 mai 2017
Jour: mercredi

Conditions climatiques: Nuageux
Température: 11°C

Période(s) de comptage	AM	Midi	PM	Soir
Début	6:00	11:00	15:00	
Fin	9:00	13:00	18:00	
Durée	3:00	2:00	3:00	

Durée du comptage 8:00

Géolocalisation:

Lien hypertexte de localisation:

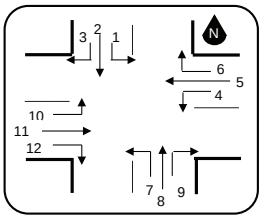
Observation:

Remarque:

Comptages

0317-55-4

Date: May 10, 2017
Jour: mercredi



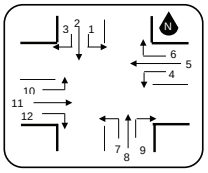
TOTAL Véhicules, Piétons et Cyclistes

Période		Entrée privé						Marie-Victorin						Montée Lapierre						Marie-Victorin						Grand Total
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	1:00																									
1:00	2:00																									
2:00	3:00																									
3:00	4:00																									
4:00	5:00																									
5:00	6:00																									
6:00	7:00	1								21	86		107			6		31	37				40	12	52	196
7:00	8:00									15	105		120			13		32	45				63	14	77	242
8:00	9:00									32	95		127		1	8		43	51				61	12	73	251
9:00	10:00																									
10:00	11:00																									
11:00	12:00	1								28	61		89			9		52	61				48	5	53	203
12:00	13:00									22	41		63		1	5		46	51				58	8	66	180
13:00	14:00																									
14:00	15:00																									
15:00	16:00	1								28	77		105			7		40	47				100	8	108	260
16:00	17:00	2								22	101		123			13		44	57				139	11	150	330
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18:00	19:00																									
19:00	20:00																									
20:00	21:00																									
21:00	22:00																									
22:00	23:00																									
23:00	0:00																									
TOTAL		**5**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**182**	**631**	**0**	**813**	**0**	**2**	**67**	**0**	**298**	**365**	**0**	**0**	**0**	**643**	**76**	**719**	1897

Comptages

0317-55-4

Date: May 10, 2017
Jour: mercredi



TOTAL Véhicules, Piétons et Cyclistes

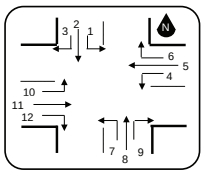
Période		Entrée privé – Approche Nord						Marie-Victorin – Approche Est						Montée Lapierre – Approche Sud						Marie-Victorin – Approche Ouest						Grand Total
				Gauche	Tout Droit	Droite				Gauche	Tout Droit	Droite				Gauche	Tout Droit	Droite				Gauche	Tout Droit	Droite		
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à	Piétons	Cyclistes	←	↑	→	Total	Piétons	Cyclistes	←	↑	→	Total	Piétons	Cyclistes	←	↑	→	Total	Piétons	Cyclistes	←	↑	→	Total	
0:00	0:15																									
0:15	0:30																									
0:30	0:45																									
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5:30	5:45																									
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6:30	6:45									3	26		29			3		7	10				19	2	21	60
6:45	7:00									6	17		23					13	13				11	5	16	52
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9:00	9:15																									
9:15	9:30																									
9:30	9:45																									
9:45	10:00																									
10:00	10:15																									
10:15	10:30																									
10:30	10:45																									
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11:45	12:00									9	9		18			2		8	10				8		8	36
12:00	12:15									4	12		16		1	1		18	19				15	2	17	52
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14:45	15:00																									
15:00	15:15	1								11	21		32					15	15				21	1	22	69
15:15	15:30									5	11		16			2		10	12				29	1	30	58
15:30	15:45									10	19		29			3		9	12				19	2	21	62
15:45	16:00									2	26		28			2		6	8				31	4	35	71
16:00	16:15									8	27		35			3		7	10				30	2	32	77
16:15	16:30									5	27		32			3		21	24				37	3	40	96
16:30	16:45	2								4	21		25			2		11	13				40	4	44	82
16:45	17:00									5	26		31			5		5	10				32	2	34	75
17:00	17:15							1		8	23		31			1		3	4				38	1	39	74
17:15	17:30									2	18		20			2		1	3				30	1	31	54
17:30	17:45									1	13		14			2		4	6				39	2	41	61
17:45	18:00									3	11		14			1		2	3				27	2	29	46
18:00	18:15																									
18:15	18:30																									
18:30	18:45																									
18:45	19:00																									
19:00	19:15																									
19:15	19:30																									
19:30	19:45																									
19:45	20:00																									
20:00	20:15																									
20:15	20:30																									
20:30	20:45																									
20:45	21:00																									
21:00	21:15																									
21:15	21:30																									
21:30	21:45																									
21:45	22:00																									
22:00	22:15																									
22:15	22:30																									
22:30	22:45																									
22:45	23:00																									
23:00	23:15																									
23:15	23:30																									
23:30	23:45																									
23:45	0:00																									
TOTAL		**5**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**182**	**631**	**0**	**813**	**0**	**2**	**67**	**0**	**298**	**365**	**0**	**0**	**0**	**643**	**76**	**719**	1897

Comptages

0317-55-4

Date: May 10, 2017
Jour: mercredi





Automobiles, Piétons et Cyclistes

Période		Entrée privé – Approche Nord						Marie-Victorin – Approche Est						Montée Lapierre – Approche Sud						Marie-Victorin – Approche Ouest						Grand total
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		Autos
0:00	0:15																									
0:15	0:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
0:30	0:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
0:45	1:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:00	1:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:15	1:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:30	1:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:45	2:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
2:00	2:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
2:15	2:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
2:30	2:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
2:45	3:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
3:00	3:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
3:15	3:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
3:30	3:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
3:45	4:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
4:00	4:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
4:15	4:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
4:30	4:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
4:45	5:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
5:00	5:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
5:15	5:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
5:30	5:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
5:45	6:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
6:00	6:15	1								1	22		23			2		2	4				1	2	3	30
6:15	6:30									2	19		21			1		3	4				8	2	10	35
6:30	6:45									2	25		27			3		5	8				17	2	19	54
6:45	7:00									5	15		20					5	5				9	5	14	39
7:00	7:15									3	23		26			2		3	5				12	4	16	47
7:15	7:30									3	26		29			2		3	5				12	8	20	54
7:30	7:45										25		25			1		3	4				18	1	19	48
7:45	8:00									2	27		29			6		1	7				19	1	20	56
8:00	8:15										21		21			3		3	6				11	6	17	44
8:15	8:30									3	24		27					4	4				13	1	14	45
8:30	8:45									3	29		32		1	2		3	5				16	2	18	55
8:45	9:00									5	18		23			1		2	3				16	2	18	44
9:00	9:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
9:15	9:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
9:30	9:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
9:45	10:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
10:00	10:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
10:15	10:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
10:30	10:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
10:45	11:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
11:00	11:15	1								5	14		19			1		1	2				10	2	12	33
11:15	11:30									2	22		24			1		3	4				17	2	19	47
11:30	11:45									2	12		14			4		7	11				9		9	34
11:45	12:00									4	9		13			2		2	4				8		8	25
12:00	12:15										11		11		1								15	2	17	28
12:15	12:30									2	9		11			2		1	3				11	1	12	26
12:30	12:45									2	8		10			1		1	2				14	3	17	29
12:45	13:00									2	11		13			1		8	9				16	1	17	39
13:00	13:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
13:15	13:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
13:30	13:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
13:45	14:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
14:00	14:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
14:15	14:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
14:30	14:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
14:45	15:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
15:00	15:15	1								5	20		25					5	5				21	1	22	52
15:15	15:30										10		10			2		2	4				27		27	41
15:30	15:45									4	18		22			3		5	8				18	2	20	50
15:45	16:00										25		25			2		1	3				30	3	33	61
16:00	16:15									6	25		31			2		2	4				29	2	31	66
16:15	16:30									3	25		28			3		1	4				35	2	37	69
16:30	16:45	2								2	21		23			2		2	4				40	4	44	71
16:45	17:00									3	25		28			5		1	6				32	2	34	68
17:00	17:15									6	21		27			1		1	2				35	1	36	65
17:15	17:30									1	18		19			2		1	3				29	1	30	52
17:30	17:45									1	13		14			2		2	4				38	2	40	58
17:45	18:00									3	11		14			1		2	3				26	2	28	45
18:00	18:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
18:15	18:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
18:30	18:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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19:00	19:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
19:15	19:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
19:30	19:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
19:45	20:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
20:00	20:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
20:15	20:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
20:30	20:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
20:45	21:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
21:00	21:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
21:15	21:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
21:30	21:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
21:45	22:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
22:00	22:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
22:15	22:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
22:30	22:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
22:45	23:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
23:00	23:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
23:15	23:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
23:30	23:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
23:45	0:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
TOTAL		**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**82**	**602**	**0**	**684**	**0**	**2**	**60**	**0**	**85**	**145**	**0**	**0**	**0**	**612**	**69**	**681**	1510

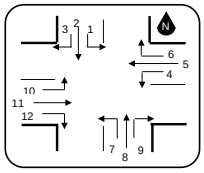
Comptages

Date: May 10, 2017
Jour: mercredi

0317-55-4



Camions, Autobus

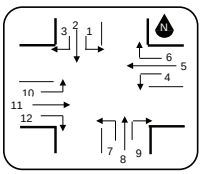


Période		Entrée privé – Approche Nord						Marie-Victorin – Approche Est						Montée Lapierre – Approche Sud						Marie-Victorin – Approche Ouest						Grand total
		'	'	Gauche 1	Tout Droit 2	Droite 3	Total	'	'	Gauche 4	Tout Droit 5	Droite 6	Total	'	'	Gauche 7	Tout Droit 8	Droite 9	Total	'	'	Gauche 10	Tout Droit 11	Droite 12	Total	Légers
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30			0	0	0				0	0	0				0	0	0				0	0	0		
0:30	0:45			0	0	0				0	0	0				0	0	0				0	0	0		
0:45	1:00			0	0	0				0	0	0				0	0	0				0	0	0		
1:00	1:15			0	0	0				0	0	0				0	0	0				0	0	0		
1:15	1:30			0	0	0				0	0	0				0	0	0				0	0	0		
1:30	1:45			0	0	0				0	0	0				0	0	0				0	0	0		
1:45	2:00			0	0	0				0	0	0				0	0	0				0	0	0		
2:00	2:15			0	0	0				0	0	0				0	0	0				0	0	0		
2:15	2:30			0	0	0				0	0	0				0	0	0				0	0	0		
2:30	2:45			0	0	0				0	0	0				0	0	0				0	0	0		
2:45	3:00			0	0	0				0	0	0				0	0	0				0	0	0		
3:00	3:15			0	0	0				0	0	0				0	0	0				0	0	0		
3:15	3:30			0	0	0				0	0	0				0	0	0				0	0	0		
3:30	3:45			0	0	0				0	0	0				0	0	0				0	0	0		
3:45	4:00			0	0	0				0	0	0				0	0	0				0	0	0		
4:00	4:15			0	0	0				0	0	0				0	0	0				0	0	0		
4:15	4:30			0	0	0				0	0	0				0	0	0				0	0	0		
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4:45	5:00			0	0	0				0	0	0				0	0	0				0	0	0		
5:00	5:15			0	0	0				0	0	0				0	0	0				0	0	0		
5:15	5:30			0	0	0				0	0	0				0	0	0				0	0	0		
5:30	5:45			0	0	0				0	0	0				0	0	0				0	0	0		
5:45	6:00			0	0	0				0	0	0				0	0	0				0	0	0		
6:00	6:15									2	1		3					1	1							4
6:15	6:30										1		1					2	2				1	1	2	5
6:30	6:45										1		1					1	1				2		2	4
6:45	7:00									1	1		2					4	4				2		2	8
7:00	7:15										1		1			2			2				1		1	4
7:15	7:30									1			1													1
7:30	7:45									1	2		3					8	8							11
7:45	8:00									1	1		2					4	4							6
8:00	8:15									2			2										1		1	3
8:15	8:30									1	2		3					6	6				1	1	2	11
8:30	8:45									1			1			2		6	8				2		2	11
8:45	9:00									1	1		2					9	9				1		1	12
9:00	9:15			0	0	0				0	0	0				0	0	0				0	0	0		
9:15	9:30			0	0	0				0	0	0				0	0	0				0	0	0		
9:30	9:45			0	0	0				0	0	0				0	0	0				0	0	0		
9:45	10:00			0	0	0				0	0	0				0	0	0				0	0	0		
10:00	10:15			0	0	0				0	0	0				0	0	0				0	0	0		
10:15	10:30			0	0	0				0	0	0				0	0	0				0	0	0		
10:30	10:45			0	0	0				0	0	0				0	0	0				0	0	0		
10:45	11:00			0	0	0				0	0	0				0	0	0				0	0	0		
11:00	11:15									2	1		3			1		6	7				1		1	11
11:15	11:30										2		2					8	8							10
11:30	11:45									1	1		2					7	7				3		3	12
11:45	12:00									1			1					3	3							4
12:00	12:15										1		1			1		11	12							13
12:15	12:30									1	1		2					3	3				1		1	6
12:30	12:45									1			1					6	6				1		1	8
12:45	13:00									1			1					3	3							4
13:00	13:15			0	0	0				0	0	0				0	0	0				0	0	0		
13:15	13:30			0	0	0				0	0	0				0	0	0				0	0	0		
13:30	13:45			0	0	0				0	0	0				0	0	0				0	0	0		
13:45	14:00			0	0	0				0	0	0				0	0	0				0	0	0		
14:00	14:15			0	0	0				0	0	0				0	0	0				0	0	0		
14:15	14:30			0	0	0				0	0	0				0	0	0				0	0	0		
14:30	14:45			0	0	0				0	0	0				0	0	0				0	0	0		
14:45	15:00			0	0	0				0	0	0				0	0	0				0	0	0		
15:00	15:15									3	1		4					7	7							11
15:15	15:30									2	1		3					4	4				2	1	3	10
15:30	15:45									2	1		3					3	3				1		1	7
15:45	16:00									2	1		3					3	3				1	1	2	8
16:00	16:15									2	2		4					3	3				1		1	8
16:15	16:30										2		2					12	12				2		2	16
16:30	16:45																	5	5							5
16:45	17:00										1		1					2	2							3
17:00	17:15									1	2		3					2	2				3		3	8
17:15	17:30																						1		1	1
17:30	17:45																	1	1				1		1	2
17:45	18:00																						1		1	1
18:00	18:15			0	0	0				0	0	0				0	0	0				0	0	0		
18:15	18:30			0	0	0				0	0	0				0	0	0				0	0	0		
18:30	18:45			0	0	0				0	0	0				0	0	0				0	0	0		
18:45	19:00			0	0	0				0	0	0				0	0	0				0	0	0		
19:00	19:15			0	0	0				0	0	0				0	0	0				0	0	0		
19:15	19:30			0	0	0				0	0	0				0	0	0				0	0	0		
19:30	19:45			0	0	0				0	0	0				0	0	0				0	0	0		
19:45	20:00			0	0	0				0	0	0				0	0	0				0	0	0		
20:00	20:15			0	0	0				0	0	0				0	0	0				0	0	0		
20:15	20:30			0	0	0				0	0	0				0	0	0				0	0	0		
20:30	20:45			0	0	0				0	0	0				0	0	0				0	0	0		
20:45	21:00			0	0	0				0	0	0				0	0	0				0	0	0		
21:00	21:15			0	0	0				0	0	0				0	0	0				0	0	0		
21:15	21:30			0	0	0				0	0	0				0	0	0				0	0	0		
21:30	21:45			0	0	0				0	0	0				0	0	0				0	0	0		
21:45	22:00			0	0	0				0	0	0				0	0	0				0	0	0		
22:00	22:15			0	0	0				0	0	0				0	0	0				0	0	0		
22:15	22:30			0	0	0				0	0	0				0	0	0				0	0	0		
22:30	22:45			0	0	0				0	0	0				0	0	0				0	0	0		
22:45	23:00			0	0	0				0	0	0				0	0	0				0	0	0		
23:00	23:15			0	0	0				0	0	0				0	0	0				0	0	0		
23:15	23:30			0	0	0				0	0	0				0	0	0				0	0	0		
23:30	23:45			0	0	0				0	0	0				0	0	0				0	0	0		
23:45	0:00			0	0	0				0	0	0				0	0	0				0	0	0		
TOTAL		*0*	*0*	**0**	**0**	**0**	**0**	*0*	*0*	**30**	**28**	**0**	**58**	*0*	*0*	**6**	**0**	**130**	**136**	*0*	*0*	**0**	**30**	**4**	**34**	228

Comptages

0317-55-4

Date: May 10, 2017
Jour: mercredi



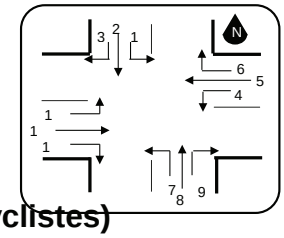
Articulés

Période		Entrée privé – Approche Nord						Marie-Victorin – Approche Est						Montée Lapierre – Approche Sud						Marie-Victorin – Approche Ouest						Grand total Lourds
		Virage en U		Gauche	Tout Droit	Droite	Total	Virage en U		Gauche	Tout Droit	Droite	Total	Virage en U		Gauche	Tout Droit	Droite	Total	Virage en U		Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
0:30	0:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
0:45	1:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:00	1:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:15	1:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:30	1:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:45	2:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:00	2:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:15	2:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:30	2:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:45	3:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:00	3:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:15	3:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:30	3:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:45	4:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:00	4:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:15	4:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:30	4:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:45	5:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:00	5:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:15	5:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:30	5:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:45	6:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
6:00	6:15									7			7					1	1							8
6:15	6:30																	2	2							2
6:30	6:45									1			1					1	1							2
6:45	7:00										1		1					4	4							5
7:00	7:15																									
7:15	7:30																									
7:30	7:45									3			3					6	6				1		1	10
7:45	8:00									1			1					4	4							5
8:00	8:15									5			5													5
8:15	8:30									8			8					3	3							11
8:30	8:45									1			1					4	4							5
8:45	9:00									2			2					3	3							5
9:00	9:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
9:15	9:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
9:30	9:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
9:45	10:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:00	10:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:15	10:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:30	10:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:45	11:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
11:00	11:15									3			3					2	2							5
11:15	11:30									3			3					5	5							8
11:30	11:45									1			1					5	5				1		1	7
11:45	12:00									4			4					3	3							7
12:00	12:15									4			4					7	7							11
12:15	12:30									4			4					2	2							6
12:30	12:45									2			2					4	4					1	1	7
12:45	13:00									3			3													3
13:00	13:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:15	13:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:30	13:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:45	14:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:00	14:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:15	14:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:30	14:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:45	15:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
15:00	15:15									3			3					3	3							6
15:15	15:30									3			3					4	4							7
15:30	15:45									4			4					1	1							5
15:45	16:00																	2	2							2
16:00	16:15															1		2	3							3
16:15	16:30									2			2					8	8					1	1	11
16:30	16:45									2			2					4	4							6
16:45	17:00									2			2					2	2							4
17:00	17:15							1		1			1													1
17:15	17:30									1			1													1
17:30	17:45																	1	1							1
17:45	18:00																									
18:00	18:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:15	18:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:30	18:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:45	19:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:00	19:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:15	19:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:30	19:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:45	20:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:00	20:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:15	20:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:30	20:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:45	21:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:00	21:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:15	21:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:30	21:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:45	22:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:00	22:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:15	22:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:30	22:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:45	23:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:00	23:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:15	23:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:30	23:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:45	0:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
TOTAL		**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**70**	**1**	**0**	**71**	**0**	**0**	**1**	**0**	**83**	**84**	**0**	**0**	**0**	**1**	**3**	**4**	159

Compilation des heures de pointes

0317-55-4

Date: May 10, 2017
Jour: mercredi



Heure de pointe du réseau

AM 7:45 à 8:45 - (Ensemble des véhicules, piétons et cyclistes)

Période		Entrée privé – Approche Nord						Marie-Victorin – Approche Est						Montée Lapierre – Approche Sud						Marie-Victorin – Approche Ouest						Grand total véhicules
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
7:45	8:00									4	28		**32**			6		9	**15**				19	1	**20**	**67**
8:00	8:15									7	21		**28**			3		3	**6**				12	6	**18**	**52**
8:15	8:30									12	26		**38**					13	**13**				14	2	**16**	**67**
8:30	8:45									5	29		**34**		*1*	4		13	**17**				18	2	**20**	**71**
TOTAL										**28**	**104**		**132**		***1***	**13**		**38**	**51**				**63**	**11**	**74**	**257**
% Légers				0.0%	0.0%	0.0%	0.0%			17.9%	2.9%	0.0%	6.1%			15.4%	0.0%	42.1%	35.3%			0.0%	6.3%	9.1%	6.8%	12.1%
% Lourds				0.0%	0.0%	0.0%	0.0%			53.6%	0.0%	0.0%	11.4%			0.0%	0.0%	28.9%	21.6%			0.0%	0.0%	######	0.0%	10.1%
PHF										**0.58**	**0.90**		**0.87**			**0.54**		**0.73**	**0.75**				**0.83**	**0.46**	**0.93**	**0.90**

Midi 11:15 à 12:15 - (Ensemble des véhicules, piétons et cyclistes)

Période		Entrée privé – Approche Nord						Marie-Victorin – Approche Est						Montée Lapierre – Approche Sud						Marie-Victorin – Approche Ouest						Grand total véhicules
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
11:15	11:30									5	24		**29**			1		16	**17**				17	2	**19**	**65**
11:30	11:45									4	13		**17**			4		19	**23**				12	1	**13**	**53**
11:45	12:00									9	9		**18**			2		8	**10**				8		**8**	**36**
12:00	12:15									4	12		**16**		*1*	1		18	**19**				15	2	**17**	**52**
TOTAL										**22**	**58**		**80**		***1***	**8**		**61**	**69**				**52**	**5**	**57**	**206**
% Légers				0.0%	0.0%	0.0%	0.0%			9.1%	6.9%	0.0%	7.5%			12.5%	0.0%	47.5%	43.5%			0.0%	5.8%	0.0%	5.3%	18.9%
% Lourds				0.0%	0.0%	0.0%	0.0%			54.5%	0.0%	0.0%	15.0%			0.0%	0.0%	32.8%	29.0%			0.0%	0.0%	######	1.8%	16.0%
PHF										**0.61**	**0.60**		**0.69**			**0.50**		**0.80**	**0.75**				**0.76**	**0.63**	**0.75**	**0.79**

PM 16:00 à 17:00 - (Ensemble des véhicules, piétons et cyclistes)

Période		Entrée privé – Approche Nord						Marie-Victorin – Approche Est						Montée Lapierre – Approche Sud						Marie-Victorin – Approche Ouest						Grand total véhicules
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
16:00	16:15									8	27		**35**			3		7	**10**				30	2	**32**	**77**
16:15	16:30									5	27		**32**			3		21	**24**				37	3	**40**	**96**
16:30	16:45	*2*								4	21		**25**			2		11	**13**				40	4	**44**	**82**
16:45	17:00									5	26		**31**			5		5	**10**				32	2	**34**	**75**
TOTAL		***2***								**22**	**101**		**123**			**13**		**44**	**57**				**139**	**11**	**150**	**330**
% Légers				0.0%	0.0%	0.0%	0.0%			9.1%	5.0%	0.0%	5.7%			0.0%	0.0%	50.0%	38.6%			0.0%	2.2%	0.0%	2.0%	9.7%
% Lourds				0.0%	0.0%	0.0%	0.0%			27.3%	0.0%	0.0%	4.9%			7.7%	0.0%	36.4%	29.8%			0.0%	0.0%	9.1%	0.7%	7.3%
PHF										**0.69**	**0.94**		**0.88**			**0.65**		**0.52**	**0.59**				**0.87**	**0.69**	**0.85**	**0.86**

Soir 0:00 à 1:00 - (Ensemble des véhicules, piétons et cyclistes)

Période		Entrée privé – Approche Nord						Marie-Victorin – Approche Est						Montée Lapierre – Approche Sud						Marie-Victorin – Approche Ouest						Grand total véhicules
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30																									
0:30	0:45																									
0:45	1:00																									
TOTAL																										
% Légers				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%	0.0%
% Lourds				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%	0.0%
PHF																										

Diagramme de compilation

0317-55-4

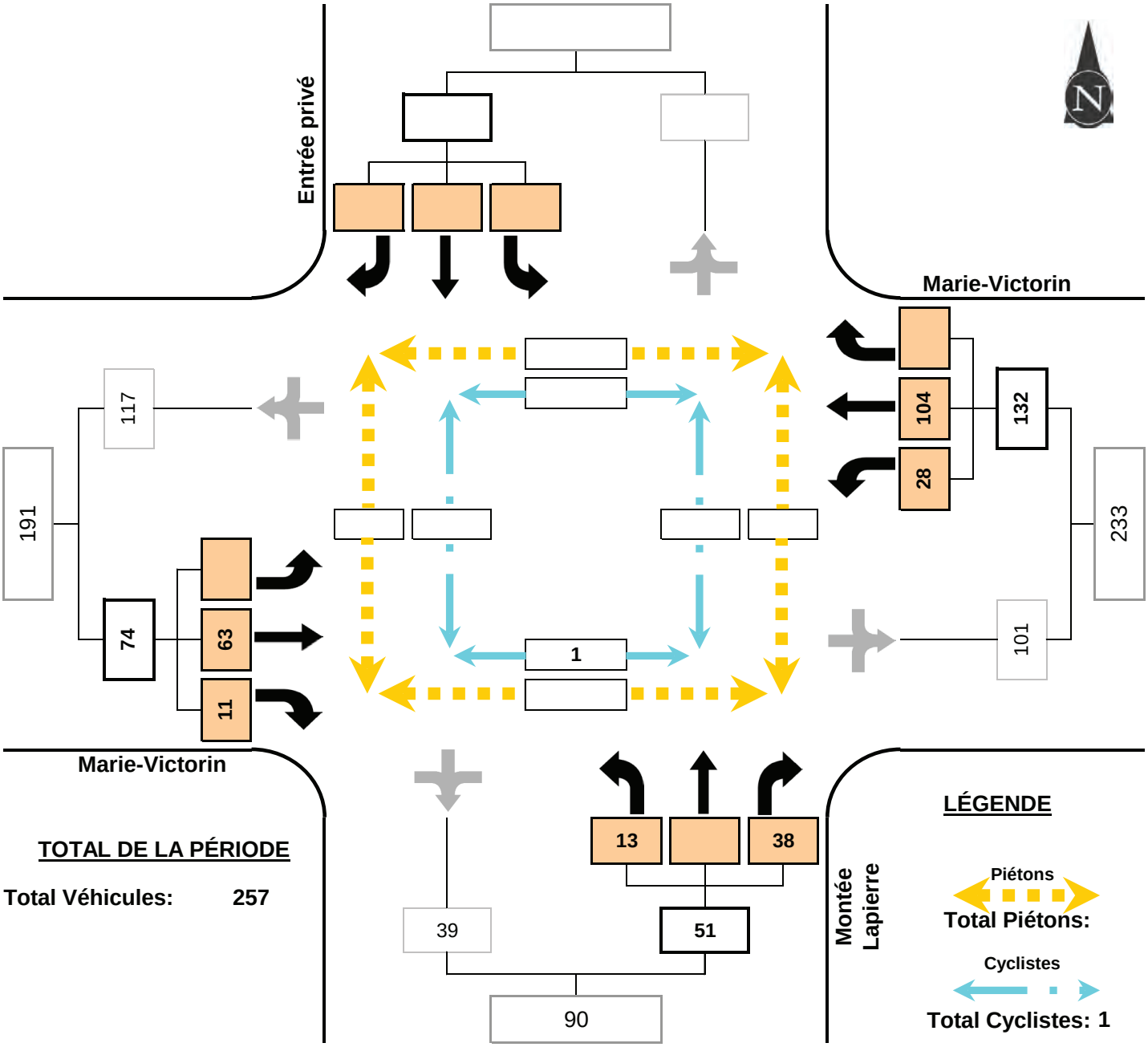
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 10 May 2017
Jour: mercredi

Intersection: Entrée privé _ Marie-Victorin

AM

Période: 7:45 à 8:45



TOTAL DE LA PÉRIODE

Total Véhicules: 257

LÉGENDE

Piétons
Total Piétons:

Cyclistes
Total Cyclistes: 1

Diagramme de compilation

0317-55-4

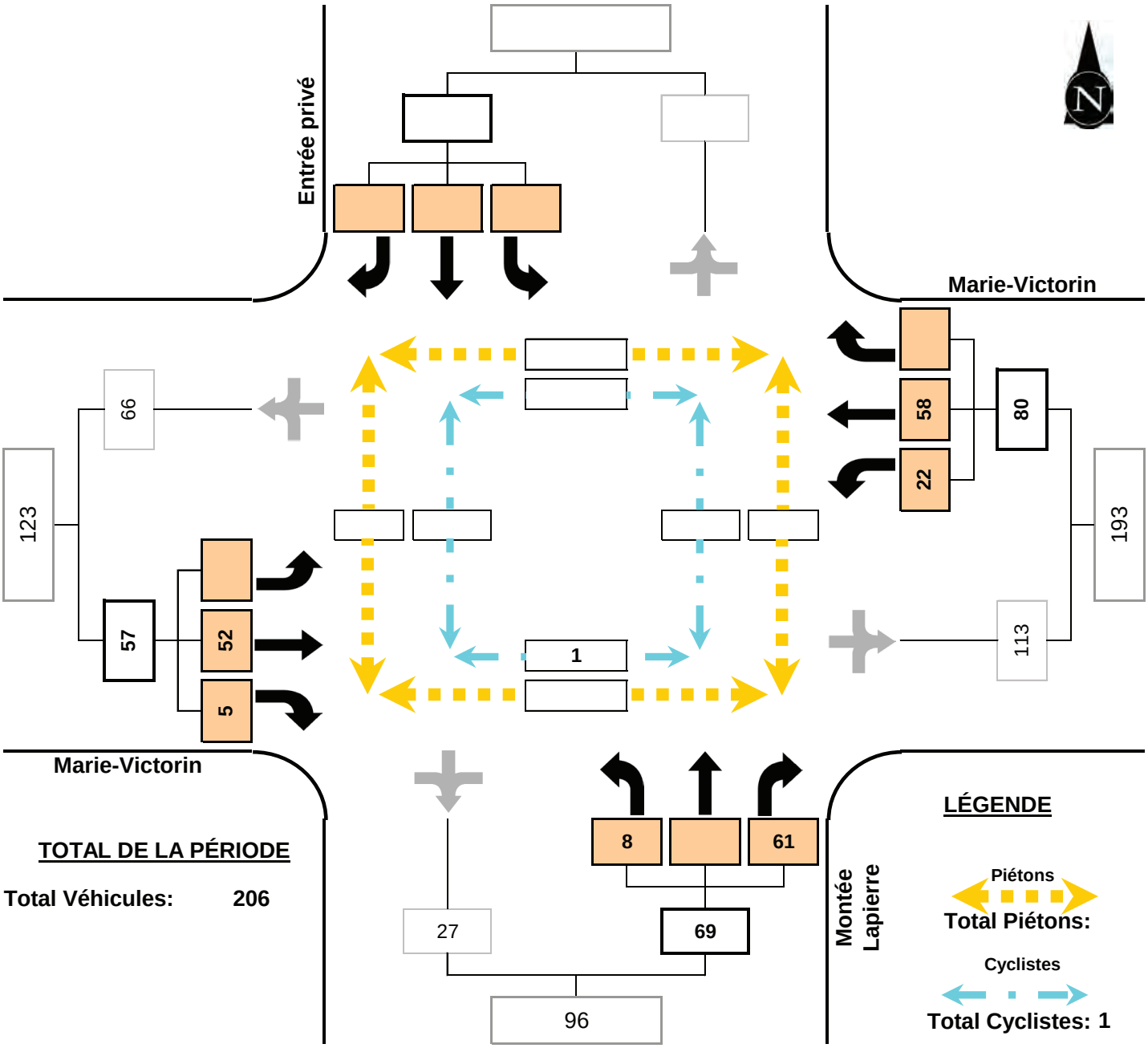
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 10 May 2017
Jour: mercredi

Intersection: Entrée privé _ Marie-Victorin

Midi

Période: 11:15 à 12:15



TOTAL DE LA PÉRIODE

Total Véhicules: 206

LÉGENDE

Piétons
Total Piétons:

Cyclistes
Total Cyclistes: 1

Diagramme de compilation

0317-55-4

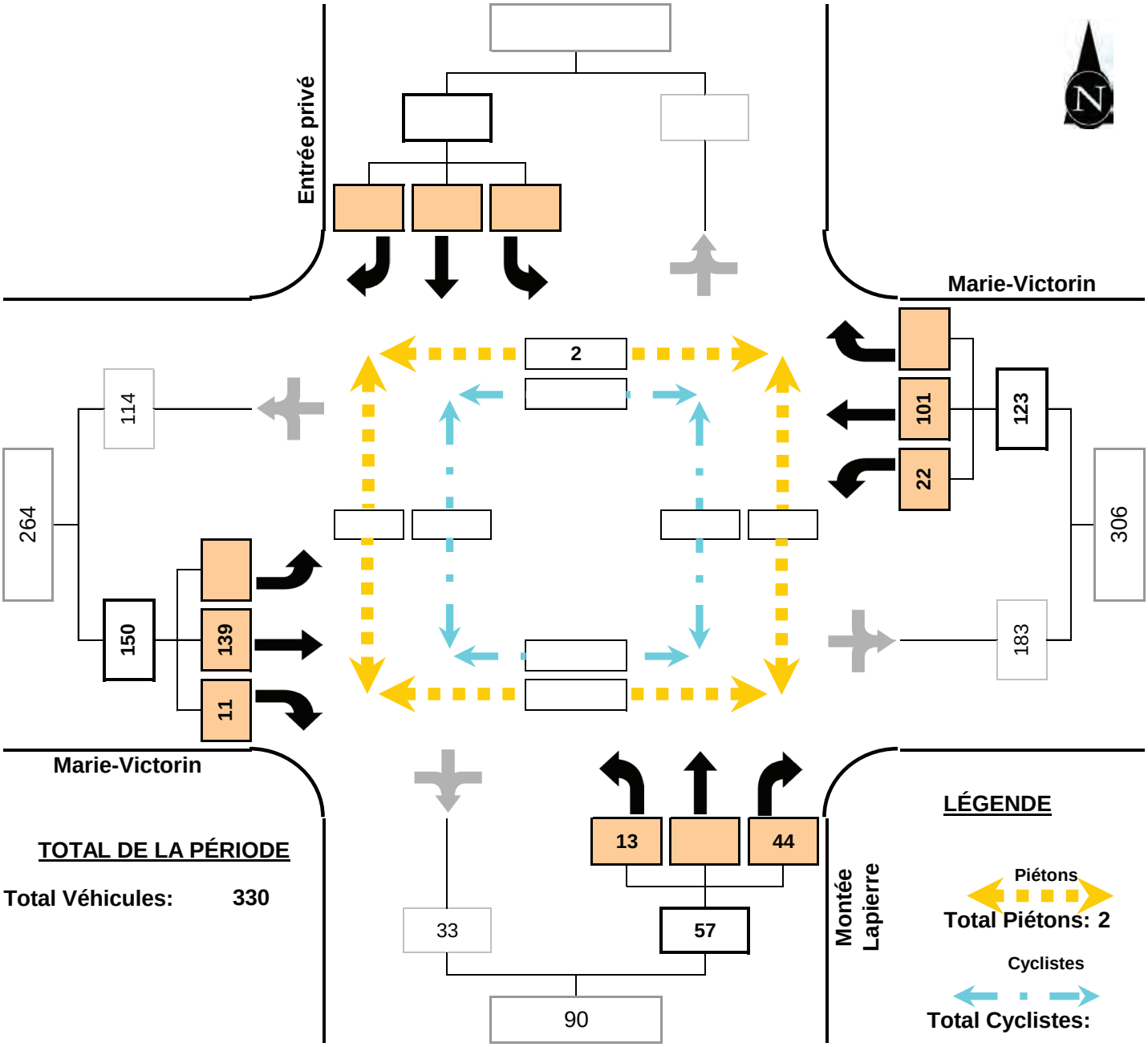
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 10 May 2017
Jour: mercredi

Intersection: Entrée privé _ Marie-Victorin

PM

Période: 16:00 à 17:00



TOTAL DE LA PÉRIODE

Total Véhicules: 330

Compilation Data Traffic

Titre: 0317-55-5

Comptage

Ville ou Arrondissement: Contrecoeur

Intersection: Mtée Lapierre _ Rte des Aciéries

Approche Nord Mtée Lapierre
Approche Est Rte des Aciéries
Approche Sud Mtée Lapierre
Approche Ouest Rte des Aciéries

Classification

Automobiles, Piétons et Cyclistes

Camions, Autobus

Articulés



Date: 9 mai 2017
Jour: mardi

Conditions climatiques: Nuageux
Température: 3°C

Période(s) de comptage	AM	Midi	PM	Soir
Début	6:00	11:00	15:00	
Fin	9:00	13:00	18:00	
Durée	3:00	2:00	3:00	

Durée du comptage 8:00

Géolocalisation:

Lien hypertexte de localisation:

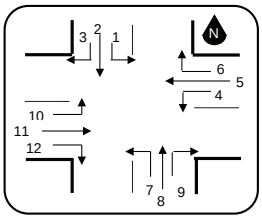
Observation:

Remarque:

Comptages

0317-55-5

Date: May 9, 2017
Jour: mardi



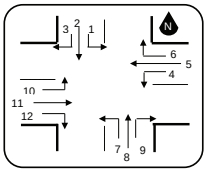
TOTAL Véhicules, Piétons et Cyclistes

Période		Mtée Lapierre						Rte des Aciéries						Mtée Lapierre						Rte des Aciéries						Grand Total
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	1:00																									
1:00	2:00																									
2:00	3:00																									
3:00	4:00																									
4:00	5:00																									
5:00	6:00																									
6:00	7:00			*14*	*7*		*21*	*1*		*1*		*18*	*19*				*24*	*38*	*62*							102
7:00	8:00			*34*	*21*	*1*	*56*			*7*	*1*	*20*	*28*			*1*	*30*	*55*	*86*				*2*	*2*	*4*	174
8:00	9:00			*23*	*7*	*1*	*31*			*2*		*7*	*9*			*1*	*24*	*28*	*53*				*1*	*2*	*3*	96
9:00	10:00																									
10:00	11:00																									
11:00	12:00			*35*	*12*		*47*			*1*		*9*	*10*				*27*	*10*	*37*				*1*		*1*	95
12:00	13:00			*13*	*13*	*2*	*28*					*16*	*16*				*23*	*10*	*33*					*1*	*1*	78
13:00	14:00																									
14:00	15:00																									
15:00	16:00			*31*	*13*	*5*	*49*			*3*	*3*	*9*	*15*				*22*	*14*	*36*			*1*		*1*	*2*	102
16:00	17:00			*27*	*15*	*1*	*43*			*4*	*1*	*6*	*11*			*1*	*19*	*13*	*33*			*1*	*1*	*1*	*3*	90
17:00	18:00		*1*	*9*	*8*		*17*			*5*		*13*	*18*		*3*	*1*	*9*	*5*	*15*			*1*	*1*		*2*	52
18:00	19:00																									
19:00	20:00																									
20:00	21:00																									
21:00	22:00																									
22:00	23:00																									
23:00	0:00																									
TOTAL		**0**	**1**	**186**	**96**	**10**	**292**	**1**	**0**	**23**	**5**	**98**	**126**	**0**	**3**	**4**	**178**	**173**	**355**	**0**	**0**	**3**	**6**	**7**	**16**	789

Comptages

0317-55-5

Date: May 9, 2017
Jour: mardi



TOTAL Véhicules, Piétons et Cyclistes

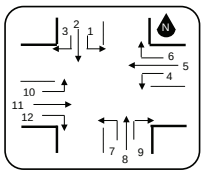
Période		Mtée Lapierre – Approche Nord						Rte des Aciéries – Approche Est						Mtée Lapierre – Approche Sud						Rte des Aciéries – Approche Ouest						Grand Total
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30																									
0:30	0:45																									
0:45	1:00																									
1:00	1:15																									
1:15	1:30																									
1:30	1:45																									
1:45	2:00																									
2:00	2:15																									
2:15	2:30																									
2:30	2:45																									
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3:30	3:45																									
3:45	4:00																									
4:00	4:15																									
4:15	4:30																									
4:30	4:45																									
4:45	5:00																									
5:00	5:15																									
5:15	5:30																									
5:30	5:45																									
5:45	6:00																									
6:00	6:15			4			**4**					3	**3**				4	5	**9**							16
6:15	6:30				2		**2**					5	**5**				5	9	**14**							21
6:30	6:45			6	4		**10**	*1*		1		5	**6**				8	11	**19**							35
6:45	7:00			4	1		**5**					5	**5**				7	13	**20**							30
7:00	7:15			6	5		**11**					6	**6**				6	15	**21**				2	1	**3**	41
7:15	7:30			13	6		**19**			2		7	**9**				6	16	**22**							50
7:30	7:45			8	6	1	**15**			1		2	**3**			1	12	10	**23**							41
7:45	8:00			7	4		**11**			4	1	5	**10**				6	14	**20**					1	**1**	42
8:00	8:15			7			**7**										6	12	**18**					2	**2**	27
8:15	8:30			6	3	1	**10**			1		1	**2**			1	6	5	**12**				1		**1**	25
8:30	8:45			6	1		**7**			1		6	**7**				6	3	**9**							23
8:45	9:00			4	3		**7**										6	8	**14**							21
9:00	9:15																									
9:15	9:30																									
9:30	9:45																									
9:45	10:00																									
10:00	10:15																									
10:15	10:30																									
10:30	10:45																									
10:45	11:00																									
11:00	11:15			10	5		**15**					4	**4**				10	2	**12**							31
11:15	11:30			9	3		**12**					1	**1**				5	2	**7**							20
11:30	11:45			3	4		**7**			1		3	**4**				6	6	**12**							23
11:45	12:00			13			**13**					1	**1**				6		**6**				1		**1**	21
12:00	12:15			5	1		**6**					7	**7**				5	4	**9**					1	**1**	23
12:15	12:30			3	5		**8**					4	**4**				5	3	**8**							20
12:30	12:45			2	4		**6**					3	**3**				5		**5**							14
12:45	13:00			3	3	2	**8**					2	**2**				8	3	**11**							21
13:00	13:15																									
13:15	13:30																									
13:30	13:45																									
13:45	14:00																									
14:00	14:15																									
14:15	14:30																									
14:30	14:45																									
14:45	15:00																									
15:00	15:15			9	3		**12**				1	1	**2**				5	1	**6**					1	**1**	21
15:15	15:30			5	3	1	**9**			1	1	2	**4**				5	2	**7**							20
15:30	15:45			5	4		**9**			1	1	2	**4**				4	4	**8**			1			**1**	22
15:45	16:00			12	3	4	**19**			1		4	**5**				8	7	**15**							39
16:00	16:15			12	5	1	**18**					3	**3**				3	4	**7**							28
16:15	16:30			8	6		**14**			3			**3**				2	2	**4**							21
16:30	16:45			4	2		**6**				1	2	**3**			1	7	3	**11**					1	**1**	21
16:45	17:00			3	2		**5**			1		1	**2**				7	4	**11**			1	1		**2**	20
17:00	17:15			4	1		**5**			1		3	**4**		*1*		5	3	**8**							17
17:15	17:30		*1*							2		1	**3**				2		**2**				1		**1**	6
17:30	17:45			4	4		**8**			2		4	**6**					1	**1**			1			**1**	16
17:45	18:00			1	3		**4**					5	**5**		*2*	1	2	1	**4**							13
18:00	18:15																									
18:15	18:30																									
18:30	18:45																									
18:45	19:00																									
19:00	19:15																									
19:15	19:30																									
19:30	19:45																									
19:45	20:00																									
20:00	20:15																									
20:15	20:30																									
20:30	20:45																									
20:45	21:00																									
21:00	21:15																									
21:15	21:30																									
21:30	21:45																									
21:45	22:00																									
22:00	22:15																									
22:15	22:30																									
22:30	22:45																									
22:45	23:00																									
23:00	23:15																									
23:15	23:30																									
23:30	23:45																									
23:45	0:00																									
TOTAL		***0***	***1***	**186**	**96**	**10**	**292**	***1***	***0***	**23**	**5**	**98**	**126**	***0***	***3***	**4**	**178**	**173**	**355**	***0***	***0***	**3**	**6**	**7**	**16**	789

Comptages

0317-55-5

Date: May 9, 2017
Jour: mardi





Automobiles, Piétons et Cyclistes

Période		Mtée Lapierre – Approche Nord						Rte des Aciéries – Approche Est						Mtée Lapierre – Approche Sud						Rte des Aciéries – Approche Ouest						Grand total
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Autos
de	à			1	2	3				4	5	6				7	8	9				10	11	12		
0:00	0:15																									
0:15	0:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
0:30	0:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
0:45	1:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:00	1:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:15	1:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:30	1:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:45	2:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
2:00	2:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
2:15	2:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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2:45	3:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
3:00	3:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
3:15	3:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
3:30	3:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
3:45	4:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
4:00	4:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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4:45	5:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
5:00	5:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
5:15	5:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
5:30	5:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
5:45	6:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
6:00	6:15			1			1					3	3				2	5	7							11
6:15	6:30				1		1					3	3				4	9	13							17
6:30	6:45			2	2		4	1		1		4	5				7	11	18							27
6:45	7:00			3	1		4					5	5				6	13	19							28
7:00	7:15			6	5		11					2	2				3	14	17				2	1	3	33
7:15	7:30			11	3		14			2			2				2	15	17							33
7:30	7:45			6		1	7			1		2	3				6	8	14							24
7:45	8:00			1	3		4			4	1	5	10				5	12	17					1	1	32
8:00	8:15			6			6										4	8	12					1	1	19
8:15	8:30				3	1	4			1		1	2			1	4	5	10				1		1	17
8:30	8:45			2	1		3			1		2	3				1	3	4							10
8:45	9:00			2	1		3										1	7	8							11
9:00	9:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
9:15	9:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
9:30	9:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
9:45	10:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
10:00	10:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
10:15	10:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
10:30	10:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
10:45	11:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
11:00	11:15			6	2		8					2	2				5	1	6							16
11:15	11:30			3	3		6											2	2							8
11:30	11:45			1	1		2					2	2				1	3	4							8
11:45	12:00			4			4										3		3				1		1	8
12:00	12:15			1	1		2											4	4							6
12:15	12:30			1	1		2					1	1					2	2							5
12:30	12:45											1	1				2		2							3
12:45	13:00				1	2	3					1	1				1	2	3							7
13:00	13:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
13:15	13:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
13:30	13:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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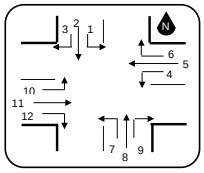
Comptages

Date: May 9, 2017
Jour: mardi

0317-55-5




Camions, Autobus

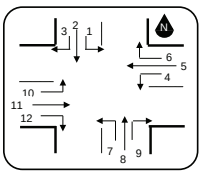


Période		Mtée Lapierre						Rte des Aciéries						Mtée Lapierre						Rte des Aciéries						Grand
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		'	'	Gauche	Tout Droit	Droite	Total	'	'	Gauche	Tout Droit	Droite	Total	'	'	Gauche	Tout Droit	Droite	Total	'	'	Gauche	Tout Droit	Droite	Total	total
				1	2	3				4	5	6				7	8	9				10	11	12		Légers
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30			0	0	0				0	0	0				0	0	0				0	0	0		
0:30	0:45			0	0	0				0	0	0				0	0	0				0	0	0		
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1:15	1:30			0	0	0				0	0	0				0	0	0				0	0	0		
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TOTAL		*0*	*0*	15	4	2	21	*0*	*0*	1	0	6	7	*0*	*0*	1	7	4	12	*0*	*0*	0	0	0	0	40

Comptages

0317-55-5

Date: May 9, 2017
Jour: mardi



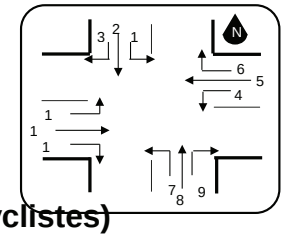
Articulés

Période		Mtée Lapierre						Rte des Aciéries						Mtée Lapierre						Rte des Aciéries						Grand
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Virage en U		Gauche	Tout Droit	Droite	Total	Virage en U		Gauche	Tout Droit	Droite	Total	Virage en U		Gauche	Tout Droit	Droite	Total	Virage en U		Gauche	Tout Droit	Droite	Total	total
				1	2	3				4	5	6				7	8	9				10	11	12		Lourds
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
0:30	0:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
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6:15	6:30											2	**2**				1		**1**							3
6:30	6:45			4	2		**6**					1	**1**				1		**1**							8
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7:15	7:30			2	3		**5**					7	**7**				4	1	**5**							17
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8:15	8:30			5			**5**										2		**2**							7
8:30	8:45			4			**4**					2	**2**				5		**5**							11
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10:30	10:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:45	11:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
11:00	11:15			2	2		**4**					2	**2**				5	1	**6**							12
11:15	11:30			5			**5**										5		**5**							10
11:30	11:45			2	3		**5**										5	2	**7**							12
11:45	12:00			9			**9**					1	**1**				3		**3**							13
12:00	12:15			4			**4**					7	**7**				5		**5**					1	**1**	17
12:15	12:30			2	4		**6**					3	**3**				4	1	**5**							14
12:30	12:45			1	3		**4**					2	**2**				3		**3**							9
12:45	13:00			2	2		**4**					1	**1**				7	1	**8**							13
13:00	13:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:15	13:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:30	13:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:45	14:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:00	14:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:15	14:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:30	14:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:45	15:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
15:00	15:15			6			**6**					1	**1**				3		**3**							10
15:15	15:30			1	1		**2**				1	1	**2**				3		**3**							7
15:30	15:45			2	2		**4**					1	**1**				3	1	**4**							9
15:45	16:00			5			**5**					1	**1**				2	1	**3**							9
16:00	16:15			3			**3**										1	1	**2**							5
16:15	16:30			4	1		**5**										1		**1**							6
16:30	16:45			2			**2**				1		**1**				3	1	**4**							7
16:45	17:00																4		**4**							4
17:00	17:15																									
17:15	17:30																2		**2**							2
17:30	17:45			1			**1**																			1
17:45	18:00																1		**1**							1
18:00	18:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:15	18:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:30	18:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:45	19:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:00	19:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:15	19:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:30	19:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:45	20:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:00	20:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:15	20:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:30	20:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:45	21:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:00	21:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:15	21:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:30	21:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:45	22:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:00	22:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:15	22:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:30	22:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:45	23:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:00	23:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:15	23:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:30	23:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:45	0:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
TOTAL		**0**	**0**	**77**	**31**	**0**	**108**	**0**	**0**	**0**	**2**	**36**	**38**	**0**	**0**	**0**	**92**	**19**	**111**	**0**	**0**	**0**	**0**	**2**	**2**	259

Compilation des heures de pointes

0317-55-5

Date: May 9, 2017
Jour: mardi



Heure de pointe du réseau

AM 7:00 à 8:00 - (Ensemble des véhicules, piétons et cyclistes)

Période		Mtée Lapierre						Rte des Aciéries						Mtée Lapierre						Rte des Aciéries						Grand total véhicules
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
7:00	7:15			6	5		11					6	6				6	15	21				2	1	3	41
7:15	7:30			13	6		19			2		7	9				6	16	22							50
7:30	7:45			8	6	1	15			1		2	3			1	12	10	23							41
7:45	8:00			7	4		11			4	1	5	10				6	14	20					1	1	42
TOTAL				**34**	**21**	**1**	**56**			**7**	**1**	**20**	**28**			**1**	**30**	**55**	**86**				**2**	**2**	**4**	**174**
% Légers				5.9%	0.0%	0.0%	3.6%			0.0%	0.0%	0.0%	0.0%			#####	3.3%	1.8%	3.5%			0.0%	0.0%	0.0%	0.0%	2.9%
% Lourds				23.5%	47.6%	0.0%	32.1%			0.0%	0.0%	55.0%	39.3%			0.0%	43.3%	9.1%	20.9%			0.0%	0.0%	######	0.0%	27.0%
PHF				**0.65**	**0.88**	**0.25**	**0.74**			**0.44**	**0.25**	**0.71**	**0.70**			**0.25**	**0.63**	**0.86**	**0.93**				**0.25**	**0.50**	**0.33**	**0.87**

Midi 11:00 à 12:00 - (Ensemble des véhicules, piétons et cyclistes)

Période		Mtée Lapierre						Rte des Aciéries						Mtée Lapierre						Rte des Aciéries						Grand total véhicules
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
11:00	11:15			10	5		15					4	4				10	2	12							31
11:15	11:30			9	3		12					1	1				5	2	7							20
11:30	11:45			3	4		7			1		3	4				6	6	12							23
11:45	12:00			13			13					1	1				6		6				1		1	21
TOTAL				**35**	**12**		**47**			**1**		**9**	**10**				**27**	**10**	**37**				**1**		**1**	**95**
% Légers				8.6%	8.3%	0.0%	8.5%			#####	0.0%	22.2%	30.0%			0.0%	0.0%	10.0%	2.7%			0.0%	0.0%	0.0%	0.0%	8.4%
% Lourds				51.4%	41.7%	0.0%	48.9%			0.0%	0.0%	33.3%	30.0%			0.0%	66.7%	30.0%	56.8%			0.0%	0.0%	0.0%	0.0%	49.5%
PHF				**0.67**	**0.60**		**0.78**			**0.25**		**0.56**	**0.63**				**0.68**	**0.42**	**0.77**				**0.25**		**0.25**	**0.77**

PM 15:30 à 16:30 - (Ensemble des véhicules, piétons et cyclistes)

Période		Mtée Lapierre						Rte des Aciéries						Mtée Lapierre						Rte des Aciéries						Grand total véhicules
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
15:30	15:45			5	4		9			1	1	2	4				4	4	8			1			1	22
15:45	16:00			12	3	4	19			1		4	5				8	7	15							39
16:00	16:15			12	5	1	18					3	3				3	4	7							28
16:15	16:30			8	6		14			3			3				2	2	4							21
TOTAL				**37**	**18**	**5**	**60**			**5**	**1**	**9**	**15**				**17**	**17**	**34**			**1**			**1**	**110**
% Légers				2.7%	0.0%	40.0%	5.0%			0.0%	0.0%	22.2%	13.3%			0.0%	0.0%	11.8%	5.9%			0.0%	0.0%	0.0%	0.0%	6.4%
% Lourds				37.8%	16.7%	0.0%	28.3%			0.0%	0.0%	22.2%	13.3%			0.0%	41.2%	17.6%	29.4%			0.0%	0.0%	0.0%	0.0%	26.4%
PHF				**0.77**	**0.75**	**0.31**	**0.79**			**0.42**	**0.25**	**0.56**	**0.75**				**0.53**	**0.61**	**0.57**			**0.25**			**0.25**	**0.71**

Soir 0:00 à 1:00 - (Ensemble des véhicules, piétons et cyclistes)

Période		Mtée Lapierre						Rte des Aciéries						Mtée Lapierre						Rte des Aciéries						Grand total véhicules
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30																									
0:30	0:45																									
0:45	1:00																									
TOTAL																										
% Légers				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%	0.0%
% Lourds				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%	0.0%
PHF																										

Diagramme de compilation

0317-55-5

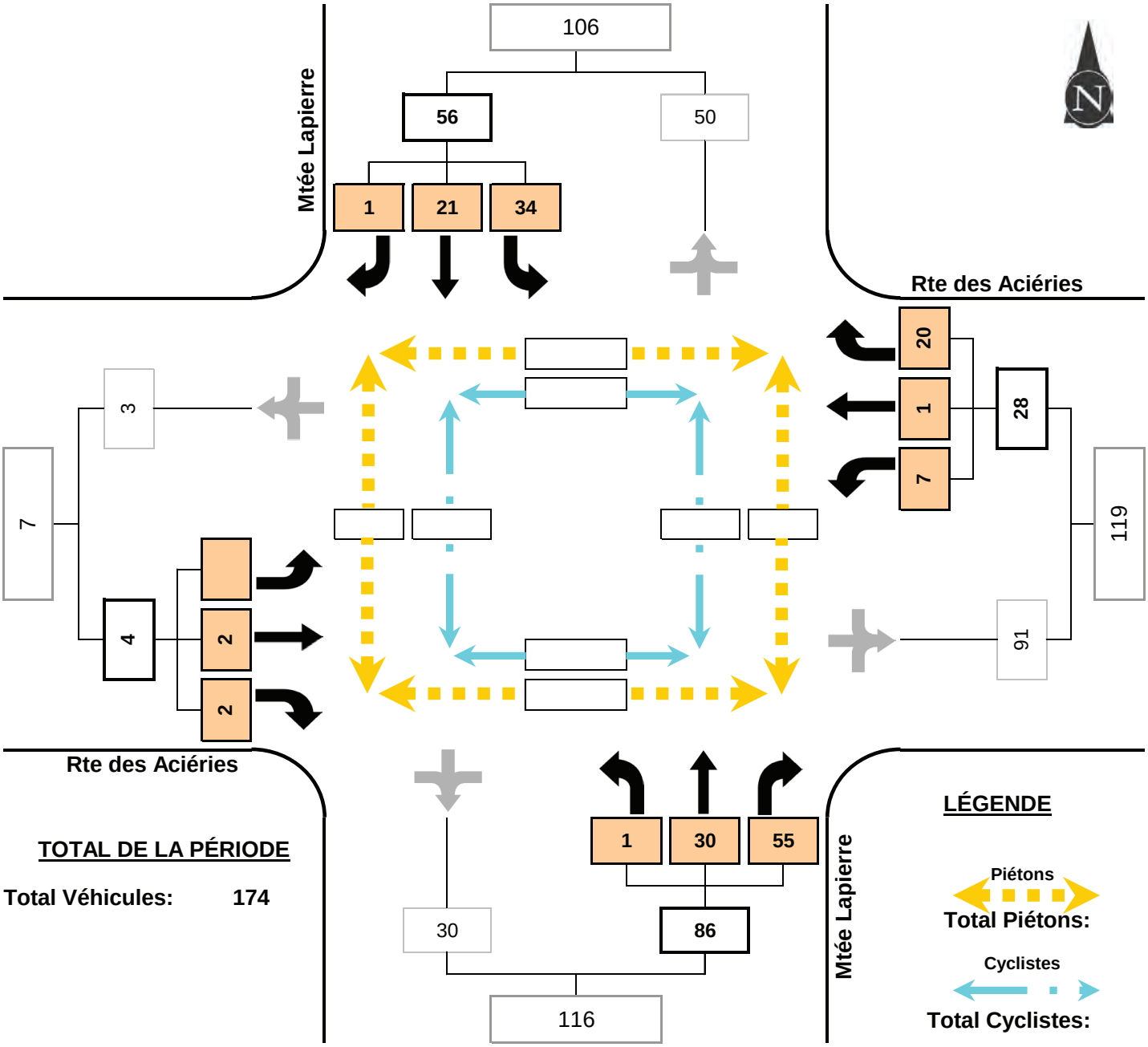
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 9 May 2017
Jour: mardi

Intersection: Mtée Lapierre _ Rte des Aciéries

AM

Période: 7:00 à 8:00



TOTAL DE LA PÉRIODE

Total Véhicules: 174

Diagramme de compilation

0317-55-5

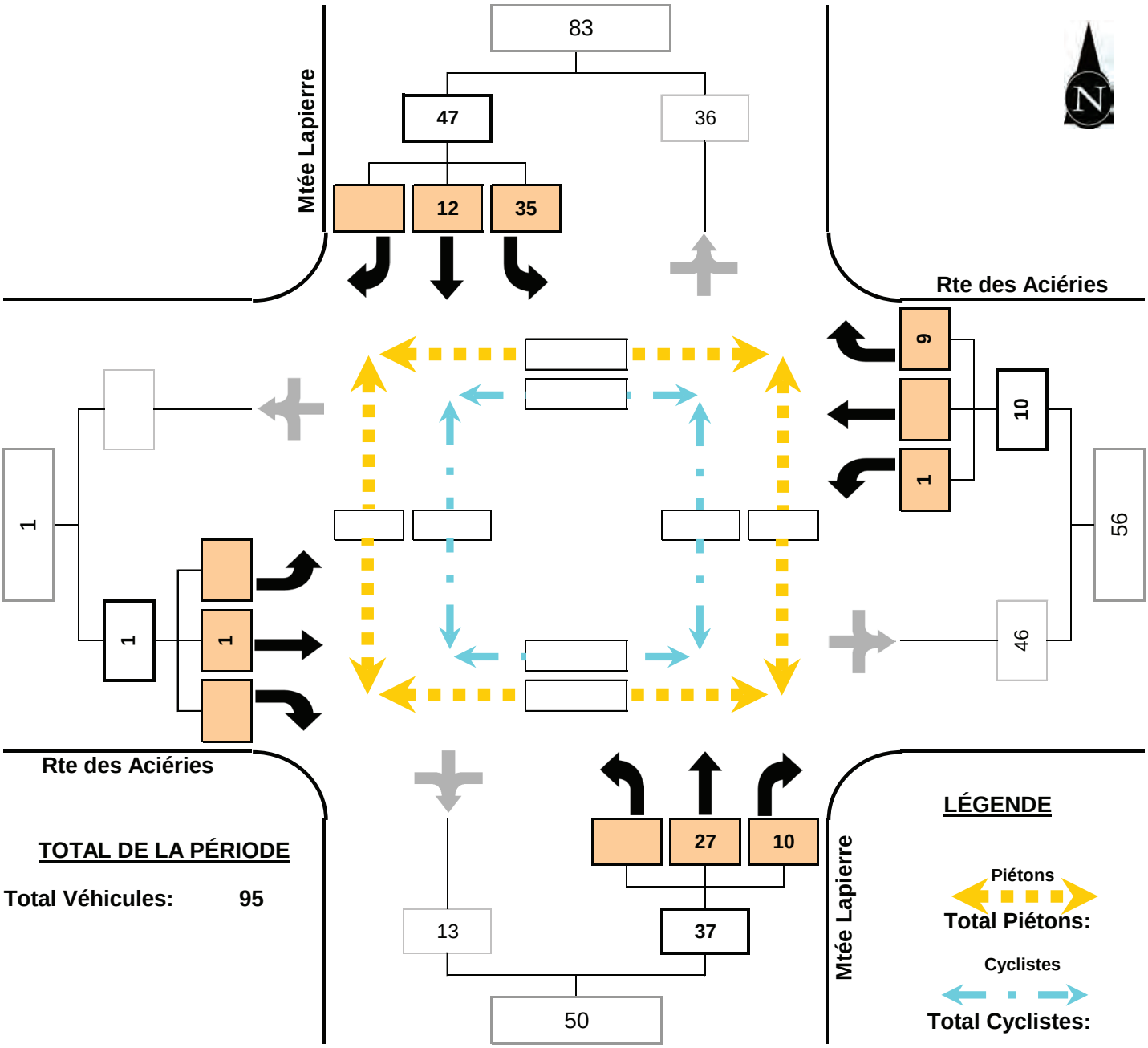
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 9 May 2017
Jour: mardi

Intersection: Mtée Lapierre _ Rte des Aciéries

Midi

Période: 11:00 à 12:00



TOTAL DE LA PÉRIODE

Total Véhicules: 95

Diagramme de compilation

0317-55-5

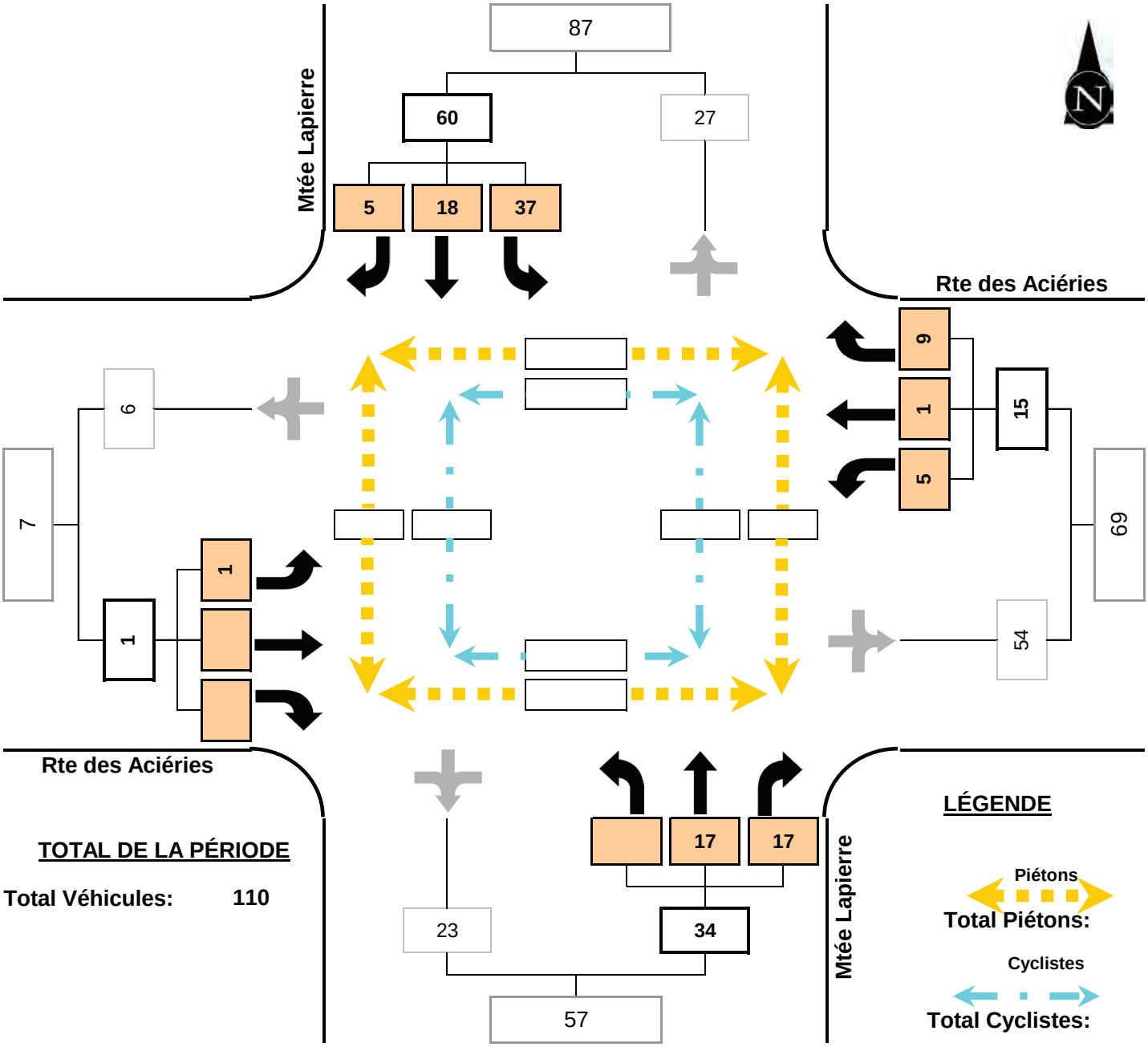
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 9 May 2017
Jour: mardi

Intersection: Mtée Lapierre _ Rte des Aciéries

PM

Période: 15:30 à 16:30



TOTAL DE LA PÉRIODE

Total Véhicules: 110

Compilation Data Traffic

Titre: 0317-55-6

Comptage

Ville ou Arrondissement: Contrecoeur

Intersection: N/A _ Rte des Aciéries

Approche Nord	N/A
Approche Est	Rte des Aciéries
Approche Sud	Entrée/Sortie A-30 Ouest
Approche Ouest	Rte des Aciéries

Classification

Automobiles, Piétons et Cyclistes

Camions, Autobus

Articulés



Date: 9 mai 2017
Jour: mardi

Conditions climatiques: Nuageux
Température: 3°C

Période(s) de comptage	AM	Midi	PM	Soir
Début	6:00	11:00	15:00	
Fin	9:00	13:00	18:00	
Durée	3:00	2:00	3:00	

Durée du comptage 8:00

Géolocalisation:

Lien hypertexte de localisation:

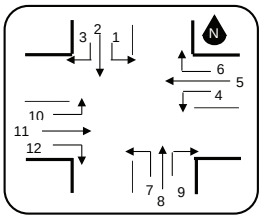
Observation:

Remarque:

Comptages

0317-55-6

Date: May 9, 2017
Jour: mardi



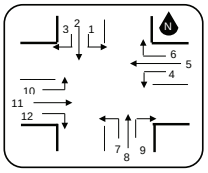
TOTAL Véhicules, Piétons et Cyclistes

Période		N/A						Rte des Aciéries						Entrée/Sortie A-30 Ouest						Rte des Aciéries						Grand Total
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	1:00																									
1:00	2:00																									
2:00	3:00																									
3:00	4:00																									
4:00	5:00																									
5:00	6:00																									
6:00	7:00									*1*			*1*			*20*		*1*	*21*				*29*	*23*	*52*	74
7:00	8:00									*12*	*7*		*19*			*20*		*1*	*21*				*57*	*33*	*90*	130
8:00	9:00										*1*		*1*			*8*		*2*	*10*				*26*	*26*	*52*	63
9:00	10:00																									
10:00	11:00																									
11:00	12:00									*7*	*5*		*12*			*5*			*5*				*9*	*37*	*46*	63
12:00	13:00									*10*	*2*		*12*			*14*			*14*				*2*	*19*	*21*	47
13:00	14:00																									
14:00	15:00																									
15:00	16:00									*29*	*8*		*37*			*7*			*7*				*8*	*37*	*45*	89
16:00	17:00									*17*	*7*		*24*			*4*		*1*	*5*				*6*	*35*	*41*	70
17:00	18:00									*13*	*6*		*19*		*3*	*14*			*14*				*4*	*11*	*15*	48
18:00	19:00																									
19:00	20:00																									
20:00	21:00																									
21:00	22:00																									
22:00	23:00																									
23:00	0:00																									
TOTAL		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**89**	**36**	**0**	**125**	**0**	**3**	**92**	**0**	**5**	**97**	**0**	**0**	**0**	**141**	**221**	**362**	584

Comptages

0317-55-6

Date: May 9, 2017
Jour: mardi



TOTAL Véhicules, Piétons et Cyclistes

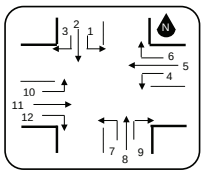
Période		N/A						Rte des Aciéries						Entrée/Sortie A-30 Ouest						Rte des Aciéries						Grand Total
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→																				
0:00	0:15																									
0:15	0:30																									
0:30	0:45																									
0:45	1:00																									
1:00	1:15																									
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3:15	3:30																									
3:30	3:45																									
3:45	4:00																									
4:00	4:15																									
4:15	4:30																									
4:30	4:45																									
4:45	5:00																									
5:00	5:15																									
5:15	5:30																									
5:30	5:45																									
5:45	6:00																									
6:00	6:15									1			**1**			3			**3**				3	7	**10**	14
6:15	6:30															5			**5**				5	4	**9**	14
6:30	6:45															7		1	**8**				12	6	**18**	26
6:45	7:00															5			**5**				9	6	**15**	20
7:00	7:15									3			**3**			6		1	**7**				17	7	**24**	34
7:15	7:30									1	1		**2**			7			**7**				18	11	**29**	38
7:30	7:45															3			**3**				9	7	**16**	19
7:45	8:00									8	6		**14**			4			**4**				13	8	**21**	39
8:00	8:15																						14	5	**19**	19
8:15	8:30															2		2	**4**				3	9	**12**	16
8:30	8:45										1		**1**			6			**6**				2	7	**9**	16
8:45	9:00																						7	5	**12**	12
9:00	9:15																									
9:15	9:30																									
9:30	9:45																									
9:45	10:00																									
10:00	10:15																									
10:15	10:30																									
10:30	10:45																									
10:45	11:00																									
11:00	11:15									2	3		**5**			1			**1**				2	11	**13**	19
11:15	11:30									4			**4**			1			**1**				1	10	**11**	16
11:30	11:45										1		**1**			3			**3**				4	5	**9**	13
11:45	12:00									1	1		**2**										2	11	**13**	15
12:00	12:15									1			**1**			7			**7**					8	**8**	16
12:15	12:30									5			**5**			4			**4**				1	5	**6**	15
12:30	12:45									3			**3**			3			**3**					2	**2**	8
12:45	13:00									1	2		**3**										1	4	**5**	8
13:00	13:15																									
13:15	13:30																									
13:30	13:45																									
13:45	14:00																									
14:00	14:15																									
14:15	14:30																									
14:30	14:45																									
14:45	15:00																									
15:00	15:15									9	3		**12**										1	10	**11**	23
15:15	15:30									3	1		**4**			2			**2**				1	6	**7**	13
15:30	15:45									10	3		**13**			2			**2**				2	7	**9**	24
15:45	16:00									7	1		**8**			3			**3**				4	14	**18**	29
16:00	16:15									5	3		**8**										1	15	**16**	24
16:15	16:30									2	1		**3**			2		1	**3**				1	9	**10**	16
16:30	16:45									8	2		**10**			1			**1**				1	6	**7**	18
16:45	17:00									2	1		**3**			1			**1**				3	5	**8**	12
17:00	17:15									5	1		**6**		*1*	3			**3**				2	5	**7**	16
17:15	17:30									5	2		**7**			2			**2**					1	**1**	10
17:30	17:45									3	2		**5**			5			**5**				1	4	**5**	15
17:45	18:00										1		**1**		*2*	4			**4**				1	1	**2**	7
18:00	18:15																									
18:15	18:30																									
18:30	18:45																									
18:45	19:00																									
19:00	19:15																									
19:15	19:30																									
19:30	19:45																									
19:45	20:00																									
20:00	20:15																									
20:15	20:30																									
20:30	20:45																									
20:45	21:00																									
21:00	21:15																									
21:15	21:30																									
21:30	21:45																									
21:45	22:00																									
22:00	22:15																									
22:15	22:30																									
22:30	22:45																									
22:45	23:00																									
23:00	23:15																									
23:15	23:30																									
23:30	23:45																									
23:45	0:00																									
TOTAL		*0*	*0*	**0**	**0**	**0**	**0**	*0*	*0*	**89**	**36**	**0**	**125**	*0*	*3*	**92**	**0**	**5**	**97**	*0*	*0*	**0**	**141**	**221**	**362**	584

Comptages

0317-55-6

Date: May 9, 2017
Jour: mardi





Automobiles, Piétons et Cyclistes

Période		N/A						Rte des Aciéries						Entrée/Sortie A-30 Ouest						Rte des Aciéries						Grand total Autos
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
0:30	0:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
0:45	1:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:00	1:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:15	1:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:30	1:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:45	2:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
2:00	2:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
2:15	2:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
2:30	2:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
2:45	3:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
3:00	3:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
3:15	3:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
3:30	3:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
3:45	4:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
4:00	4:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
4:15	4:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
4:30	4:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
4:45	5:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
5:00	5:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
5:15	5:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
5:30	5:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
5:45	6:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
6:00	6:15									1			1			3			3				3	3	6	10
6:15	6:30															3			3				5	4	9	12
6:30	6:45															6		1	7				11	2	13	20
6:45	7:00															5			5				9	5	14	19
7:00	7:15									3			3			2		1	3				16	7	23	29
7:15	7:30									1	1		2			1			1				16	10	26	29
7:30	7:45															3			3				7	5	12	15
7:45	8:00									8	6		14			4			4				11	3	14	32
8:00	8:15																						10	4	14	14
8:15	8:30															2		1	3				2	4	6	9
8:30	8:45															3			3				2	3	5	8
8:45	9:00																						5	4	9	9
9:00	9:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
9:15	9:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
9:30	9:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
9:45	10:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
10:00	10:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
10:15	10:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
10:30	10:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
10:45	11:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
11:00	11:15										2		2										1	6	7	9
11:15	11:30									4			4											5	5	9
11:30	11:45										1		1			1			1				1	3	4	6
11:45	12:00									1			1										1	4	5	6
12:00	12:15																							4	4	4
12:15	12:30									1			1			1			1					3	3	5
12:30	12:45									1			1			1			1							2
12:45	13:00										1		1											1	1	2
13:00	13:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
13:15	13:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
13:30	13:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
13:45	14:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
14:00	14:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
14:15	14:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
14:30	14:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
14:45	15:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
15:00	15:15									8	2		10										1	4	5	15
15:15	15:30									1			1			1			1				1	3	4	6
15:30	15:45									10	3		13										1	4	5	18
15:45	16:00									6	1		7			2			2				3	8	11	20
16:00	16:15									5	2		7											12	12	19
16:15	16:30									2	1		3			2		1	3				1	5	6	12
16:30	16:45									8	1		9			1			1					4	4	14
16:45	17:00									1	1		2			1			1				3	5	8	11
17:00	17:15									3	1		4		1	3			3				1	5	6	13
17:15	17:30									4	2		6			2			2					1	1	9
17:30	17:45									3	2		5			5			5				1	3	4	14
17:45	18:00										1		1		2	4			4				1		1	6
18:00	18:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
18:15	18:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
18:30	18:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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19:00	19:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
19:15	19:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
19:30	19:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
19:45	20:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
20:00	20:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
20:15	20:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
20:30	20:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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21:00	21:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
21:15	21:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
21:30	21:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
21:45	22:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
22:00	22:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
22:15	22:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
22:30	22:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
22:45	23:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
23:00	23:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
23:15	23:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
23:30	23:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
23:45	0:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
TOTAL		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**71**	**28**	**0**	**99**	**0**	**3**	**56**	**0**	**4**	**60**	**0**	**0**	**0**	**113**	**134**	**247**	406

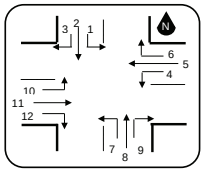
Comptages

Date: May 9, 2017
Jour: mardi

0317-55-6



Camions, Autobus

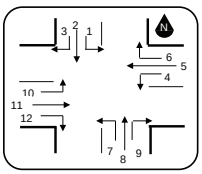


Période		N/A						Rte des Aciéries						Entrée/Sortie A-30 Ouest						Rte des Aciéries						Grand
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		'	'	Gauche	Tout Droit	Droite	Total	'	'	Gauche	Tout Droit	Droite	Total	'	'	Gauche	Tout Droit	Droite	Total	'	'	Gauche	Tout Droit	Droite	Total	total
				1	2	3				4	5	6				7	8	9				10	11	12		Légers
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30			0	0	0				0	0	0				0	0	0				0	0	0		
0:30	0:45			0	0	0				0	0	0				0	0	0				0	0	0		
0:45	1:00			0	0	0				0	0	0				0	0	0				0	0	0		
1:00	1:15			0	0	0				0	0	0				0	0	0				0	0	0		
1:15	1:30			0	0	0				0	0	0				0	0	0				0	0	0		
1:30	1:45			0	0	0				0	0	0				0	0	0				0	0	0		
1:45	2:00			0	0	0				0	0	0				0	0	0				0	0	0		
2:00	2:15			0	0	0				0	0	0				0	0	0				0	0	0		
2:15	2:30			0	0	0				0	0	0				0	0	0				0	0	0		
2:30	2:45			0	0	0				0	0	0				0	0	0				0	0	0		
2:45	3:00			0	0	0				0	0	0				0	0	0				0	0	0		
3:00	3:15			0	0	0				0	0	0				0	0	0				0	0	0		
3:15	3:30			0	0	0				0	0	0				0	0	0				0	0	0		
3:30	3:45			0	0	0				0	0	0				0	0	0				0	0	0		
3:45	4:00			0	0	0				0	0	0				0	0	0				0	0	0		
4:00	4:15			0	0	0				0	0	0				0	0	0				0	0	0		
4:15	4:30			0	0	0				0	0	0				0	0	0				0	0	0		
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4:45	5:00			0	0	0				0	0	0				0	0	0				0	0	0		
5:00	5:15			0	0	0				0	0	0				0	0	0				0	0	0		
5:15	5:30			0	0	0				0	0	0				0	0	0				0	0	0		
5:30	5:45			0	0	0				0	0	0				0	0	0				0	0	0		
5:45	6:00			0	0	0				0	0	0				0	0	0				0	0	0		
6:00	6:15																									
6:15	6:30																									
6:30	6:45																									
6:45	7:00																									
7:00	7:15																									
7:15	7:30																									
7:30	7:45																					1		**1**	1	
7:45	8:00																					1	1	**2**	2	
8:00	8:15																									
8:15	8:30																					1		**1**	1	
8:30	8:45										1		**1**			1			**1**						2	
8:45	9:00																						1	1	**2**	2
9:00	9:15			0	0	0				0	0	0				0	0	0				0	0	0		
9:15	9:30			0	0	0				0	0	0				0	0	0				0	0	0		
9:30	9:45			0	0	0				0	0	0				0	0	0				0	0	0		
9:45	10:00			0	0	0				0	0	0				0	0	0				0	0	0		
10:00	10:15			0	0	0				0	0	0				0	0	0				0	0	0		
10:15	10:30			0	0	0				0	0	0				0	0	0				0	0	0		
10:30	10:45			0	0	0				0	0	0				0	0	0				0	0	0		
10:45	11:00			0	0	0				0	0	0				0	0	0				0	0	0		
11:00	11:15																							2	**2**	2
11:15	11:30															1			**1**					1	**1**	2
11:30	11:45															2			**2**				1		**1**	3
11:45	12:00																									
12:00	12:15																									
12:15	12:30																									
12:30	12:45									1			**1**											1	**1**	2
12:45	13:00																							1	**1**	1
13:00	13:15			0	0	0				0	0	0				0	0	0				0	0	0		
13:15	13:30			0	0	0				0	0	0				0	0	0				0	0	0		
13:30	13:45			0	0	0				0	0	0				0	0	0				0	0	0		
13:45	14:00			0	0	0				0	0	0				0	0	0				0	0	0		
14:00	14:15			0	0	0				0	0	0				0	0	0				0	0	0		
14:15	14:30			0	0	0				0	0	0				0	0	0				0	0	0		
14:30	14:45			0	0	0				0	0	0				0	0	0				0	0	0		
14:45	15:00			0	0	0				0	0	0				0	0	0				0	0	0		
15:00	15:15																									
15:15	15:30																							2	**2**	2
15:30	15:45																							1	**1**	1
15:45	16:00															1			**1**					2	**2**	3
16:00	16:15										1		**1**													1
16:15	16:30																									
16:30	16:45																									
16:45	17:00																									
17:00	17:15																						1		**1**	1
17:15	17:30																									
17:30	17:45																									
17:45	18:00																							1	**1**	1
18:00	18:15			0	0	0				0	0	0				0	0	0				0	0	0		
18:15	18:30			0	0	0				0	0	0				0	0	0				0	0	0		
18:30	18:45			0	0	0				0	0	0				0	0	0				0	0	0		
18:45	19:00			0	0	0				0	0	0				0	0	0				0	0	0		
19:00	19:15			0	0	0				0	0	0				0	0	0				0	0	0		
19:15	19:30			0	0	0				0	0	0				0	0	0				0	0	0		
19:30	19:45			0	0	0				0	0	0				0	0	0				0	0	0		
19:45	20:00			0	0	0				0	0	0				0	0	0				0	0	0		
20:00	20:15			0	0	0				0	0	0				0	0	0				0	0	0		
20:15	20:30			0	0	0				0	0	0				0	0	0				0	0	0		
20:30	20:45			0	0	0				0	0	0				0	0	0				0	0	0		
20:45	21:00			0	0	0				0	0	0				0	0	0				0	0	0		
21:00	21:15			0	0	0				0	0	0				0	0	0				0	0	0		
21:15	21:30			0	0	0				0	0	0				0	0	0				0	0	0		
21:30	21:45			0	0	0				0	0	0				0	0	0				0	0	0		
21:45	22:00			0	0	0				0	0	0				0	0	0				0	0	0		
22:00	22:15			0	0	0				0	0	0				0	0	0				0	0	0		
22:15	22:30			0	0	0				0	0	0				0	0	0				0	0	0		
22:30	22:45			0	0	0				0	0	0				0	0	0				0	0	0		
22:45	23:00			0	0	0				0	0	0				0	0	0				0	0	0		
23:00	23:15			0	0	0				0	0	0				0	0	0				0	0	0		
23:15	23:30			0	0	0				0	0	0				0	0	0				0	0	0		
23:30	23:45			0	0	0				0	0	0				0	0	0				0	0	0		
23:45	0:00			0	0	0				0	0	0				0	0	0				0	0	0		
TOTAL		***0***	***0***	**0**	**0**	**0**	**0**	***0***	***0***	**1**	**2**	**0**	**3**	***0***	***0***	**5**	**0**	**0**	**5**	***0***	***0***	**0**	**6**	**13**	**19**	27

Comptages

0317-55-6

Date: May 9, 2017
Jour: mardi



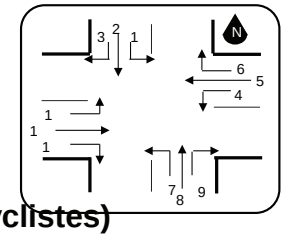
Articulés

Période		N/A						Rte des Aciéries						Entrée/Sortie A-30 Ouest						Rte des Aciéries						Grand total Lourds
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Virage en U	,	Gauche	Tout Droit	Droite	Total	Virage en U	,	Gauche	Tout Droit	Droite	Total	Virage en U	,	Gauche	Tout Droit	Droite	Total	Virage en U	,	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
0:30	0:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
0:45	1:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:00	1:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:15	1:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:30	1:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:45	2:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:00	2:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:15	2:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:30	2:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:45	3:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:00	3:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:15	3:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:30	3:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:45	4:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:00	4:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:15	4:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:30	4:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:45	5:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:00	5:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:15	5:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:30	5:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:45	6:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
6:00	6:15																							4	**4**	4
6:15	6:30															2			**2**							2
6:30	6:45															1			**1**				1	4	**5**	6
6:45	7:00																							1	**1**	1
7:00	7:15															4			**4**				1		**1**	5
7:15	7:30															6			**6**				2	1	**3**	9
7:30	7:45																						1	2	**3**	3
7:45	8:00																						1	4	**5**	5
8:00	8:15																						4	1	**5**	5
8:15	8:30																	1	**1**					5	**5**	6
8:30	8:45															2			**2**					4	**4**	6
8:45	9:00																						1		**1**	1
9:00	9:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
9:15	9:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
9:30	9:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
9:45	10:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:00	10:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:15	10:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:30	10:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:45	11:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
11:00	11:15									2	1		**3**			1			**1**				1	3	**4**	8
11:15	11:30																						1	4	**5**	5
11:30	11:45																						2	2	**4**	4
11:45	12:00										1		**1**										1	7	**8**	9
12:00	12:15									1			**1**			7			**7**					4	**4**	12
12:15	12:30									4			**4**			3			**3**				1	2	**3**	10
12:30	12:45									1			**1**			2			**2**					1	**1**	4
12:45	13:00									1	1		**2**										1	2	**3**	5
13:00	13:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:15	13:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:30	13:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:45	14:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:00	14:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:15	14:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:30	14:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:45	15:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
15:00	15:15									1	1		**2**											6	**6**	8
15:15	15:30									2	1		**3**			1			**1**					1	**1**	5
15:30	15:45															2			**2**				1	2	**3**	5
15:45	16:00									1			**1**										1	4	**5**	6
16:00	16:15																						1	3	**4**	4
16:15	16:30																							4	**4**	4
16:30	16:45										1		**1**										1	2	**3**	4
16:45	17:00									1			**1**													1
17:00	17:15									2			**2**													2
17:15	17:30									1			**1**													1
17:30	17:45																							1	**1**	1
17:45	18:00																									
18:00	18:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:15	18:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:30	18:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:45	19:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:00	19:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:15	19:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:30	19:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:45	20:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:00	20:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:15	20:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:30	20:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:45	21:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:00	21:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:15	21:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:30	21:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:45	22:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:00	22:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:15	22:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:30	22:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:45	23:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:00	23:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:15	23:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:30	23:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:45	0:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
TOTAL		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**17**	**6**	**0**	**23**	**0**	**0**	**31**	**0**	**1**	**32**	**0**	**0**	**0**	**22**	**74**	**96**	151

Compilation des heures de pointes

0317-55-6

Date: May 9, 2017
Jour: mardi



Heure de pointe du réseau

AM 7:00 à 8:00 - (Ensemble des véhicules, piétons et cyclistes)

Période		N/A						Rte des Aciéries						Entrée/Sortie A-30 Ouest						Rte des Aciéries						Grand total véhicules
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
7:00	7:15									3			**3**			6		1	**7**				17	7	**24**	**34**
7:15	7:30									1	1		**2**			7			**7**				18	11	**29**	**38**
7:30	7:45															3			**3**				9	7	**16**	**19**
7:45	8:00									8	6		**14**			4			**4**				13	8	**21**	**39**
TOTAL										**12**	**7**		**19**			**20**		**1**	**21**				**57**	**33**	**90**	**130**
% Légers				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	3.5%	3.0%	3.3%	2.3%
% Lourds				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			50.0%	0.0%	0.0%	47.6%			0.0%	8.8%	0.0%	13.3%	16.9%
PHF										**0.38**	**0.29**		**0.34**			**0.71**		**0.25**	**0.75**				**0.79**	**0.75**	**0.78**	**0.83**

Midi 11:00 à 12:00 - (Ensemble des véhicules, piétons et cyclistes)

Période		N/A						Rte des Aciéries						Entrée/Sortie A-30 Ouest						Rte des Aciéries						Grand total véhicules
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
11:00	11:15									2	3		**5**			1			**1**				2	11	**13**	**19**
11:15	11:30									4			**4**			1			**1**				1	10	**11**	**16**
11:30	11:45										1		**1**			3			**3**				4	5	**9**	**13**
11:45	12:00									1	1		**2**										2	11	**13**	**15**
TOTAL										**7**	**5**		**12**			**5**			**5**				**9**	**37**	**46**	**63**
% Légers				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			60.0%	0.0%	0.0%	60.0%			0.0%	11.1%	8.1%	8.7%	11.1%
% Lourds				0.0%	0.0%	0.0%	0.0%			28.6%	40.0%	0.0%	33.3%			20.0%	0.0%	0.0%	20.0%			0.0%	55.6%	0.0%	45.7%	41.3%
PHF										**0.44**	**0.42**		**0.60**			**0.42**			**0.42**				**0.56**	**0.84**	**0.88**	**0.83**

PM 15:30 à 16:30 - (Ensemble des véhicules, piétons et cyclistes)

Période		N/A						Rte des Aciéries						Entrée/Sortie A-30 Ouest						Rte des Aciéries						Grand total véhicules
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
15:30	15:45									10	3		**13**			2			**2**				2	7	**9**	**24**
15:45	16:00									7	1		**8**			3			**3**				4	14	**18**	**29**
16:00	16:15									5	3		**8**										1	15	**16**	**24**
16:15	16:30									2	1		**3**			2		1	**3**				1	9	**10**	**16**
TOTAL										**24**	**8**		**32**			**7**		**1**	**8**				**8**	**45**	**53**	**93**
% Légers				0.0%	0.0%	0.0%	0.0%			0.0%	12.5%	0.0%	3.1%			14.3%	0.0%	0.0%	12.5%			0.0%	0.0%	6.7%	5.7%	5.4%
% Lourds				0.0%	0.0%	0.0%	0.0%			4.2%	0.0%	0.0%	3.1%			28.6%	0.0%	0.0%	25.0%			0.0%	37.5%	28.9%	30.2%	20.4%
PHF										**0.60**	**0.67**		**0.62**			**0.58**		**0.25**	**0.67**				**0.50**	**0.75**	**0.74**	**0.80**

Soir 0:00 à 1:00 - (Ensemble des véhicules, piétons et cyclistes)

Période		N/A						Rte des Aciéries						Entrée/Sortie A-30 Ouest						Rte des Aciéries						Grand total véhicules
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30																									
0:30	0:45																									
0:45	1:00																									
TOTAL																										
% Légers				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%	0.0%
% Lourds				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%	0.0%
PHF																										

Diagramme de compilation

0317-55-6

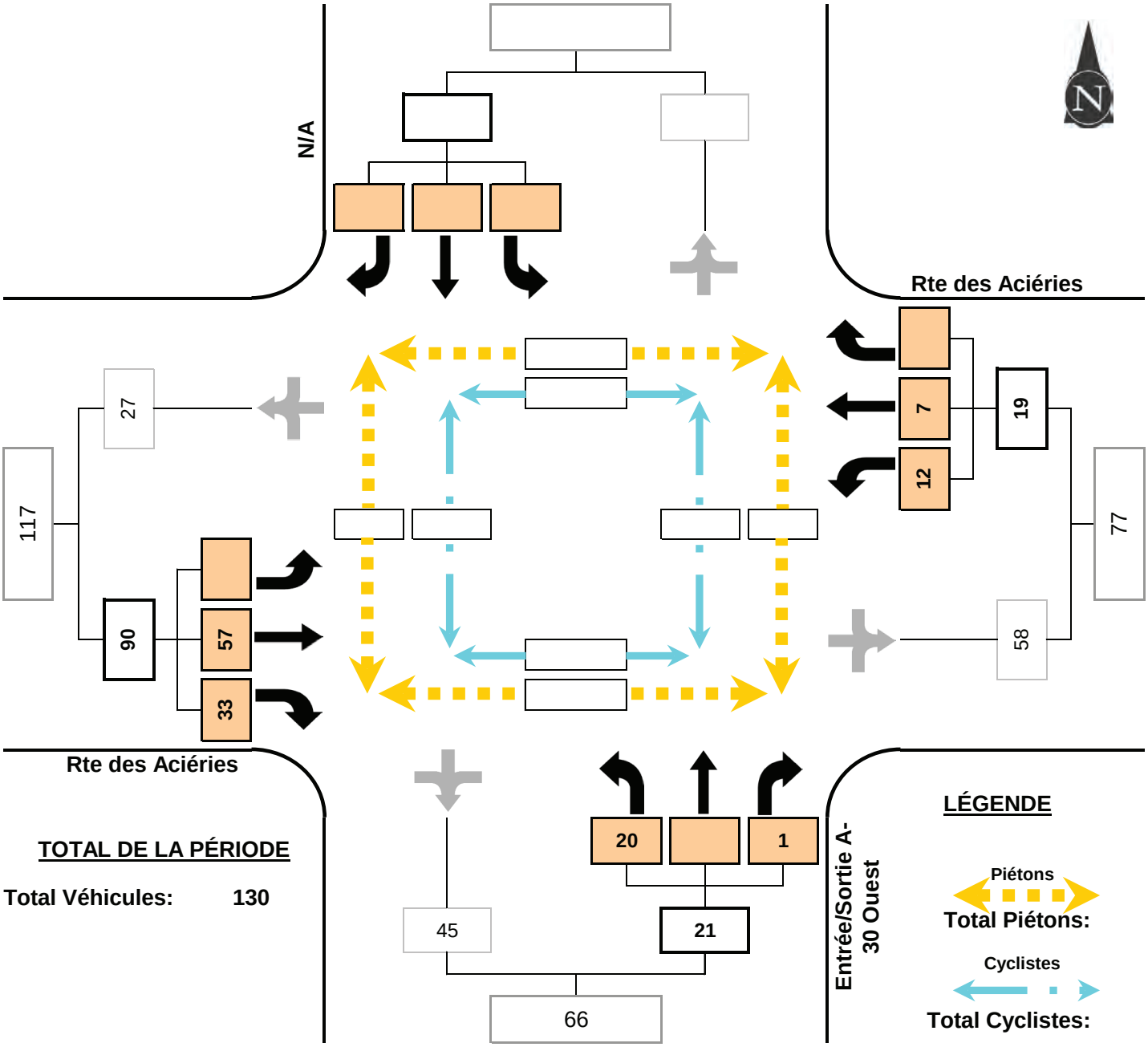
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 9 May 2017
Jour: mardi

Intersection: N/A _ Rte des Aciéries

AM

Période: 7:00 à 8:00



TOTAL DE LA PÉRIODE

Total Véhicules: 130

Diagramme de compilation

0317-55-6

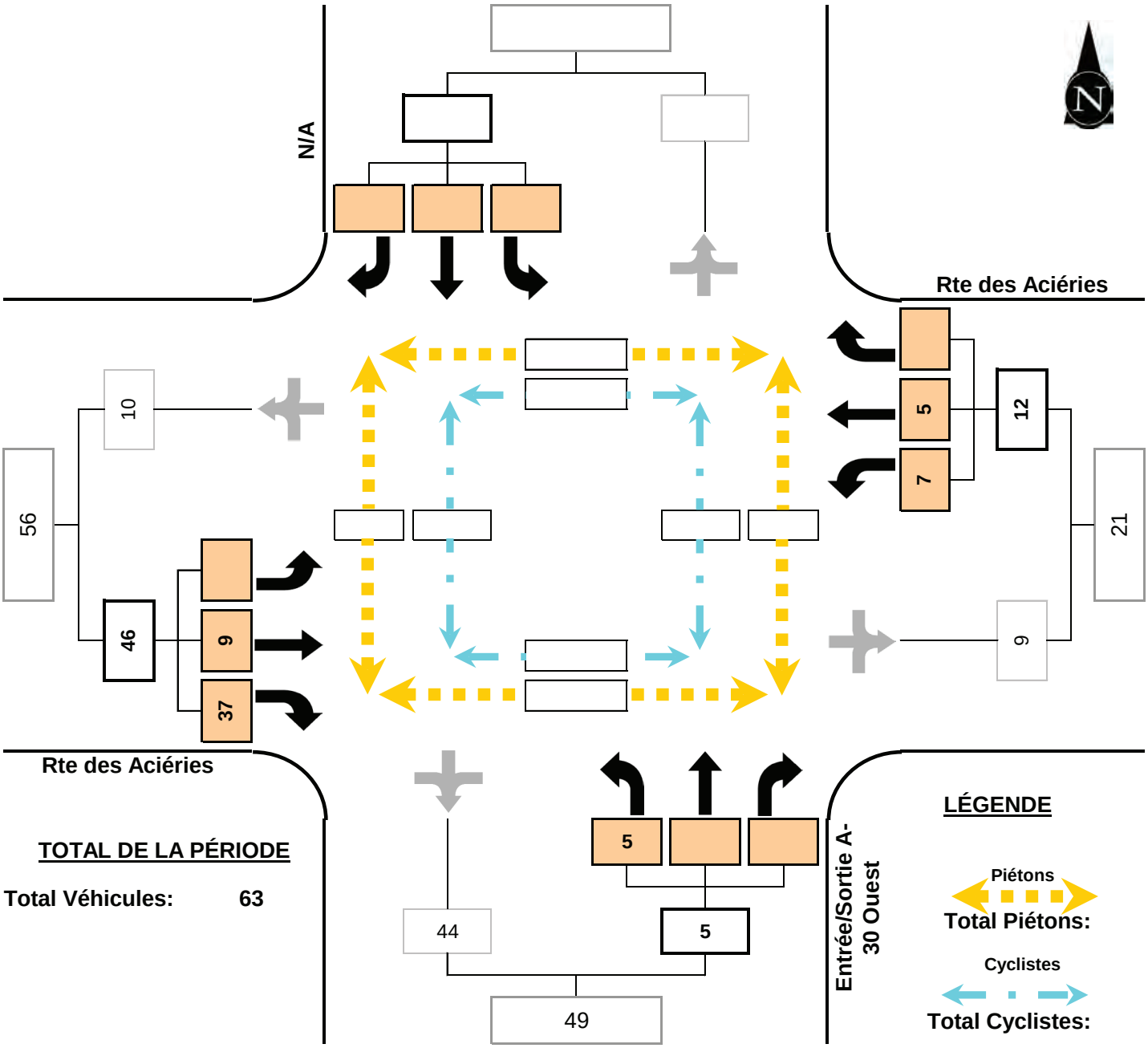
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 9 May 2017
Jour: mardi

Intersection: N/A _ Rte des Aciéries

Midi

Période: 11:00 à 12:00



TOTAL DE LA PÉRIODE

Total Véhicules: 63

Diagramme de compilation

0317-55-6

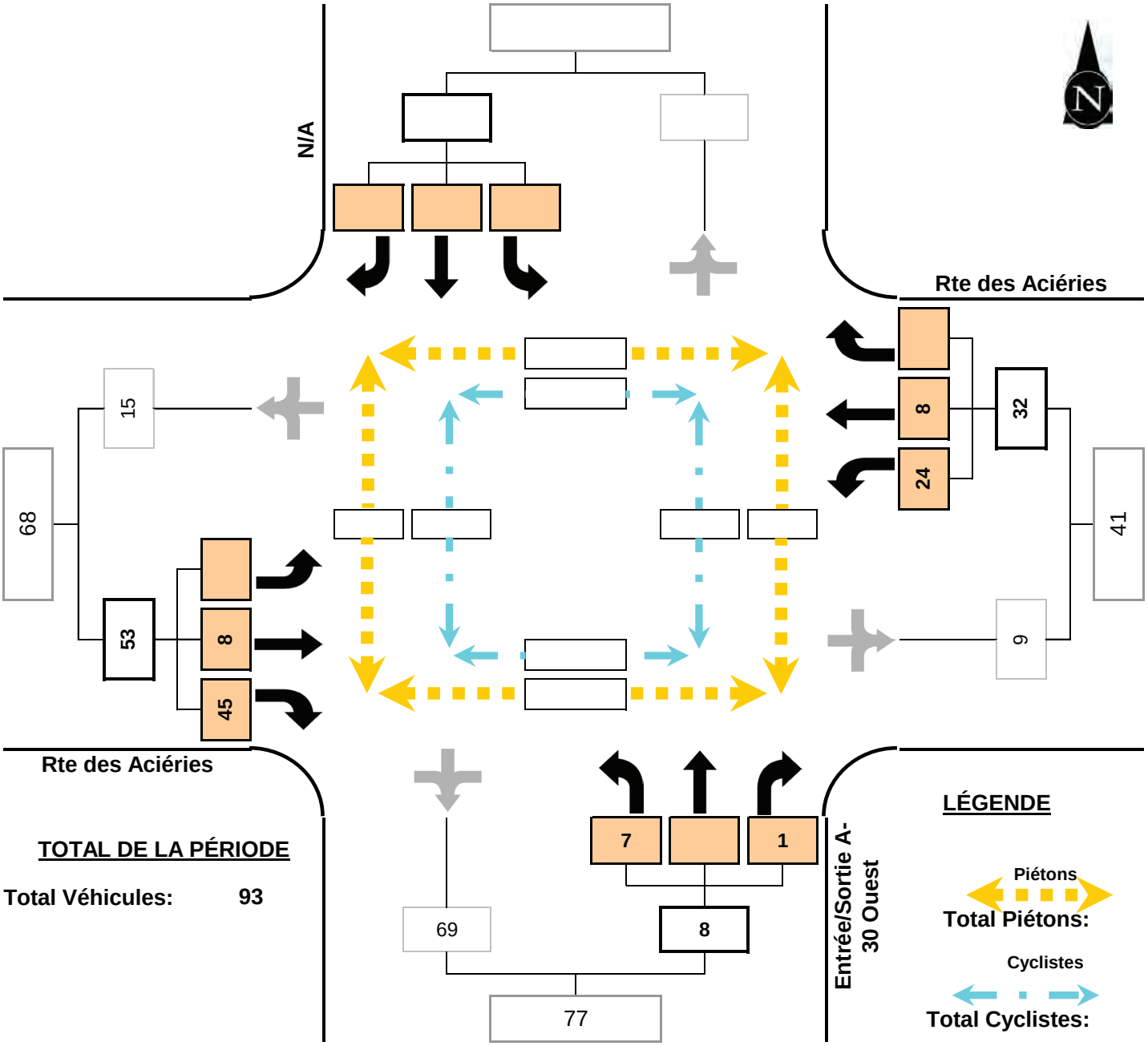
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 9 May 2017
Jour: mardi

Intersection: N/A _ Rte des Aciéries

PM

Période: 15:30 à 16:30



TOTAL DE LA PÉRIODE

Total Véhicules: 93

Compilation Data Traffic

Titre: 0317-55-7

Comptage

Ville ou Arrondissement: Contrecoeur

Intersection: Mtée Lapierre _ N/A

Approche Nord	Mtée Lapierre
Approche Est	N/A
Approche Sud	Mtée Lapierre
Approche Ouest	Entrée/Sortie A-30 Est

Classification

Automobiles, Piétons et Cyclistes

Camions, Autobus

Articulés



Date: 9 mai 2017
Jour: mardi

Conditions climatiques: Nuageux
Température: 3°C

Période(s) de comptage	AM	Midi	PM	Soir
Début	6:00	11:00	15:00	
Fin	9:00	13:00	18:00	
Durée	3:00	2:00	3:00	

Durée du comptage 8:00

Géolocalisation:

Lien hypertexte de localisation:

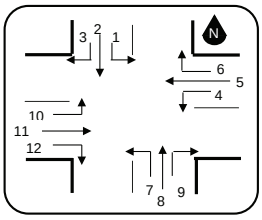
Observation:

Remarque:

Comptages

0317-55-7

Date: May 9, 2017
Jour: mardi



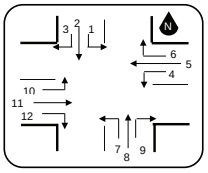
TOTAL Véhicules, Piétons et Cyclistes

Période		Mtée Lapierre						N/A						Mtée Lapierre						Entrée/Sortie A-30 Est						Grand Total
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9		10		11	12			
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	1:00																									
1:00	2:00																									
2:00	3:00																									
3:00	4:00																									
4:00	5:00																									
5:00	6:00																									
6:00	7:00				1	8	9									1	20		21	1		44		2	46	76
7:00	8:00				5	25	30									2	17		19			67		1	68	117
8:00	9:00				4	7	11									3	13		16			41		2	43	70
9:00	10:00																									
10:00	11:00																									
11:00	12:00				5	8	13									2	8		10			30		1	31	54
12:00	13:00				1	14	15										8		8			24		3	27	50
13:00	14:00																									
14:00	15:00																									
15:00	16:00				6	11	17									1	9		10	1		27		13	40	67
16:00	17:00				7	14	21									1	8		9			23		12	35	65
17:00	18:00				7	9	16		1							2	7		9		1	12		22	34	59
18:00	19:00																									
19:00	20:00																									
20:00	21:00																									
21:00	22:00																									
22:00	23:00																									
23:00	0:00																									
TOTAL		**0**	**0**	**0**	**36**	**96**	**132**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**12**	**90**	**0**	**102**	**2**	**1**	**268**	**0**	**56**	**324**	558

Comptages

0317-55-7

Date: May 9, 2017
Jour: mardi



TOTAL Véhicules, Piétons et Cyclistes

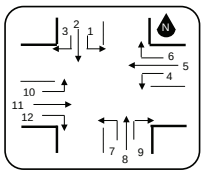
Période		Mtée Lapierre						N/A						Mtée Lapierre						Entrée/Sortie A-30 Est						Grand Total
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30																									
0:30	0:45																									
0:45	1:00																									
1:00	1:15																									
1:15	1:30																									
1:30	1:45																									
1:45	2:00																									
2:00	2:15																									
2:15	2:30																									
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4:15	4:30																									
4:30	4:45																									
4:45	5:00																									
5:00	5:15																									
5:15	5:30																									
5:30	5:45																									
5:45	6:00																									
6:00	6:15					1	**1**										2		**2**			6			**6**	9
6:15	6:30				1	1	**2**									1	4		**5**	*1*		10		2	**12**	19
6:30	6:45					4	**4**										7		**7**			13			**13**	24
6:45	7:00					2	**2**										7		**7**			15			**15**	24
7:00	7:15					6	**6**									1	2		**3**			16			**16**	25
7:15	7:30				1	7	**8**										7		**7**			19			**19**	34
7:30	7:45				2	5	**7**									1	2		**3**			17			**17**	27
7:45	8:00				2	7	**9**										6		**6**			15		1	**16**	31
8:00	8:15					2	**2**									1	4		**5**			15			**15**	22
8:15	8:30				2	2	**4**										3		**3**			9		1	**10**	17
8:30	8:45				1	1	**2**									1	2		**3**			8		1	**9**	14
8:45	9:00				1	2	**3**									1	4		**5**			9			**9**	17
9:00	9:15																									
9:15	9:30																									
9:30	9:45																									
9:45	10:00																									
10:00	10:15																									
10:15	10:30																									
10:30	10:45																									
10:45	11:00																									
11:00	11:15				1	4	**5**									1	3		**4**			9			**9**	18
11:15	11:30				3		**3**										2		**2**			5		1	**6**	11
11:30	11:45				1	4	**5**									1	3		**4**			9			**9**	18
11:45	12:00																					7			**7**	7
12:00	12:15					2	**2**										2		**2**			7		1	**8**	12
12:15	12:30				1	5	**6**										3		**3**			4			**4**	13
12:30	12:45					4	**4**										1		**1**			5			**5**	10
12:45	13:00					3	**3**										2		**2**			8		2	**10**	15
13:00	13:15																									
13:15	13:30																									
13:30	13:45																									
13:45	14:00																									
14:00	14:15																									
14:15	14:30																									
14:30	14:45																									
14:45	15:00																									
15:00	15:15				1	3	**4**										1		**1**			5		4	**9**	14
15:15	15:30				1	2	**3**										1		**1**	*1*		6		5	**11**	15
15:30	15:45				1	5	**6**									1			**1**			6		2	**8**	15
15:45	16:00				3	1	**4**										7		**7**			10		2	**12**	23
16:00	16:15				1	4	**5**										2		**2**			3		5	**8**	15
16:15	16:30				2	6	**8**										2		**2**			4		1	**5**	15
16:30	16:45				2	2	**4**									1	3		**4**			6		4	**10**	18
16:45	17:00				2	2	**4**										1		**1**			10		2	**12**	17
17:00	17:15					2	**2**										5		**5**			7		1	**8**	15
17:15	17:30				2	1	**3**									2			**2**		*1*	2		4	**6**	11
17:30	17:45				2	4	**6**															1		11	**12**	18
17:45	18:00				3	2	**5**		*1*								2		**2**			2		6	**8**	15
18:00	18:15																									
18:15	18:30																									
18:30	18:45																									
18:45	19:00																									
19:00	19:15																									
19:15	19:30																									
19:30	19:45																									
19:45	20:00																									
20:00	20:15																									
20:15	20:30																									
20:30	20:45																									
20:45	21:00																									
21:00	21:15																									
21:15	21:30																									
21:30	21:45																									
21:45	22:00																									
22:00	22:15																									
22:15	22:30																									
22:30	22:45																									
22:45	23:00																									
23:00	23:15																									
23:15	23:30																									
23:30	23:45																									
23:45	0:00																									
TOTAL		*0*	*0*	0	36	96	132	*0*	*1*	0	0	0	0	*0*	*0*	12	90	0	102	*2*	*1*	268	0	56	324	558

Comptages

0317-55-7

Date: May 9, 2017
Jour: mardi





Automobiles, Piétons et Cyclistes

Période		Mtée Lapierre – Approche Nord						N/A – Approche Est						Mtée Lapierre – Approche Sud						Entrée/Sortie A-30 Est – Approche Ouest						Grand total
		Piétons	*Cyclistes*	Gauche	Tout Droit	Droite	Total	*Piétons*	*Cyclistes*	Gauche	Tout Droit	Droite	Total	*Piétons*	*Cyclistes*	Gauche	Tout Droit	Droite	Total	*Piétons*	*Cyclistes*	Gauche	Tout Droit	Droite	Total	Autos
de	à			1	2	3				4	5	6				7	8	9				10	11	12		
0:00	0:15																									
0:15	0:30	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
0:30	0:45	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
0:45	1:00	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
1:00	1:15	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
1:15	1:30	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
1:30	1:45	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
1:45	2:00	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
2:00	2:15	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
2:15	2:30	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
2:30	2:45	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
2:45	3:00	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
3:00	3:15	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
3:15	3:30	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
3:30	3:45	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
3:45	4:00	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
4:00	4:15	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
4:15	4:30	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
4:30	4:45	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
4:45	5:00	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
5:00	5:15	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
5:15	5:30	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
5:30	5:45	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
5:45	6:00	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
6:00	6:15					1	**1**										2		**2**			4			**4**	7
6:15	6:30					1	**1**									1	4		**5**	*1*		9		2	**11**	17
6:30	6:45					1	**1**										7		**7**			12			**12**	20
6:45	7:00					2	**2**										7		**7**			13			**13**	22
7:00	7:15					6	**6**									1	2		**3**			13			**13**	22
7:15	7:30				1	4	**5**										7		**7**			13			**13**	25
7:30	7:45				2		**2**									1	2		**3**			8			**8**	13
7:45	8:00				2	6	**8**										6		**6**			13		1	**14**	28
8:00	8:15					1	**1**									1	4		**5**			8			**8**	14
8:15	8:30				2	2	**4**										3		**3**			7		1	**8**	15
8:30	8:45				1	1	**2**									1	2		**3**			2			**2**	7
8:45	9:00				1		**1**									1	4		**5**			4			**4**	10
9:00	9:15	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
9:15	9:30	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
9:30	9:45	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
9:45	10:00	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
10:00	10:15	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
10:15	10:30	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
10:30	10:45	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
10:45	11:00	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
11:00	11:15				1	1	**2**									1	3		**4**			3			**3**	9
11:15	11:30				3		**3**										2		**2**					1	**1**	6
11:30	11:45					1	**1**									1	3		**4**			1			**1**	6
11:45	12:00																					3			**3**	3
12:00	12:15					1	**1**										2		**2**			2		1	**3**	6
12:15	12:30				1		**1**										2		**2**							3
12:30	12:45																1		**1**			1			**1**	2
12:45	13:00					1	**1**										2		**2**			1		2	**3**	6
13:00	13:15	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
13:15	13:30	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
13:30	13:45	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
13:45	14:00	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
14:00	14:15	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
14:15	14:30	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
14:30	14:45	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
14:45	15:00	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
15:00	15:15				1	3	**4**															3		3	**6**	10
15:15	15:30				1	1	**2**										1		**1**	*1*		2		5	**7**	10
15:30	15:45				1	3	**4**									1			**1**			2		2	**4**	9
15:45	16:00				3	1	**4**										5		**5**			6		2	**8**	17
16:00	16:15				1	4	**5**										2		**2**			1		5	**6**	13
16:15	16:30				2	5	**7**										2		**2**			2		1	**3**	12
16:30	16:45				2	2	**4**									1	3		**4**			3		4	**7**	15
16:45	17:00				2	2	**4**										1		**1**			6		2	**8**	13
17:00	17:15					2	**2**										5		**5**			3		1	**4**	11
17:15	17:30				2	1	**3**									2			**2**		*1*			4	**4**	9
17:30	17:45				2	4	**6**															1		11	**12**	18
17:45	18:00				3	2	**5**		*1*								2		**2**			1		6	**7**	14
18:00	18:15	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
18:15	18:30	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
18:30	18:45	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
18:45	19:00	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
19:00	19:15	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
19:15	19:30	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
19:30	19:45	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
19:45	20:00	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
20:00	20:15	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
20:15	20:30	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
20:30	20:45	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
20:45	21:00	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
21:00	21:15	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
21:15	21:30	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
21:30	21:45	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
21:45	22:00	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
22:00	22:15	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
22:15	22:30	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
22:30	22:45	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
22:45	23:00	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
23:00	23:15	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
23:15	23:30	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
23:30	23:45	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
23:45	0:00	*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		*0*	*0*	0	0	0		
TOTAL		***0***	***0***	**0**	**34**	**59**	**93**	***0***	***1***	**0**	**0**	**0**	**0**	***0***	***0***	**12**	**86**	**0**	**98**	***2***	***1***	**147**	**0**	**54**	**201**	392

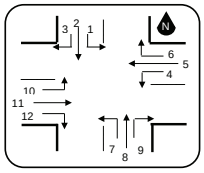
Comptages

Date: May 9, 2017
Jour: mardi

0317-55-7



Camions, Autobus

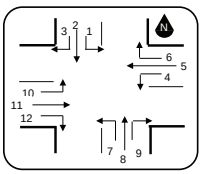


Période		Mtée Lapierre						N/A						Mtée Lapierre						Entrée/Sortie A-30 Est						Grand
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						total
		'	'	Gauche	Tout Droit	Droite	Total	'	'	Gauche	Tout Droit	Droite	Total	'	'	Gauche	Tout Droit	Droite	Total	'	'	Gauche	Tout Droit	Droite	Total	Légers
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30			0	0	0				0	0	0				0	0	0				0	0	0		
0:30	0:45			0	0	0				0	0	0				0	0	0				0	0	0		
0:45	1:00			0	0	0				0	0	0				0	0	0				0	0	0		
1:00	1:15			0	0	0				0	0	0				0	0	0				0	0	0		
1:15	1:30			0	0	0				0	0	0				0	0	0				0	0	0		
1:30	1:45			0	0	0				0	0	0				0	0	0				0	0	0		
1:45	2:00			0	0	0				0	0	0				0	0	0				0	0	0		
2:00	2:15			0	0	0				0	0	0				0	0	0				0	0	0		
2:15	2:30			0	0	0				0	0	0				0	0	0				0	0	0		
2:30	2:45			0	0	0				0	0	0				0	0	0				0	0	0		
2:45	3:00			0	0	0				0	0	0				0	0	0				0	0	0		
3:00	3:15			0	0	0				0	0	0				0	0	0				0	0	0		
3:15	3:30			0	0	0				0	0	0				0	0	0				0	0	0		
3:30	3:45			0	0	0				0	0	0				0	0	0				0	0	0		
3:45	4:00			0	0	0				0	0	0				0	0	0				0	0	0		
4:00	4:15			0	0	0				0	0	0				0	0	0				0	0	0		
4:15	4:30			0	0	0				0	0	0				0	0	0				0	0	0		
4:30	4:45			0	0	0				0	0	0				0	0	0				0	0	0		
4:45	5:00			0	0	0				0	0	0				0	0	0				0	0	0		
5:00	5:15			0	0	0				0	0	0				0	0	0				0	0	0		
5:15	5:30			0	0	0				0	0	0				0	0	0				0	0	0		
5:30	5:45			0	0	0				0	0	0				0	0	0				0	0	0		
5:45	6:00			0	0	0				0	0	0				0	0	0				0	0	0		
6:00	6:15																									
6:15	6:30				1		1																			1
6:30	6:45																									
6:45	7:00																									
7:00	7:15																									
7:15	7:30																									
7:30	7:45																					3			**3**	3
7:45	8:00																									
8:00	8:15																									
8:15	8:30																									
8:30	8:45																							1	**1**	1
8:45	9:00																									
9:00	9:15			0	0	0				0	0	0				0	0	0				0	0	0		
9:15	9:30			0	0	0				0	0	0				0	0	0				0	0	0		
9:30	9:45			0	0	0				0	0	0				0	0	0				0	0	0		
9:45	10:00			0	0	0				0	0	0				0	0	0				0	0	0		
10:00	10:15			0	0	0				0	0	0				0	0	0				0	0	0		
10:15	10:30			0	0	0				0	0	0				0	0	0				0	0	0		
10:30	10:45			0	0	0				0	0	0				0	0	0				0	0	0		
10:45	11:00			0	0	0				0	0	0				0	0	0				0	0	0		
11:00	11:15					1	1																			1
11:15	11:30																									
11:30	11:45				1		1															1			**1**	2
11:45	12:00																									
12:00	12:15																									
12:15	12:30																1		**1**			1			**1**	2
12:30	12:45					1	1																			1
12:45	13:00																									
13:00	13:15			0	0	0				0	0	0				0	0	0				0	0	0		
13:15	13:30			0	0	0				0	0	0				0	0	0				0	0	0		
13:30	13:45			0	0	0				0	0	0				0	0	0				0	0	0		
13:45	14:00			0	0	0				0	0	0				0	0	0				0	0	0		
14:00	14:15			0	0	0				0	0	0				0	0	0				0	0	0		
14:15	14:30			0	0	0				0	0	0				0	0	0				0	0	0		
14:30	14:45			0	0	0				0	0	0				0	0	0				0	0	0		
14:45	15:00			0	0	0				0	0	0				0	0	0				0	0	0		
15:00	15:15																1		**1**					1	**1**	2
15:15	15:30																					1			**1**	1
15:30	15:45																									
15:45	16:00																2		**2**							2
16:00	16:15																									
16:15	16:30																									
16:30	16:45																					1			**1**	1
16:45	17:00																									
17:00	17:15																					3			**3**	3
17:15	17:30																									
17:30	17:45																									
17:45	18:00																									
18:00	18:15			0	0	0				0	0	0				0	0	0				0	0	0		
18:15	18:30			0	0	0				0	0	0				0	0	0				0	0	0		
18:30	18:45			0	0	0				0	0	0				0	0	0				0	0	0		
18:45	19:00			0	0	0				0	0	0				0	0	0				0	0	0		
19:00	19:15			0	0	0				0	0	0				0	0	0				0	0	0		
19:15	19:30			0	0	0				0	0	0				0	0	0				0	0	0		
19:30	19:45			0	0	0				0	0	0				0	0	0				0	0	0		
19:45	20:00			0	0	0				0	0	0				0	0	0				0	0	0		
20:00	20:15			0	0	0				0	0	0				0	0	0				0	0	0		
20:15	20:30			0	0	0				0	0	0				0	0	0				0	0	0		
20:30	20:45			0	0	0				0	0	0				0	0	0				0	0	0		
20:45	21:00			0	0	0				0	0	0				0	0	0				0	0	0		
21:00	21:15			0	0	0				0	0	0				0	0	0				0	0	0		
21:15	21:30			0	0	0				0	0	0				0	0	0				0	0	0		
21:30	21:45			0	0	0				0	0	0				0	0	0				0	0	0		
21:45	22:00			0	0	0				0	0	0				0	0	0				0	0	0		
22:00	22:15			0	0	0				0	0	0				0	0	0				0	0	0		
22:15	22:30			0	0	0				0	0	0				0	0	0				0	0	0		
22:30	22:45			0	0	0				0	0	0				0	0	0				0	0	0		
22:45	23:00			0	0	0				0	0	0				0	0	0				0	0	0		
23:00	23:15			0	0	0				0	0	0				0	0	0				0	0	0		
23:15	23:30			0	0	0				0	0	0				0	0	0				0	0	0		
23:30	23:45			0	0	0				0	0	0				0	0	0				0	0	0		
23:45	0:00			0	0	0				0	0	0				0	0	0				0	0	0		
TOTAL		***0***	***0***	**0**	**2**	**2**	**4**	***0***	***0***	**0**	**0**	**0**	**0**	***0***	***0***	**0**	**4**	**0**	**4**	***0***	***0***	**10**	**0**	**2**	**12**	20

Comptages

0317-55-7

Date: May 9, 2017
Jour: mardi



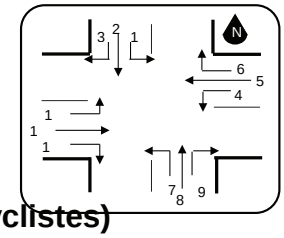
Articulés

Période		Mtée Lapierre						N/A						Mtée Lapierre						Entrée/Sortie A-30 Est						Grand total Lourds
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Virage en U	,	Gauche	Tout Droit	Droite	Total	Virage en U	,	Gauche	Tout Droit	Droite	Total	Virage en U	,	Gauche	Tout Droit	Droite	Total	Virage en U	,	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
0:30	0:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
0:45	1:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:00	1:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:15	1:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:30	1:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:45	2:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:00	2:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:15	2:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:30	2:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:45	3:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:00	3:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:15	3:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:30	3:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:45	4:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:00	4:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:15	4:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:30	4:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:45	5:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:00	5:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:15	5:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:30	5:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:45	6:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
6:00	6:15																					2			**2**	2
6:15	6:30																					1			**1**	1
6:30	6:45					3	**3**															1			**1**	4
6:45	7:00																					2			**2**	2
7:00	7:15																					3			**3**	3
7:15	7:30					3	**3**															6			**6**	9
7:30	7:45					5	**5**															6			**6**	11
7:45	8:00					1	**1**															2			**2**	3
8:00	8:15					1	**1**															7			**7**	8
8:15	8:30																					2			**2**	2
8:30	8:45																					6			**6**	6
8:45	9:00					2	**2**															5			**5**	7
9:00	9:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
9:15	9:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
9:30	9:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
9:45	10:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:00	10:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:15	10:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:30	10:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:45	11:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
11:00	11:15					2	**2**															6			**6**	8
11:15	11:30																					5			**5**	5
11:30	11:45					3	**3**															7			**7**	10
11:45	12:00																					4			**4**	4
12:00	12:15					1	**1**															5			**5**	6
12:15	12:30					5	**5**															3			**3**	8
12:30	12:45					3	**3**															4			**4**	7
12:45	13:00					2	**2**															7			**7**	9
13:00	13:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:15	13:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:30	13:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:45	14:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:00	14:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:15	14:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:30	14:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:45	15:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
15:00	15:15																					2			**2**	2
15:15	15:30					1	**1**															3			**3**	4
15:30	15:45					2	**2**															4			**4**	6
15:45	16:00																					4			**4**	4
16:00	16:15																					2			**2**	2
16:15	16:30					1	**1**															2			**2**	3
16:30	16:45																					2			**2**	2
16:45	17:00																					4			**4**	4
17:00	17:15																					1			**1**	1
17:15	17:30																					2			**2**	2
17:30	17:45																									
17:45	18:00																					1			**1**	1
18:00	18:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:15	18:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:30	18:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:45	19:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:00	19:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:15	19:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:30	19:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:45	20:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:00	20:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:15	20:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:30	20:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:45	21:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:00	21:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:15	21:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:30	21:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:45	22:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:00	22:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:15	22:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:30	22:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:45	23:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:00	23:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:15	23:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:30	23:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:45	0:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
TOTAL		**0**	**0**	**0**	**0**	**35**	**35**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**111**	**0**	**0**	**111**	146

Compilation des heures de pointes

0317-55-7

Date: May 9, 2017
Jour: mardi



Heure de pointe du réseau

AM 7:00 à 8:00 - (Ensemble des véhicules, piétons et cyclistes)

Période		Mtée Lapierre – Approche Nord						N/A – Approche Est						Mtée Lapierre – Approche Sud						Entrée/Sortie A-30 Est – Approche Ouest						Grand total véhicules
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
7:00	7:15					6	**6**									1	2		**3**			16			**16**	**25**
7:15	7:30				1	7	**8**										7		**7**			19			**19**	**34**
7:30	7:45				2	5	**7**									1	2		**3**			17			**17**	**27**
7:45	8:00				2	7	**9**										6		**6**			15		1	**16**	**31**
TOTAL					**5**	**25**	**30**									**2**	**17**		**19**			**67**		**1**	**68**	**117**
% Légers				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			4.5%	0.0%	0.0%	4.4%	2.6%
% Lourds				0.0%	0.0%	36.0%	30.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			25.4%	0.0%	0.0%	25.0%	22.2%
PHF					**0.63**	**0.89**	**0.83**									**0.50**	**0.61**		**0.68**			**0.88**		**0.25**	**0.89**	**0.86**

Midi 11:00 à 12:00 - (Ensemble des véhicules, piétons et cyclistes)

Période		Mtée Lapierre – Approche Nord						N/A – Approche Est						Mtée Lapierre – Approche Sud						Entrée/Sortie A-30 Est – Approche Ouest						Grand total véhicules
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
11:00	11:15				1	4	**5**									1	3		**4**			9			**9**	**18**
11:15	11:30				3		**3**										2		**2**			5		1	**6**	**11**
11:30	11:45				1	4	**5**									1	3		**4**			9			**9**	**18**
11:45	12:00																					7			**7**	**7**
TOTAL					**5**	**8**	**13**									**2**	**8**		**10**			**30**		**1**	**31**	**54**
% Légers				0.0%	20.0%	12.5%	15.4%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			3.3%	0.0%	0.0%	3.2%	5.6%
% Lourds				0.0%	0.0%	62.5%	38.5%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			73.3%	0.0%	0.0%	71.0%	50.0%
PHF					**0.42**	**0.50**	**0.65**									**0.50**	**0.67**		**0.63**			**0.83**		**0.25**	**0.86**	**0.75**

PM 15:45 à 16:45 - (Ensemble des véhicules, piétons et cyclistes)

Période		Mtée Lapierre – Approche Nord						N/A – Approche Est						Mtée Lapierre – Approche Sud						Entrée/Sortie A-30 Est – Approche Ouest						Grand total véhicules
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
15:45	16:00				3	1	**4**										7		**7**			10		2	**12**	**23**
16:00	16:15				1	4	**5**										2		**2**			3		5	**8**	**15**
16:15	16:30				2	6	**8**										2		**2**			4		1	**5**	**15**
16:30	16:45				2	2	**4**									1	3		**4**			6		4	**10**	**18**
TOTAL					**8**	**13**	**21**									**1**	**14**		**15**			**23**		**12**	**35**	**71**
% Légers				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	14.3%	0.0%	13.3%			4.3%	0.0%	0.0%	2.9%	4.2%
% Lourds				0.0%	0.0%	7.7%	4.8%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			43.5%	0.0%	0.0%	28.6%	15.5%
PHF					**0.67**	**0.54**	**0.66**									**0.25**	**0.50**		**0.54**			**0.58**		**0.60**	**0.73**	**0.77**

Soir 0:00 à 1:00 - (Ensemble des véhicules, piétons et cyclistes)

Période		Mtée Lapierre – Approche Nord						N/A – Approche Est						Mtée Lapierre – Approche Sud						Entrée/Sortie A-30 Est – Approche Ouest						Grand total véhicules
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30																									
0:30	0:45																									
0:45	1:00																									
TOTAL																										
% Légers				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%	0.0%
% Lourds				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%	0.0%
PHF																										

Diagramme de compilation

0317-55-7

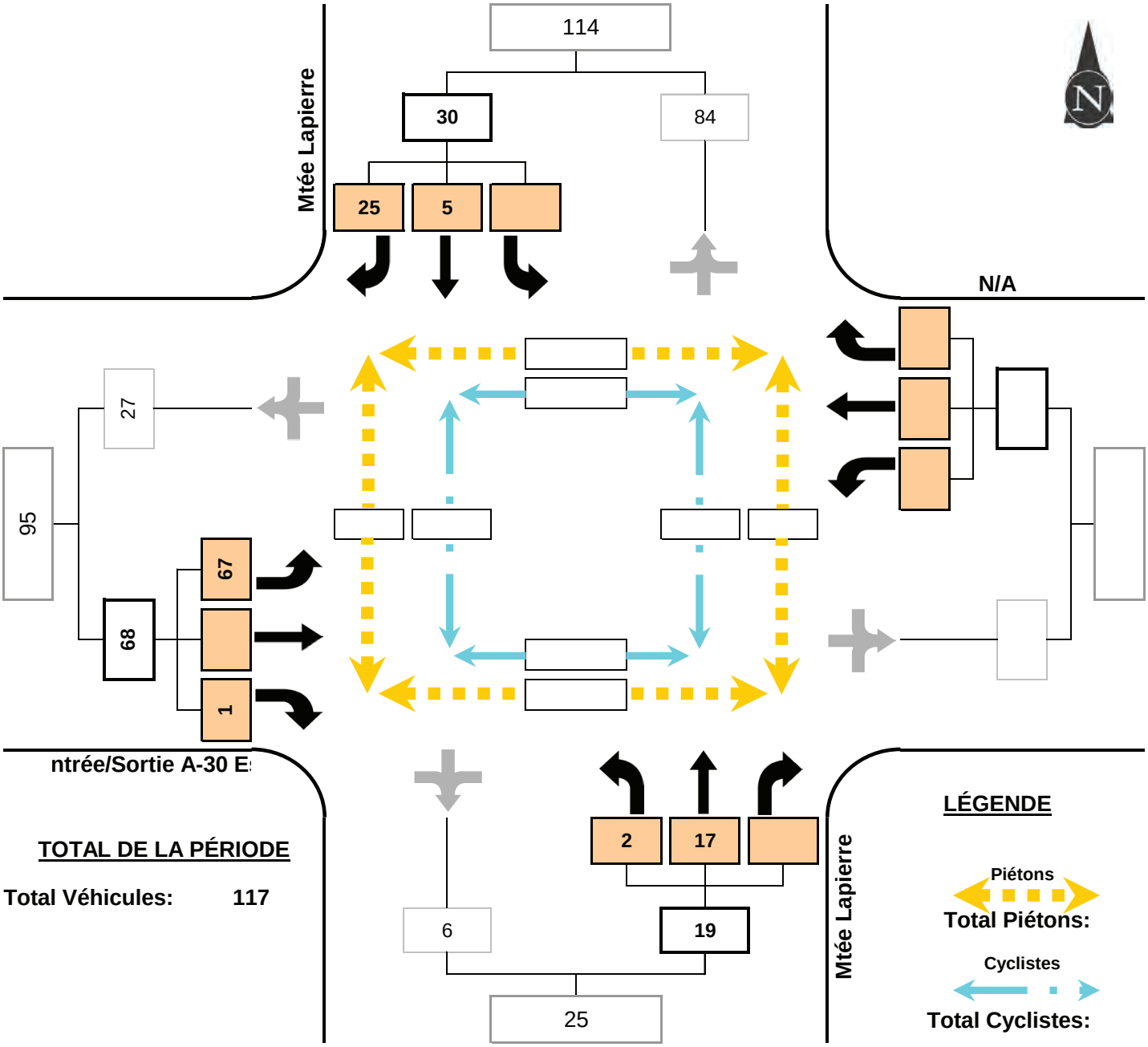
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 9 May 2017
Jour: mardi

Intersection: Mtée Lapierre _ N/A

AM

Période: 7:00 à 8:00



TOTAL DE LA PÉRIODE

Total Véhicules: 117

Diagramme de compilation

0317-55-7

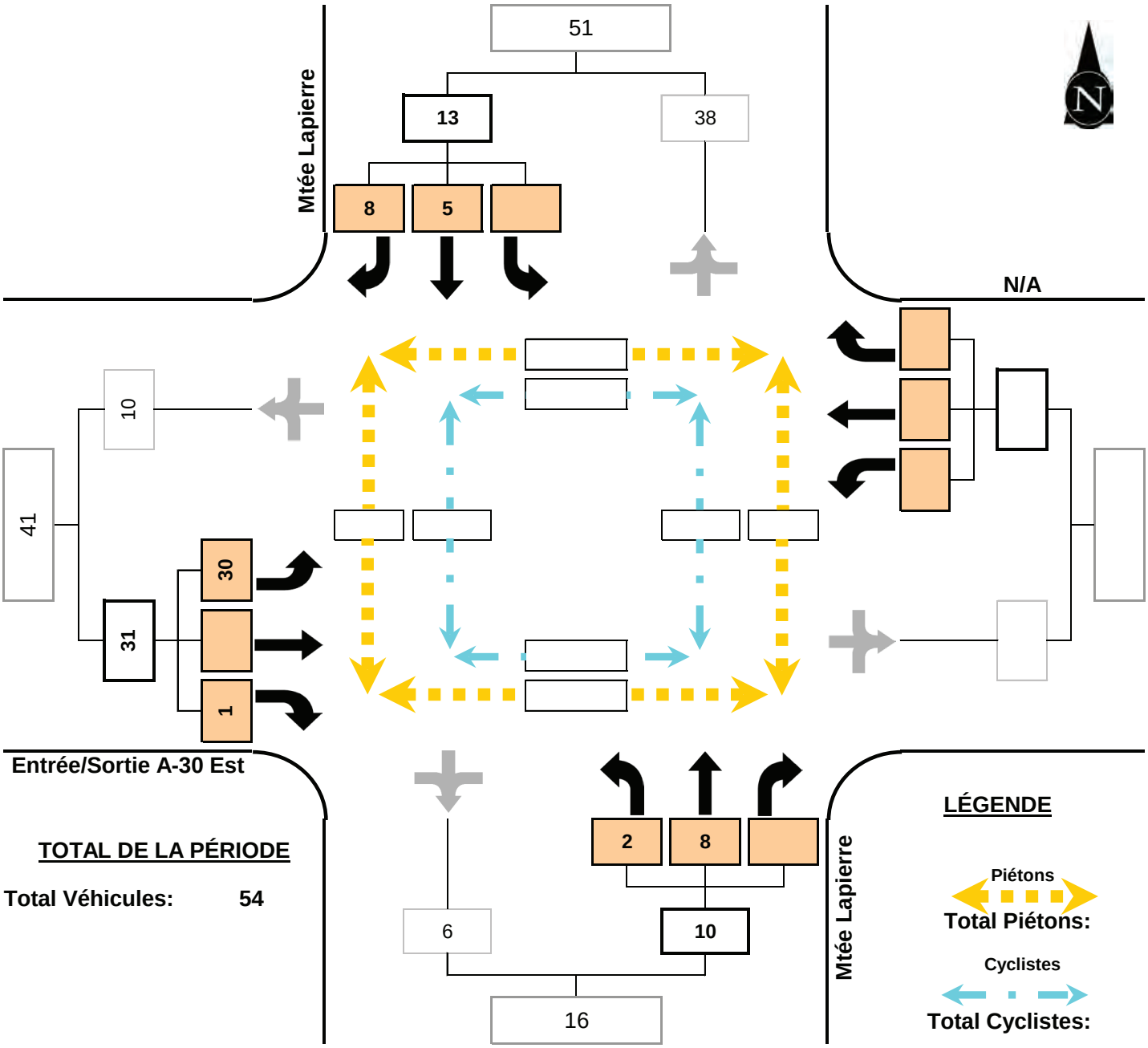
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 9 May 2017
Jour: mardi

Intersection: Mtée Lapierre _ N/A

Midi

Période: 11:00 à 12:00



TOTAL DE LA PÉRIODE

Total Véhicules: **54**

Diagramme de compilation

0317-55-7

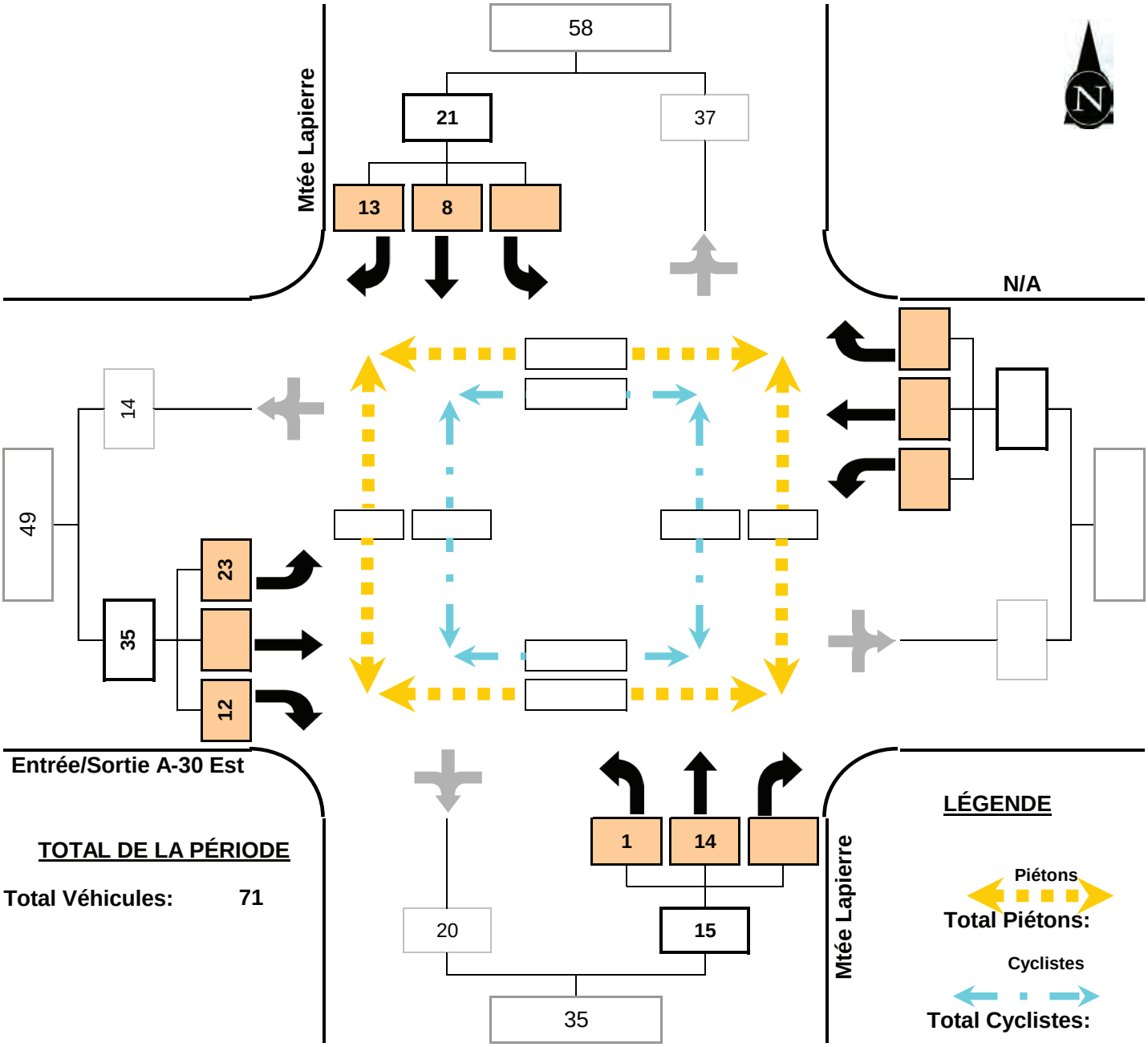
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 9 May 2017
Jour: mardi

Intersection: Mtée Lapierre _ N/A

PM

Période: 15:45 à 16:45



TOTAL DE LA PÉRIODE

Total Véhicules: 71

Compilation Data Traffic

Titre: 0317-55-1

Comptage

Ville ou Arrondissement: Contrecoeur

Intersection: Entrée privé _ Marie-Victorin

Approche Nord	Entrée privé
Approche Est	Marie-Victorin
Approche Sud	Mtée Pomme d'Or
Approche Ouest	Marie-Victorin

Classification

Automobiles, Piétons et Cyclistes

Camions, Autobus

Articulés



Date: 9 mai 2017
Jour: mardi

Conditions climatiques: Nuageux
Température: 3°C

Période(s) de comptage	AM	Midi	PM	Soir
Début	6:00	11:00	15:00	
Fin	9:00	13:00	18:00	
Durée	3:00	2:00	3:00	

Durée du comptage 8:00

Géolocalisation:

Lien hypertexte de localisation:

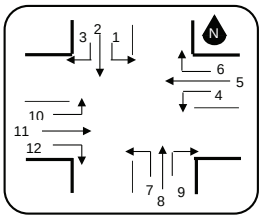
Observation:

Remarque:

Comptages

0317-55-1

Date: May 9, 2017
Jour: mardi



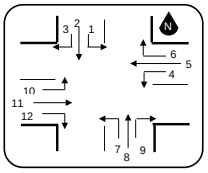
TOTAL Véhicules, Piétons et Cyclistes

Période		Entrée privé						Marie-Victorin						Mtée Pomme d'Or						Marie-Victorin						Grand Total
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9		10		11	12			
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	1:00																									
1:00	2:00																									
2:00	3:00																									
3:00	4:00																									
4:00	5:00																									
5:00	6:00																									
6:00	7:00	1						1		195	94		289			40		46	86				20	8	28	403
7:00	8:00	2						1		256	135		391			41		85	126				36	24	60	577
8:00	9:00									119	92		211			32		78	110				50	32	82	403
9:00	10:00																									
10:00	11:00																									
11:00	12:00	1								73	67		140			29		78	107				64	24	88	335
12:00	13:00	1						1		106	72		178			31		110	141				64	23	87	406
13:00	14:00																									
14:00	15:00																									
15:00	16:00	1								79	85		164			34		128	162				119	38	157	483
16:00	17:00							1		79	80		159			17		184	201	1			155	46	201	561
17:00	18:00							2		99	62		161			17		181	198				121	15	136	495
18:00	19:00																									
19:00	20:00																									
20:00	21:00																									
21:00	22:00																									
22:00	23:00																									
23:00	0:00																									
TOTAL		**6**	**0**	**0**	**0**	**0**	**0**	**6**	**0**	**1006**	**687**	**0**	**1693**	**0**	**0**	**241**	**0**	**890**	**1131**	**1**	**0**	**0**	**629**	**210**	**839**	3663

Comptages

0317-55-1

Date: May 9, 2017
Jour: mardi



TOTAL Véhicules, Piétons et Cyclistes

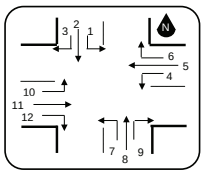
Période		Entrée privé – Approche Nord						Marie-Victorin – Approche Est						Mtée Pomme d'Or – Approche Sud						Marie-Victorin – Approche Ouest						Grand Total
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→																				
0:00	0:15																									
0:15	0:30																									
0:30	0:45																									
0:45	1:00																									
1:00	1:15																									
1:15	1:30																									
1:30	1:45																									
1:45	2:00																									
2:00	2:15																									
2:15	2:30																									
2:30	2:45																									
2:45	3:00																									
3:00	3:15																									
3:15	3:30																									
3:30	3:45																									
3:45	4:00																									
4:00	4:15																									
4:15	4:30																									
4:30	4:45																									
4:45	5:00																									
5:00	5:15																									
5:15	5:30																									
5:30	5:45																									
5:45	6:00																									
6:00	6:15	*1*								54	19		**73**			5		5	**10**				4	1	**5**	88
6:15	6:30									53	22		**75**			6		8	**14**				3	2	**5**	94
6:30	6:45							*1*		35	29		**64**			11		19	**30**				4	1	**5**	99
6:45	7:00									53	24		**77**			18		14	**32**				9	4	**13**	122
7:00	7:15									63	29		**92**			5		17	**22**				8	6	**14**	128
7:15	7:30	*2*						*1*		80	33		**113**			11		18	**29**				7	5	**12**	154
7:30	7:45									68	42		**110**			18		21	**39**				6	6	**12**	161
7:45	8:00									45	31		**76**			7		29	**36**				15	7	**22**	134
8:00	8:15									32	22		**54**			10		15	**25**				16	11	**27**	106
8:15	8:30									32	27		**59**			9		24	**33**				12	6	**18**	110
8:30	8:45									29	23		**52**			7		21	**28**				11	8	**19**	99
8:45	9:00									26	20		**46**			6		18	**24**				11	7	**18**	88
9:00	9:15																									
9:15	9:30																									
9:30	9:45																									
9:45	10:00																									
10:00	10:15																									
10:15	10:30																									
10:30	10:45																									
10:45	11:00																									
11:00	11:15	*1*								19	17		**36**			10		20	**30**				20	4	**24**	90
11:15	11:30									23	15		**38**			7		18	**25**				15	8	**23**	86
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12:00	12:15	*1*						*1*		21	12		**33**			5		34	**39**				14	10	**24**	96
12:15	12:30									17	21		**38**			6		29	**35**				12	4	**16**	89
12:30	12:45									25	15		**40**			12		22	**34**				24	3	**27**	101
12:45	13:00									43	24		**67**			8		25	**33**				14	6	**20**	120
13:00	13:15																									
13:15	13:30																									
13:30	13:45																									
13:45	14:00																									
14:00	14:15																									
14:15	14:30																									
14:30	14:45																									
14:45	15:00																									
15:00	15:15	*1*								21	24		**45**			11		23	**34**				24	13	**37**	116
15:15	15:30									11	17		**28**			5		42	**47**				28	8	**36**	111
15:30	15:45									26	22		**48**			7		30	**37**				32	4	**36**	121
15:45	16:00									21	22		**43**			11		33	**44**				35	13	**48**	135
16:00	16:15							*1*		20	26		**46**			8		56	**64**				32	18	**50**	160
16:15	16:30									19	21		**40**			5		33	**38**				55	8	**63**	141
16:30	16:45									19	17		**36**			1		48	**49**				36	7	**43**	128
16:45	17:00									21	16		**37**			3		47	**50**	*1*			32	13	**45**	132
17:00	17:15							*1*		32	23		**55**			8		49	**57**				36	6	**42**	154
17:15	17:30							*1*		19	13		**32**			7		53	**60**				28	3	**31**	123
17:30	17:45									21	14		**35**			1		39	**40**				28	5	**33**	108
17:45	18:00									27	12		**39**			1		40	**41**				29	1	**30**	110
18:00	18:15																									
18:15	18:30																									
18:30	18:45																									
18:45	19:00																									
19:00	19:15																									
19:15	19:30																									
19:30	19:45																									
19:45	20:00																									
20:00	20:15																									
20:15	20:30																									
20:30	20:45																									
20:45	21:00																									
21:00	21:15																									
21:15	21:30																									
21:30	21:45																									
21:45	22:00																									
22:00	22:15																									
22:15	22:30																									
22:30	22:45																									
22:45	23:00																									
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23:15	23:30																									
23:30	23:45																									
23:45	0:00																									
TOTAL		*6*	*0*	**0**	**0**	**0**	**0**	*6*	*0*	**1006**	**687**	**0**	**1693**	*0*	*0*	**241**	**0**	**890**	**1131**	*1*	*0*	**0**	**629**	**210**	**839**	3663

Comptages

0317-55-1

Date: May 9, 2017
Jour: mardi





Automobiles, Piétons et Cyclistes

Période		Entrée privé – Approche Nord						Marie-Victorin – Approche Est						Mtée Pomme d'Or – Approche Sud						Marie-Victorin – Approche Ouest						Grand total
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		Autos
0:00	0:15																									
0:15	0:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
0:30	0:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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1:00	1:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:15	1:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:30	1:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:45	2:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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6:00	6:15	1								50	18		68			3		5	8				4	1	5	81
6:15	6:30									48	21		69			5		7	12				2	1	3	84
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6:45	7:00									50	23		73			13		13	26				8	2	10	109
7:00	7:15									62	27		89			4		14	18				8	6	14	121
7:15	7:30	2						1		79	32		111			5		13	18				6	2	8	137
7:30	7:45									67	41		108			17		19	36				6	5	11	155
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8:00	8:15									32	22		54			6		14	20				16	5	21	95
8:15	8:30									31	26		57			6		23	29				11	3	14	100
8:30	8:45									26	22		48			4		20	24				10	1	11	83
8:45	9:00									25	19		44			4		17	21				11	4	15	80
9:00	9:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
9:15	9:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
9:30	9:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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10:00	10:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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10:45	11:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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11:15	11:30									21	13		34			4		18	22				15	3	18	74
11:30	11:45									16	17		33			3		16	19				11	4	15	67
11:45	12:00									12	17		29			4		21	25				15	2	17	71
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14:15	14:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
14:30	14:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
14:45	15:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
15:00	15:15	1								19	24		43			5		22	27				22	9	31	101
15:15	15:30									9	17		26			1		41	42				25	5	30	98
15:30	15:45									24	20		44			5		29	34				31	1	32	110
15:45	16:00									18	19		37			9		33	42				34	8	42	121
16:00	16:15							1		19	25		44			5		54	59				32	12	44	147
16:15	16:30									19	19		38			2		31	33				55	7	62	133
16:30	16:45									18	17		35					48	48				35	7	42	125
16:45	17:00									21	16		37			3		44	47	1			31	12	43	127
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17:15	17:30							1		19	13		32			5		52	57				25	2	27	116
17:30	17:45									21	14		35			1		38	39				26	4	30	104
17:45	18:00									25	12		37					40	40				27		27	104
18:00	18:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
18:15	18:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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19:45	20:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
20:00	20:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
20:15	20:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
20:30	20:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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22:00	22:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
22:15	22:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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23:45	0:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
TOTAL		**6**	**0**	**0**	**0**	**0**	**0**	**6**	**0**	**958**	**657**	**0**	**1615**	**0**	**0**	**152**	**0**	**850**	**1002**	**1**	**0**	**0**	**595**	**122**	**717**	3334

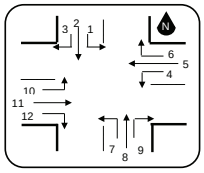
Comptages

Date: May 9, 2017
Jour: mardi

0317-55-1



Camions, Autobus

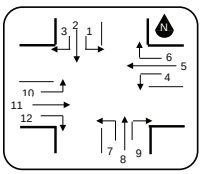


Période		Entrée privé – Approche Nord						Marie-Victorin – Approche Est						Mtée Pomme d'Or – Approche Sud						Marie-Victorin – Approche Ouest						Grand total
		'	'	Gauche	Tout Droit	Droite	Total	'	'	Gauche	Tout Droit	Droite	Total	'	'	Gauche	Tout Droit	Droite	Total	'	'	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		Légers
0:00	0:15																									
0:15	0:30			0	0	0				0	0	0				0	0	0				0	0	0		
0:30	0:45			0	0	0				0	0	0				0	0	0				0	0	0		
0:45	1:00			0	0	0				0	0	0				0	0	0				0	0	0		
1:00	1:15			0	0	0				0	0	0				0	0	0				0	0	0		
1:15	1:30			0	0	0				0	0	0				0	0	0				0	0	0		
1:30	1:45			0	0	0				0	0	0				0	0	0				0	0	0		
1:45	2:00			0	0	0				0	0	0				0	0	0				0	0	0		
2:00	2:15			0	0	0				0	0	0				0	0	0				0	0	0		
2:15	2:30			0	0	0				0	0	0				0	0	0				0	0	0		
2:30	2:45			0	0	0				0	0	0				0	0	0				0	0	0		
2:45	3:00			0	0	0				0	0	0				0	0	0				0	0	0		
3:00	3:15			0	0	0				0	0	0				0	0	0				0	0	0		
3:15	3:30			0	0	0				0	0	0				0	0	0				0	0	0		
3:30	3:45			0	0	0				0	0	0				0	0	0				0	0	0		
3:45	4:00			0	0	0				0	0	0				0	0	0				0	0	0		
4:00	4:15			0	0	0				0	0	0				0	0	0				0	0	0		
4:15	4:30			0	0	0				0	0	0				0	0	0				0	0	0		
4:30	4:45			0	0	0				0	0	0				0	0	0				0	0	0		
4:45	5:00			0	0	0				0	0	0				0	0	0				0	0	0		
5:00	5:15			0	0	0				0	0	0				0	0	0				0	0	0		
5:15	5:30			0	0	0				0	0	0				0	0	0				0	0	0		
5:30	5:45			0	0	0				0	0	0				0	0	0				0	0	0		
5:45	6:00			0	0	0				0	0	0				0	0	0				0	0	0		
6:00	6:15									1	1		2													2
6:15	6:30									1	1		2										1	1	2	4
6:30	6:45										1		1										1	1	2	3
6:45	7:00									2	1		3			1		1	2				1	1	2	7
7:00	7:15									1	2		3					3	3							6
7:15	7:30									1	1		2			2		4	6				1	1	2	10
7:30	7:45									1	1		2					2	2					1	1	5
7:45	8:00									3	2		5										1		1	6
8:00	8:15															1		1	2					1	1	3
8:15	8:30									1	1		2			1		1	2				1		1	5
8:30	8:45									3	1		4					1	1				1	2	3	8
8:45	9:00									1	1		2			1		1	2							4
9:00	9:15			0	0	0				0	0	0				0	0	0				0	0	0		
9:15	9:30			0	0	0				0	0	0				0	0	0				0	0	0		
9:30	9:45			0	0	0				0	0	0				0	0	0				0	0	0		
9:45	10:00			0	0	0				0	0	0				0	0	0				0	0	0		
10:00	10:15			0	0	0				0	0	0				0	0	0				0	0	0		
10:15	10:30			0	0	0				0	0	0				0	0	0				0	0	0		
10:30	10:45			0	0	0				0	0	0				0	0	0				0	0	0		
10:45	11:00			0	0	0				0	0	0				0	0	0				0	0	0		
11:00	11:15									1	1		2			2		1	3				2	2	4	9
11:15	11:30									2	2		4			1			1					2	2	7
11:30	11:45									2	1		3			1			1				3	2	5	9
11:45	12:00									1			1			1		1	2					2	2	5
12:00	12:15									1	1		2			1		2	3					1	1	6
12:15	12:30										2		2			1		1	2							4
12:30	12:45									1			1			3			3				1	1	2	6
12:45	13:00									2			2					1	1				1	2	3	6
13:00	13:15			0	0	0				0	0	0				0	0	0				0	0	0		
13:15	13:30			0	0	0				0	0	0				0	0	0				0	0	0		
13:30	13:45			0	0	0				0	0	0				0	0	0				0	0	0		
13:45	14:00			0	0	0				0	0	0				0	0	0				0	0	0		
14:00	14:15			0	0	0				0	0	0				0	0	0				0	0	0		
14:15	14:30			0	0	0				0	0	0				0	0	0				0	0	0		
14:30	14:45			0	0	0				0	0	0				0	0	0				0	0	0		
14:45	15:00			0	0	0				0	0	0				0	0	0				0	0	0		
15:00	15:15									2			2			3			3				1	1	2	7
15:15	15:30									1			1			1			1				3	2	5	7
15:30	15:45									2	2		4			1		1	2				1	2	3	9
15:45	16:00									3	3		6			2			2				1	1	2	10
16:00	16:15									1	1		2			1			1					1	1	4
16:15	16:30										2		2			1		2	3					1	1	6
16:30	16:45									1			1										1		1	2
16:45	17:00																	3	3				1		1	4
17:00	17:15									1	1		2			1			1				2		2	5
17:15	17:30															1		1	2				1	1	2	4
17:30	17:45																						2	1	3	3
17:45	18:00									2			2			1			1				2	1	3	6
18:00	18:15			0	0	0				0	0	0				0	0	0				0	0	0		
18:15	18:30			0	0	0				0	0	0				0	0	0				0	0	0		
18:30	18:45			0	0	0				0	0	0				0	0	0				0	0	0		
18:45	19:00			0	0	0				0	0	0				0	0	0				0	0	0		
19:00	19:15			0	0	0				0	0	0				0	0	0				0	0	0		
19:15	19:30			0	0	0				0	0	0				0	0	0				0	0	0		
19:30	19:45			0	0	0				0	0	0				0	0	0				0	0	0		
19:45	20:00			0	0	0				0	0	0				0	0	0				0	0	0		
20:00	20:15			0	0	0				0	0	0				0	0	0				0	0	0		
20:15	20:30			0	0	0				0	0	0				0	0	0				0	0	0		
20:30	20:45			0	0	0				0	0	0				0	0	0				0	0	0		
20:45	21:00			0	0	0				0	0	0				0	0	0				0	0	0		
21:00	21:15			0	0	0				0	0	0				0	0	0				0	0	0		
21:15	21:30			0	0	0				0	0	0				0	0	0				0	0	0		
21:30	21:45			0	0	0				0	0	0				0	0	0				0	0	0		
21:45	22:00			0	0	0				0	0	0				0	0	0				0	0	0		
22:00	22:15			0	0	0				0	0	0				0	0	0				0	0	0		
22:15	22:30			0	0	0				0	0	0				0	0	0				0	0	0		
22:30	22:45			0	0	0				0	0	0				0	0	0				0	0	0		
22:45	23:00			0	0	0				0	0	0				0	0	0				0	0	0		
23:00	23:15			0	0	0				0	0	0				0	0	0				0	0	0		
23:15	23:30			0	0	0				0	0	0				0	0	0				0	0	0		
23:30	23:45			0	0	0				0	0	0				0	0	0				0	0	0		
23:45	0:00			0	0	0				0	0	0				0	0	0				0	0	0		
TOTAL		*0*	*0*	**0**	**0**	**0**	**0**	*0*	*0*	**38**	**29**	**0**	**67**	*0*	*0*	**28**	**0**	**27**	**55**	*0*	*0*	**0**	**29**	**31**	**60**	182

Comptages

0317-55-1

Date: May 9, 2017
Jour: mardi



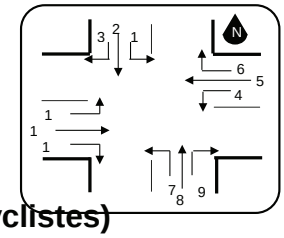
Articulés

Période		Entrée privé – Approche Nord						Marie-Victorin – Approche Est						Mtée Pomme d'Or – Approche Sud						Marie-Victorin – Approche Ouest						Grand total
		Virage en U		Gauche	Tout Droit	Droite	Total	Virage en U		Gauche	Tout Droit	Droite	Total	Virage en U		Gauche	Tout Droit	Droite	Total	Virage en U		Gauche	Tout Droit	Droite	Total	Lourds
de	à			1	2	3				4	5	6				7	8	9				10	11	12		
0:00	0:15																									
0:15	0:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
0:30	0:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
0:45	1:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:00	1:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:15	1:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:30	1:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:45	2:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:00	2:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:15	2:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:30	2:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:45	3:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:00	3:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:15	3:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:30	3:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:45	4:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:00	4:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:15	4:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:30	4:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:45	5:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:00	5:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:15	5:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:30	5:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:45	6:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
6:00	6:15									3			**3**			2			**2**							5
6:15	6:30									4			**4**			1		1	**2**							6
6:30	6:45															1			**1**							1
6:45	7:00									1			**1**			4			**4**					1	**1**	6
7:00	7:15															1			**1**							1
7:15	7:30															4		1	**5**					2	**2**	7
7:30	7:45															1			**1**							1
7:45	8:00																							4	**4**	4
8:00	8:15															3			**3**					5	**5**	8
8:15	8:30															2			**2**					3	**3**	5
8:30	8:45															3			**3**					5	**5**	8
8:45	9:00															1			**1**					3	**3**	4
9:00	9:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
9:15	9:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
9:30	9:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
9:45	10:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:00	10:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:15	10:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:30	10:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:45	11:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
11:00	11:15															3			**3**					1	**1**	4
11:15	11:30															2			**2**					3	**3**	5
11:30	11:45															2		1	**3**					1	**1**	4
11:45	12:00															1		1	**2**					1	**1**	3
12:00	12:15									1			**1**			1		1	**2**					3	**3**	6
12:15	12:30															4		1	**5**					4	**4**	9
12:30	12:45										1		**1**			9			**9**					2	**2**	12
12:45	13:00															2		1	**3**					3	**3**	6
13:00	13:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:15	13:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:30	13:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:45	14:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:00	14:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:15	14:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:30	14:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:45	15:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
15:00	15:15															3		1	**4**				1	3	**4**	8
15:15	15:30									1			**1**			3		1	**4**					1	**1**	6
15:30	15:45															1			**1**					1	**1**	2
15:45	16:00																							4	**4**	4
16:00	16:15															2		2	**4**					5	**5**	9
16:15	16:30															2			**2**							2
16:30	16:45															1			**1**							1
16:45	17:00																							1	**1**	1
17:00	17:15															1		1	**2**				2	1	**3**	5
17:15	17:30															1			**1**				2		**2**	3
17:30	17:45																	1	**1**							1
17:45	18:00																									
18:00	18:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:15	18:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:30	18:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:45	19:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:00	19:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:15	19:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:30	19:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:45	20:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:00	20:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:15	20:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:30	20:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:45	21:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:00	21:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:15	21:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:30	21:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:45	22:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:00	22:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:15	22:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:30	22:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:45	23:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:00	23:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:15	23:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:30	23:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:45	0:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
TOTAL		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**10**	**1**	**0**	**11**	**0**	**0**	**61**	**0**	**13**	**74**	**0**	**0**	**0**	**5**	**57**	**62**	147

Compilation des heures de pointes

0317-55-1

Date: May 9, 2017
Jour: mardi



Heure de pointe du réseau

AM 7:00 à 8:00 - (Ensemble des véhicules, piétons et cyclistes)

Période		Entrée privé – Approche Nord						Marie-Victorin – Approche Est						Mtée Pomme d'Or – Approche Sud						Marie-Victorin – Approche Ouest						Grand total véhicules
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
7:00	7:15									63	29		92			5		17	22				8	6	14	128
7:15	7:30	2						1		80	33		113			11		18	29				7	5	12	154
7:30	7:45									68	42		110			18		21	39				6	6	12	161
7:45	8:00									45	31		76			7		29	36				15	7	22	134
TOTAL		2						1		256	135		391			41		85	126				36	24	60	577
% Légers				0.0%	0.0%	0.0%	0.0%			2.3%	4.4%	0.0%	3.1%			4.9%	0.0%	10.6%	8.7%			0.0%	5.6%	8.3%	6.7%	4.7%
% Lourds				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			14.6%	0.0%	1.2%	5.6%			0.0%	0.0%	4.2%	10.0%	2.3%
PHF										0.80	0.80		0.87			0.57		0.73	0.81				0.60	0.86	0.68	0.90

Midi 12:00 à 13:00 - (Ensemble des véhicules, piétons et cyclistes)

Période		Entrée privé – Approche Nord						Marie-Victorin – Approche Est						Mtée Pomme d'Or – Approche Sud						Marie-Victorin – Approche Ouest						Grand total véhicules
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
12:00	12:15	1						1		21	12		33			5		34	39				14	10	24	96
12:15	12:30									17	21		38			6		29	35				12	4	16	89
12:30	12:45									25	15		40			12		22	34				24	3	27	101
12:45	13:00									43	24		67			8		25	33				14	6	20	120
TOTAL		1						1		106	72		178			31		110	141				64	23	87	406
% Légers				0.0%	0.0%	0.0%	0.0%			3.8%	4.2%	0.0%	3.9%			16.1%	0.0%	3.6%	6.4%			0.0%	3.1%	17.4%	6.9%	5.4%
% Lourds				0.0%	0.0%	0.0%	0.0%			0.9%	1.4%	0.0%	1.1%			51.6%	0.0%	2.7%	13.5%			0.0%	0.0%	13.0%	13.8%	8.1%
PHF										0.62	0.75		0.66			0.65		0.81	0.90				0.67	0.58	0.81	0.85

PM 15:45 à 16:45 - (Ensemble des véhicules, piétons et cyclistes)

Période		Entrée privé – Approche Nord						Marie-Victorin – Approche Est						Mtée Pomme d'Or – Approche Sud						Marie-Victorin – Approche Ouest						Grand total véhicules
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
15:45	16:00									21	22		43			11		33	44				35	13	48	135
16:00	16:15							1		20	26		46			8		56	64				32	18	50	160
16:15	16:30									19	21		40			5		33	38				55	8	63	141
16:30	16:45									19	17		36			1		48	49				36	7	43	128
TOTAL								1		79	86		165			25		170	195				158	46	204	564
% Légers				0.0%	0.0%	0.0%	0.0%			6.3%	7.0%	0.0%	6.7%			16.0%	0.0%	1.2%	3.1%			0.0%	1.3%	6.5%	2.5%	3.9%
% Lourds				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			20.0%	0.0%	1.2%	3.6%			0.0%	0.0%	19.6%	4.4%	2.8%
PHF										0.94	0.83		0.90			0.57		0.76	0.76				0.72	0.64	0.81	0.88

Soir 0:00 à 1:00 - (Ensemble des véhicules, piétons et cyclistes)

Période		Entrée privé – Approche Nord						Marie-Victorin – Approche Est						Mtée Pomme d'Or – Approche Sud						Marie-Victorin – Approche Ouest						Grand total véhicules
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30																									
0:30	0:45																									
0:45	1:00																									
TOTAL																										
% Légers				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%	0.0%
% Lourds				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%	0.0%
PHF																										

Diagramme de compilation

0317-55-1

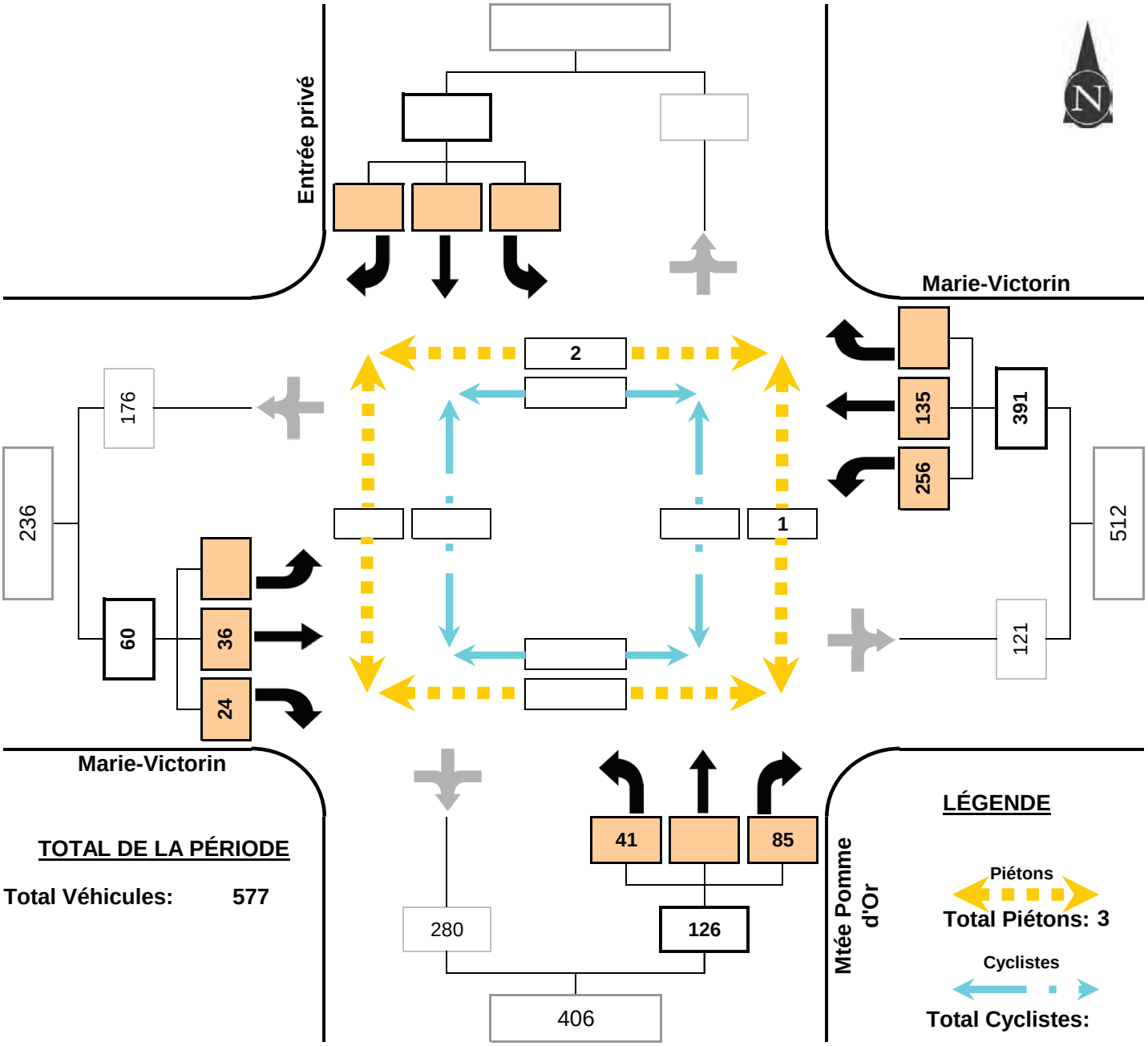
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 9 May 2017
Jour: mardi

Intersection: Entrée privé _ Marie-Victorin

AM

Période: 7:00 à 8:00



TOTAL DE LA PÉRIODE

Total Véhicules: 577

LÉGENDE

Piétons
Total Piétons: 3

Cyclistes
Total Cyclistes:

Diagramme de compilation

0317-55-1

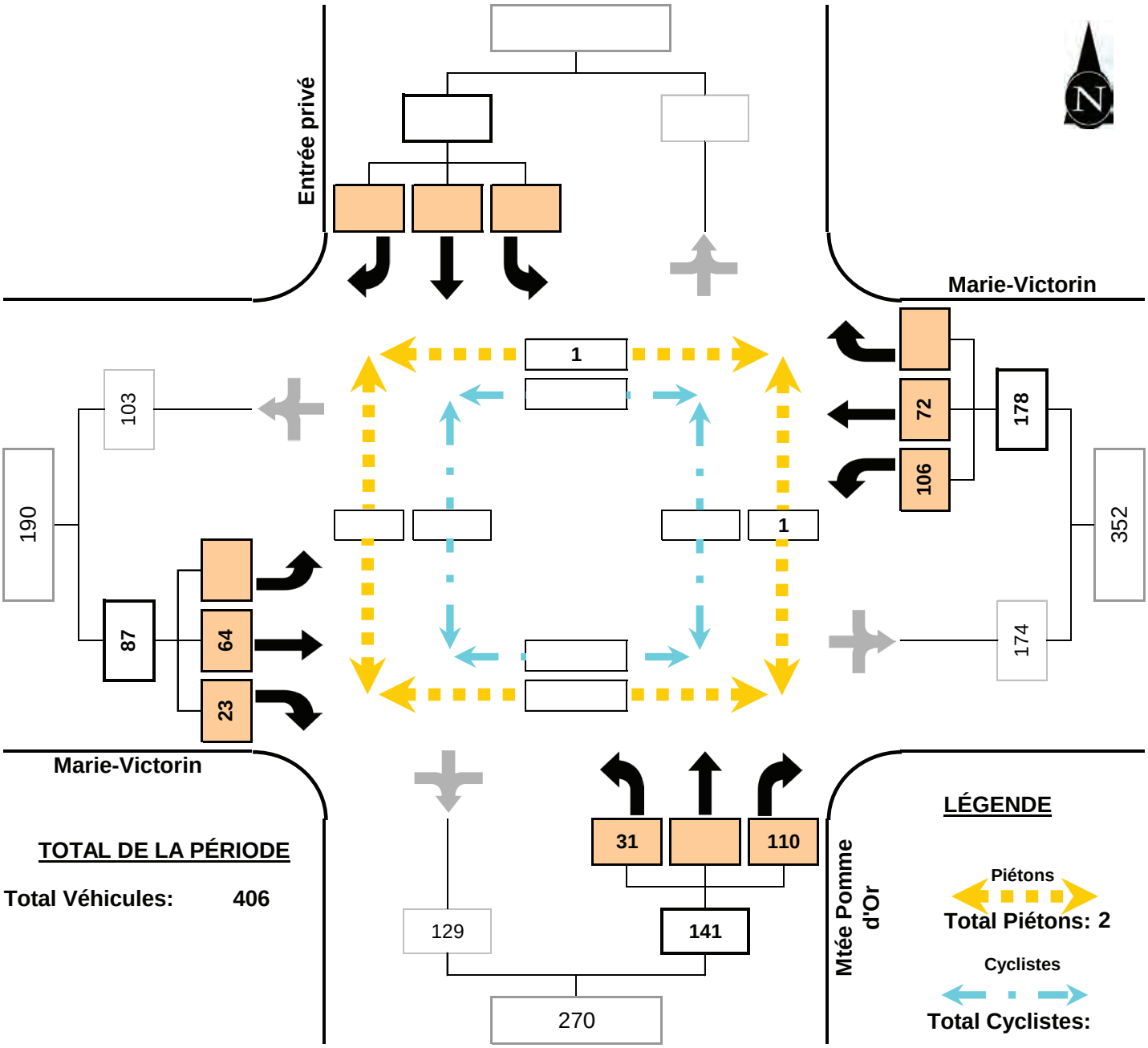
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 9 May 2017
Jour: mardi

Intersection: Entrée privé _ Marie-Victorin

Midi

Période: 12:00 à 13:00



TOTAL DE LA PÉRIODE

Total Véhicules: 406

Diagramme de compilation

0317-55-1

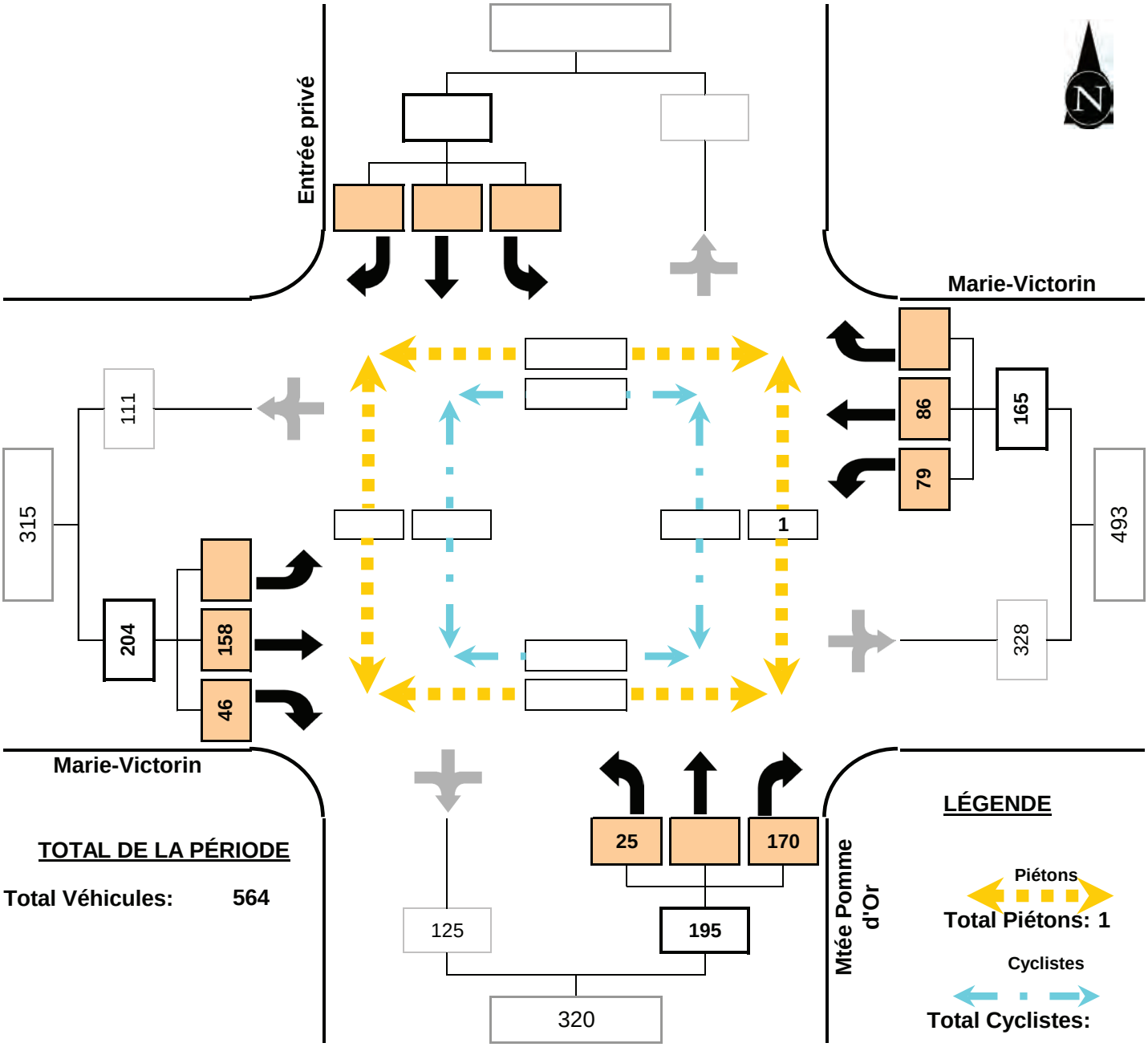
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 9 May 2017
Jour: mardi

Intersection: Entrée privé _ Marie-Victorin

PM

Période: 15:45 à 16:45



TOTAL DE LA PÉRIODE

Total Véhicules: 564

Compilation Data Traffic

Titre: 0317-55-21

Comptage

Ville ou Arrondissement: Contrecoeur

Intersection: Mtée pomme d'Or et Entrée Sortie A-30 Ouest

Approche Nord	Mtée pomme d'Or
Approche Est	Entrée Sortie A-30 Ouest
Approche Sud	Mtée pomme d'Or
Approche Ouest	Route des Aciéries

Classification

Automobiles, Piétons et Cyclistes

Camions,Autobus

Articulés



Date: 10 mai 2017
Jour: mercredi

Conditions climatiques: Nuageux
Température: 11°C

Période(s) de comptage	AM	Midi	PM	Soir
Début	6:00	11:00	15:00	
Fin	9:00	13:00	18:00	
Durée	3:00	2:00	3:00	

Durée du comptage 8:00

Géolocalisation:

Lien hypertexte de localisation:

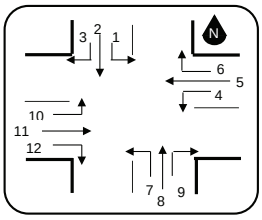
Observation:

Remarque:

Comptages

0317-55-21

Date: May 10, 2017
Jour: mercredi



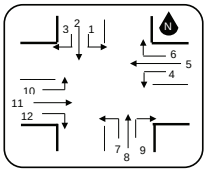
TOTAL Véhicules, Piétons et Cyclistes

Période		Mtée pomme d'Or						Entrée Sortie A-30 Ouest						Mtée pomme d'Or						Route des Aciéries						Grand Total
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	1:00																									
1:00	2:00																									
2:00	3:00																									
3:00	4:00																									
4:00	5:00																									
5:00	6:00																									
6:00	7:00			148	28	15	191			36	64	75	175			42	70	252	364			3	1	4	8	738
7:00	8:00			172	58	60	290	2		38	210	76	324			159	91	287	537			16	7	63	86	1237
8:00	9:00			87	45	15	147	2	1	27	27	49	103			67	79	149	295			6	6	21	33	578
9:00	10:00																									
10:00	11:00																									
11:00	12:00			76	55	19	150			30	6	33	69			31	53	60	144			23	14	29	66	429
12:00	13:00			47	58	25	130			26	8	37	71			28	58	77	163			30	16	35	81	445
13:00	14:00																									
14:00	15:00																									
15:00	16:00			65	60	12	137			32	9	34	75			14	105	60	179			28	35	86	149	540
16:00	17:00			74	105	11	190		2	41	8	50	99	1		8	125	74	207			31	64	124	219	715
17:00	18:00			73	67	12	152			38	17	33	88			20	123	55	198			23	37	45	105	543
18:00	19:00																									
19:00	20:00																									
20:00	21:00																									
21:00	22:00																									
22:00	23:00																									
23:00	0:00																									
TOTAL		**0**	**0**	**742**	**476**	**169**	**1387**	**4**	**3**	**268**	**349**	**387**	**1004**	**1**	**0**	**369**	**704**	**1014**	**2087**	**0**	**0**	**160**	**180**	**407**	**747**	5225

Comptages

0317-55-21

Date: May 10, 2017
Jour: mercredi



TOTAL Véhicules, Piétons et Cyclistes

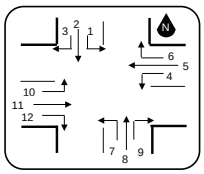
Période		Mtée pomme d'Or						Entrée Sortie A-30 Ouest						Mtée pomme d'Or						Route des Aciéries						Grand Total
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30																									
0:30	0:45																									
0:45	1:00																									
1:00	1:15																									
1:15	1:30																									
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4:15	4:30																									
4:30	4:45																									
4:45	5:00																									
5:00	5:15																									
5:15	5:30																									
5:30	5:45																									
5:45	6:00																									
6:00	6:15			37	2	4	**43**			6	11	11	**28**			6	9	52	**67**					1	**1**	139
6:15	6:30			43	2	3	**48**			5	10	14	**29**			11	16	59	**86**			1			**1**	164
6:30	6:45			29	8	2	**39**			10	13	32	**55**			9	28	62	**99**				1		**1**	194
6:45	7:00			39	16	6	**61**			15	30	18	**63**			16	17	79	**112**			2		3	**5**	241
7:00	7:15			51	13	9	**73**			6	55	14	**75**			26	20	81	**127**			1	1	1	**3**	278
7:15	7:30			48	11	11	**70**	*1*		9	40	15	**64**			39	25	89	**153**			1		3	**4**	291
7:30	7:45			46	16	20	**82**			10	61	26	**97**			41	23	61	**125**					2	**2**	306
7:45	8:00			27	18	20	**65**	*1*		13	54	21	**88**			53	23	56	**132**			14	6	57	**77**	362
8:00	8:15			24	15	8	**47**	*1*		6	13	16	**35**			25	19	51	**95**			2	5	9	**16**	193
8:15	8:30			31	10	5	**46**			8	8	12	**28**			23	22	38	**83**			1		4	**5**	162
8:30	8:45			13	8		**21**	*1*	*1*	10	1	9	**20**			13	22	32	**67**			2		2	**4**	112
8:45	9:00			19	12	2	**33**			3	5	12	**20**			6	16	28	**50**			1	1	6	**8**	111
9:00	9:15																									
9:15	9:30																									
9:30	9:45																									
9:45	10:00																									
10:00	10:15																									
10:15	10:30																									
10:30	10:45																									
10:45	11:00																									
11:00	11:15			16	14	6	**36**			5		9	**14**			7	8	14	**29**			4	2	5	**11**	90
11:15	11:30			18	12	1	**31**			13	3	8	**24**			10	12	15	**37**			7	1	7	**15**	107
11:30	11:45			18	19	7	**44**			8	2	9	**19**			10	15	16	**41**			6	5	10	**21**	125
11:45	12:00			24	10	5	**39**			4	1	7	**12**			4	18	15	**37**			6	6	7	**19**	107
12:00	12:15			16	17	5	**38**			6	1	13	**20**			10	21	20	**51**			17	3	16	**36**	145
12:15	12:30			7	15	2	**24**			8	3	2	**13**			4	12	17	**33**			6	4	6	**16**	86
12:30	12:45			11	8	4	**23**			6		15	**21**			4	18	19	**41**			6	4	7	**17**	102
12:45	13:00			13	18	14	**45**			6	4	7	**17**			10	7	21	**38**			1	5	6	**12**	112
13:00	13:15																									
13:15	13:30																									
13:30	13:45																									
13:45	14:00																									
14:00	14:15																									
14:15	14:30																									
14:30	14:45																									
14:45	15:00																									
15:00	15:15			13	13		**26**			10	3	4	**17**			4	24	11	**39**			3	6	12	**21**	103
15:15	15:30			21	12	6	**39**			5	2	7	**14**			2	30	18	**50**			8	13	21	**42**	145
15:30	15:45			15	19	2	**36**			9	2	11	**22**			6	25	15	**46**			8	5	15	**28**	132
15:45	16:00			16	16	4	**36**			8	2	12	**22**			2	26	16	**44**			9	11	38	**58**	160
16:00	16:15			17	33	6	**56**			9	5	11	**25**			2	29	19	**50**			15	19	50	**84**	215
16:15	16:30			26	25	1	**52**		*1*	13	1	17	**31**			2	24	17	**43**			4	14	23	**41**	167
16:30	16:45			20	30	2	**52**		*1*	7	2	13	**22**	*1*		3	37	26	**66**			5	13	31	**49**	189
16:45	17:00			11	17	2	**30**			12		9	**21**			1	35	12	**48**			7	18	20	**45**	144
17:00	17:15			35	24	4	**63**			9	1	3	**13**			2	39	15	**56**			3	14	13	**30**	162
17:15	17:30			13	18	2	**33**			14	3	14	**31**			4	42	14	**60**			3	10	7	**20**	144
17:30	17:45			16	14	4	**34**			7	7	7	**21**			5	22	12	**39**			9	6	12	**27**	121
17:45	18:00			9	11	2	**22**			8	6	9	**23**			9	20	14	**43**			8	7	13	**28**	116
18:00	18:15																									
18:15	18:30																									
18:30	18:45																									
18:45	19:00																									
19:00	19:15																									
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22:45	23:00																									
23:00	23:15																									
23:15	23:30																									
23:30	23:45																									
23:45	0:00																									
TOTAL		***0***	***0***	**742**	**476**	**169**	**1387**	***4***	***3***	**268**	**349**	**387**	**1004**	***1***	***0***	**369**	**704**	**1014**	**2087**	***0***	***0***	**160**	**180**	**407**	**747**	5225

Comptages

0317-55-21

Date: May 10, 2017
Jour: mercredi





Automobiles, Piétons et Cyclistes

Période		Mtée pomme d'Or						Entrée Sortie A-30 Ouest						Mtée pomme d'Or						Route des Aciéries						Grand total Autos
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
0:30	0:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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1:15	1:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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23:45	0:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
TOTAL		**0**	**0**	**660**	**380**	**153**	**1193**	**4**	**3**	**241**	**314**	**310**	**865**	**1**	**0**	**272**	**637**	**979**	**1888**	**0**	**0**	**149**	**124**	**350**	**623**	4569

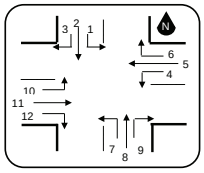
Comptages

Date: May 10, 2017
Jour: mercredi

0317-55-21



Camions,Autobus

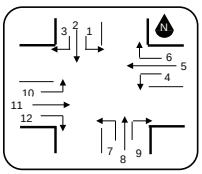


Période		Mtée pomme d'Or						Entrée Sortie A-30 Ouest						Mtée pomme d'Or						Route des Aciéries						Grand total Légers
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		'	'	Gauche	Tout Droit	Droite	Total	'	'	Gauche	Tout Droit	Droite	Total	'	'	Gauche	Tout Droit	Droite	Total	'	'	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30			0	0	0				0	0	0				0	0	0				0	0	0		
0:30	0:45			0	0	0				0	0	0				0	0	0				0	0	0		
0:45	1:00			0	0	0				0	0	0				0	0	0				0	0	0		
1:00	1:15			0	0	0				0	0	0				0	0	0				0	0	0		
1:15	1:30			0	0	0				0	0	0				0	0	0				0	0	0		
1:30	1:45			0	0	0				0	0	0				0	0	0				0	0	0		
1:45	2:00			0	0	0				0	0	0				0	0	0				0	0	0		
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17:45	18:00											1	**1**			1			**1**							2
18:00	18:15			0	0	0				0	0	0				0	0	0				0	0	0		
18:15	18:30			0	0	0				0	0	0				0	0	0				0	0	0		
18:30	18:45			0	0	0				0	0	0				0	0	0				0	0	0		
18:45	19:00			0	0	0				0	0	0				0	0	0				0	0	0		
19:00	19:15			0	0	0				0	0	0				0	0	0				0	0	0		
19:15	19:30			0	0	0				0	0	0				0	0	0				0	0	0		
19:30	19:45			0	0	0				0	0	0				0	0	0				0	0	0		
19:45	20:00			0	0	0				0	0	0				0	0	0				0	0	0		
20:00	20:15			0	0	0				0	0	0				0	0	0				0	0	0		
20:15	20:30			0	0	0				0	0	0				0	0	0				0	0	0		
20:30	20:45			0	0	0				0	0	0				0	0	0				0	0	0		
20:45	21:00			0	0	0				0	0	0				0	0	0				0	0	0		
21:00	21:15			0	0	0				0	0	0				0	0	0				0	0	0		
21:15	21:30			0	0	0				0	0	0				0	0	0				0	0	0		
21:30	21:45			0	0	0				0	0	0				0	0	0				0	0	0		
21:45	22:00			0	0	0				0	0	0				0	0	0				0	0	0		
22:00	22:15			0	0	0				0	0	0				0	0	0				0	0	0		
22:15	22:30			0	0	0				0	0	0				0	0	0				0	0	0		
22:30	22:45			0	0	0				0	0	0				0	0	0				0	0	0		
22:45	23:00			0	0	0				0	0	0				0	0	0				0	0	0		
23:00	23:15			0	0	0				0	0	0				0	0	0				0	0	0		
23:15	23:30			0	0	0				0	0	0				0	0	0				0	0	0		
23:30	23:45			0	0	0				0	0	0				0	0	0				0	0	0		
23:45	0:00			0	0	0				0	0	0				0	0	0				0	0	0		
TOTAL		***0***	***0***	**33**	**32**	**5**	**70**	***0***	***0***	**20**	**17**	**21**	**58**	***0***	***0***	**8**	**20**	**21**	**49**	***0***	***0***	**8**	**4**	**18**	**30**	207

Comptages

0317-55-21

Date: May 10, 2017
Jour: mercredi



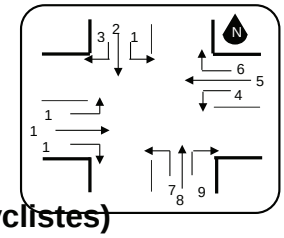
Articulés

Période		Mtée pomme d'Or						Entrée Sortie A-30 Ouest						Mtée pomme d'Or						Route des Aciéries						Grand total Lourds
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Virage en U	'	Gauche	Tout Droit	Droite	Total	Virage en U	'	Gauche	Tout Droit	Droite	Total	Virage en U	'	Gauche	Tout Droit	Droite	Total	Virage en U	'	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
0:30	0:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
0:45	1:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:00	1:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:15	1:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:30	1:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:45	2:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:00	2:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:15	2:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:30	2:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:45	3:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:00	3:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:15	3:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:30	3:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
3:45	4:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:00	4:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:15	4:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:30	4:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
4:45	5:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:00	5:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:15	5:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:30	5:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
5:45	6:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
6:00	6:15			4	1		5					2	2				2		2					1	1	10
6:15	6:30			1			1					2	2			2	1		3							6
6:30	6:45				4		4					1	1			1	3		4				1		1	10
6:45	7:00				2		2					2	2			1	1	1	3					2	2	9
7:00	7:15			3			3					2	2			5	1	1	7							12
7:15	7:30			1	1		2				1	1	2			8	3		11					1	1	16
7:30	7:45			4	6		10			2	2	2	6			6	2		8					1	1	25
7:45	8:00			1	4	1	6					1	1			7		1	8					1	1	16
8:00	8:15				3		3			2	1	2	5			2			2							10
8:15	8:30			3	3	1	7					1	1			7	1	1	9					1	1	18
8:30	8:45				2		2					4	4				4		4			1			1	11
8:45	9:00			2	1		3				3	5	8				2		2				1	4	5	18
9:00	9:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
9:15	9:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
9:30	9:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
9:45	10:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:00	10:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:15	10:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:30	10:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:45	11:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
11:00	11:15			2	1	1	4					3	3			3	1	1	5				1	2	3	15
11:15	11:30			2	4	1	7			3		1	4			7	2		9			1		4	5	25
11:30	11:45			3	5		8				1	1	2			6	3	1	10				5		5	25
11:45	12:00			2	1		3				1	2	3			2	2		4			1	3	1	5	15
12:00	12:15			4	1	1	6					3	3			7	1	1	9				1	4	5	23
12:15	12:30				4		4				1	1	2				1	2	3				3	2	5	14
12:30	12:45				2		2					5	5			2	1	1	4				3	2	5	16
12:45	13:00			4	3		7					3	3			4		1	5				3	2	5	20
13:00	13:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:15	13:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:30	13:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:45	14:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:00	14:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:15	14:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:30	14:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:45	15:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
15:00	15:15			1	3		4				1		1			2	2	1	5				3	1	4	14
15:15	15:30			2		3	5				1	3	4			2	3	1	6				5	3	8	23
15:30	15:45			3			3					4	4			3	2		5				3	1	4	16
15:45	16:00			1	3	1	5									2	1		3				3		3	11
16:00	16:15			1	2	1	4				3	1	4			1	2		3				1	1	2	13
16:15	16:30				2		2				1	1	2										1		1	5
16:30	16:45			1	3		4					1	1			1			1				3		3	9
16:45	17:00			1			1										2		2				1	1	2	5
17:00	17:15					1	1					1	1				2		2				3	1	4	8
17:15	17:30			1	1		2				1		1			3	2		5				4		4	12
17:30	17:45			2	2		4				1	1	2			1			1				3	2	5	12
17:45	18:00															4		1	5				1	1	2	7
18:00	18:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:15	18:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:30	18:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:45	19:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:00	19:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:15	19:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:30	19:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:45	20:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:00	20:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:15	20:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:30	20:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:45	21:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:00	21:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:15	21:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:30	21:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:45	22:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:00	22:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:15	22:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:30	22:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:45	23:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:00	23:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:15	23:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:30	23:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:45	0:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
TOTAL		**0**	**0**	**49**	**64**	**11**	**124**	**0**	**0**	**7**	**18**	**56**	**81**	**0**	**0**	**89**	**47**	**14**	**150**	**0**	**0**	**3**	**52**	**39**	**94**	449

Compilation des heures de pointes

0317-55-21

Date: May 10, 2017
Jour: mercredi



Heure de pointe du réseau

AM 7:00 à 8:00 - (Ensemble des véhicules, piétons et cyclistes)

Période		Mtée pomme d'Or – Approche Nord						Entrée Sortie A-30 Ouest – Approche Est						Mtée pomme d'Or – Approche Sud						Route des Aciéries – Approche Ouest						Grand total véhicules
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
de	à			1	2	3				4	5	6				7	8	9				10	11	12		
7:00	7:15			51	13	9	**73**			6	55	14	**75**			26	20	81	**127**			1	1	1	**3**	**278**
7:15	7:30			48	11	11	**70**	*1*		9	40	15	**64**			39	25	89	**153**			1		3	**4**	**291**
7:30	7:45			46	16	20	**82**			10	61	26	**97**			41	23	61	**125**					2	**2**	**306**
7:45	8:00			27	18	20	**65**	*1*		13	54	21	**88**			53	23	56	**132**			14	6	57	**77**	**362**
TOTAL				**172**	**58**	**60**	**290**	***2***		**38**	**210**	**76**	**324**			**159**	**91**	**287**	**537**			**16**	**7**	**63**	**86**	**1237**
% Légers				1.7%	5.2%	1.7%	2.4%			13.2%	1.9%	3.9%	3.7%			0.6%	5.5%	2.4%	2.4%			6.3%	0.0%	1.6%	2.3%	2.7%
% Lourds				5.2%	19.0%	1.7%	7.2%			5.3%	1.4%	7.9%	3.4%			16.4%	6.6%	0.7%	6.3%			0.0%	0.0%	4.8%	3.5%	5.6%
PHF				**0.84**	**0.81**	**0.75**	**0.88**			**0.73**	**0.86**	**0.73**	**0.84**			**0.75**	**0.91**	**0.81**	**0.88**			**0.29**	**0.29**	**0.28**	**0.28**	**0.85**

Midi 11:15 à 12:15 - (Ensemble des véhicules, piétons et cyclistes)

Période		Mtée pomme d'Or – Approche Nord						Entrée Sortie A-30 Ouest – Approche Est						Mtée pomme d'Or – Approche Sud						Route des Aciéries – Approche Ouest						Grand total véhicules
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
de	à			1	2	3				4	5	6				7	8	9				10	11	12		
11:15	11:30			18	12	1	**31**			13	3	8	**24**			10	12	15	**37**			7	1	7	**15**	**107**
11:30	11:45			18	19	7	**44**			8	2	9	**19**			10	15	16	**41**			6	5	10	**21**	**125**
11:45	12:00			24	10	5	**39**			4	1	7	**12**			4	18	15	**37**			6	6	7	**19**	**107**
12:00	12:15			16	17	5	**38**			6	1	13	**20**			10	21	20	**51**			17	3	16	**36**	**145**
TOTAL				**76**	**58**	**18**	**152**			**31**	**7**	**37**	**75**			**34**	**66**	**66**	**166**			**36**	**15**	**40**	**91**	**484**
% Légers				5.3%	13.8%	11.1%	9.2%			12.9%	42.9%	8.1%	13.3%			0.0%	1.5%	1.5%	1.2%			5.6%	6.7%	12.5%	8.8%	7.0%
% Lourds				14.5%	19.0%	11.1%	15.8%			9.7%	28.6%	18.9%	16.0%			64.7%	12.1%	3.0%	19.3%			5.6%	60.0%	22.5%	22.0%	18.2%
PHF				**0.79**	**0.76**	**0.64**	**0.86**			**0.60**	**0.58**	**0.71**	**0.78**			**0.85**	**0.79**	**0.83**	**0.81**			**0.53**	**0.63**	**0.63**	**0.63**	**0.83**

PM 15:45 à 16:45 - (Ensemble des véhicules, piétons et cyclistes)

Période		Mtée pomme d'Or – Approche Nord						Entrée Sortie A-30 Ouest – Approche Est						Mtée pomme d'Or – Approche Sud						Route des Aciéries – Approche Ouest						Grand total véhicules
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
de	à			1	2	3				4	5	6				7	8	9				10	11	12		
15:45	16:00			16	16	4	**36**			8	2	12	**22**			2	26	16	**44**			9	11	38	**58**	**160**
16:00	16:15			17	33	6	**56**			9	5	11	**25**			2	29	19	**50**			15	19	50	**84**	**215**
16:15	16:30			26	25	1	**52**		*1*	13	1	17	**31**			2	24	17	**43**			4	14	23	**41**	**167**
16:30	16:45			20	30	2	**52**		*1*	7	2	13	**22**	*1*		3	37	26	**66**			5	13	31	**49**	**189**
TOTAL				**79**	**104**	**13**	**196**		***2***	**37**	**10**	**53**	**100**	***1***		**9**	**116**	**78**	**203**			**33**	**57**	**142**	**232**	**731**
% Légers				5.1%	5.8%	0.0%	5.1%			2.7%	10.0%	5.7%	5.0%			11.1%	5.2%	2.6%	4.4%			0.0%	3.5%	2.8%	2.6%	4.1%
% Lourds				3.8%	9.6%	15.4%	7.7%			0.0%	40.0%	5.7%	7.0%			44.4%	2.6%	0.0%	3.4%			0.0%	14.0%	0.7%	3.9%	5.2%
PHF				**0.76**	**0.79**	**0.54**	**0.88**			**0.71**	**0.50**	**0.78**	**0.81**			**0.75**	**0.78**	**0.75**	**0.77**			**0.55**	**0.75**	**0.71**	**0.69**	**0.85**

Soir 0:00 à 1:00 - (Ensemble des véhicules, piétons et cyclistes)

Période		Mtée pomme d'Or – Approche Nord						Entrée Sortie A-30 Ouest – Approche Est						Mtée pomme d'Or – Approche Sud						Route des Aciéries – Approche Ouest						Grand total véhicules
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
de	à			1	2	3				4	5	6				7	8	9				10	11	12		
0:00	0:15																									
0:15	0:30																									
0:30	0:45																									
0:45	1:00																									
TOTAL																										
% Légers				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%	0.0%
% Lourds				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%	0.0%
PHF																										

Diagramme de compilation

0317-55-21

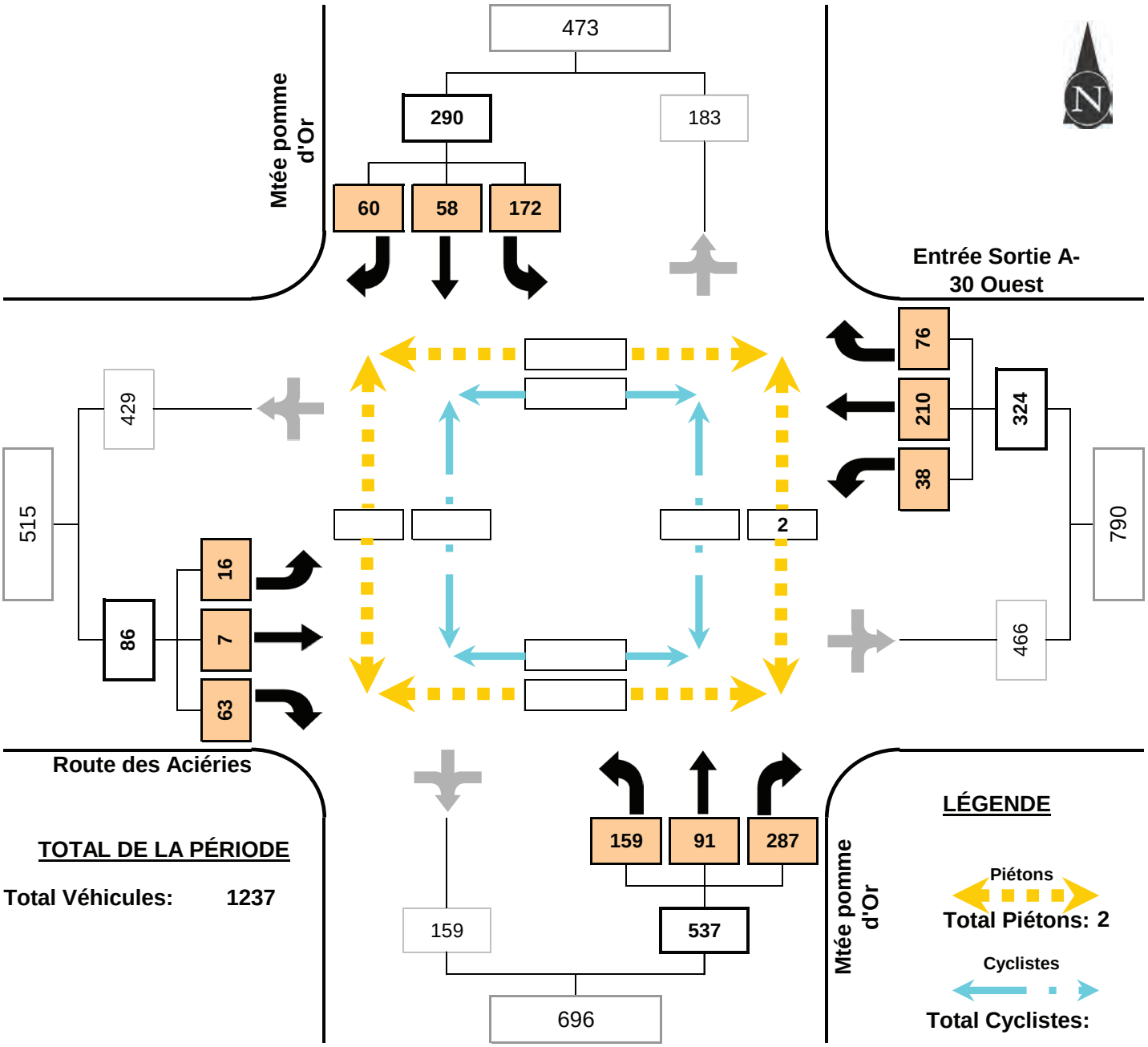
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 10 May 2017
Jour: mercredi

Intersection: Mtée pomme d'Or et Entrée Sortie A-30 Oues

AM

Période: 7:00 à 8:00



TOTAL DE LA PÉRIODE

Total Véhicules: 1237

LÉGENDE

Piétons
Total Piétons: 2

Cyclistes
Total Cyclistes:

Diagramme de compilation

0317-55-21

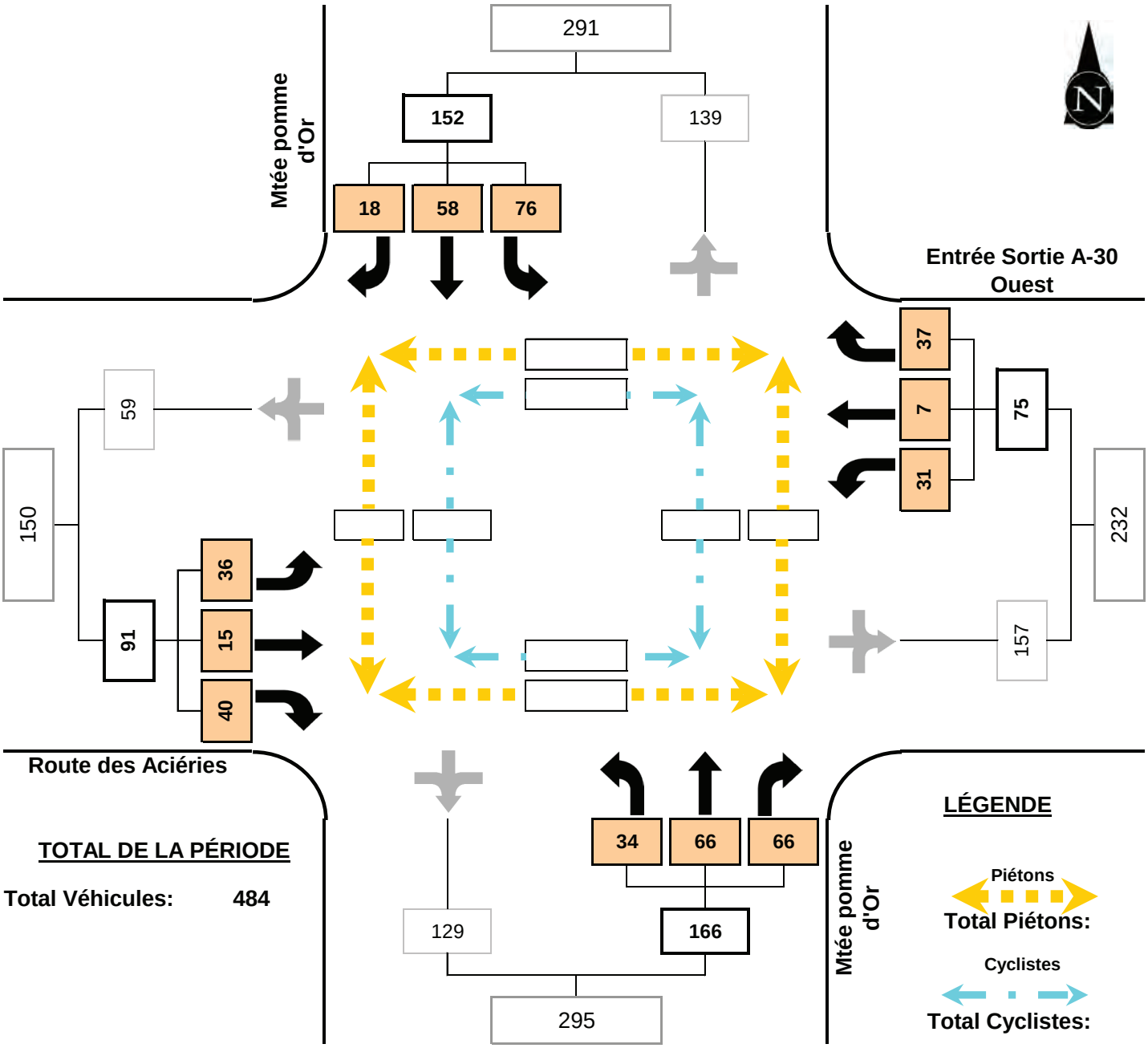
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 10 May 2017
Jour: mercredi

Intersection: Mtée pomme d'Or et Entrée Sortie A-30 Oues

Midi

Période: 11:15 à 12:15



TOTAL DE LA PÉRIODE

Total Véhicules: 484

Diagramme de compilation

0317-55-21

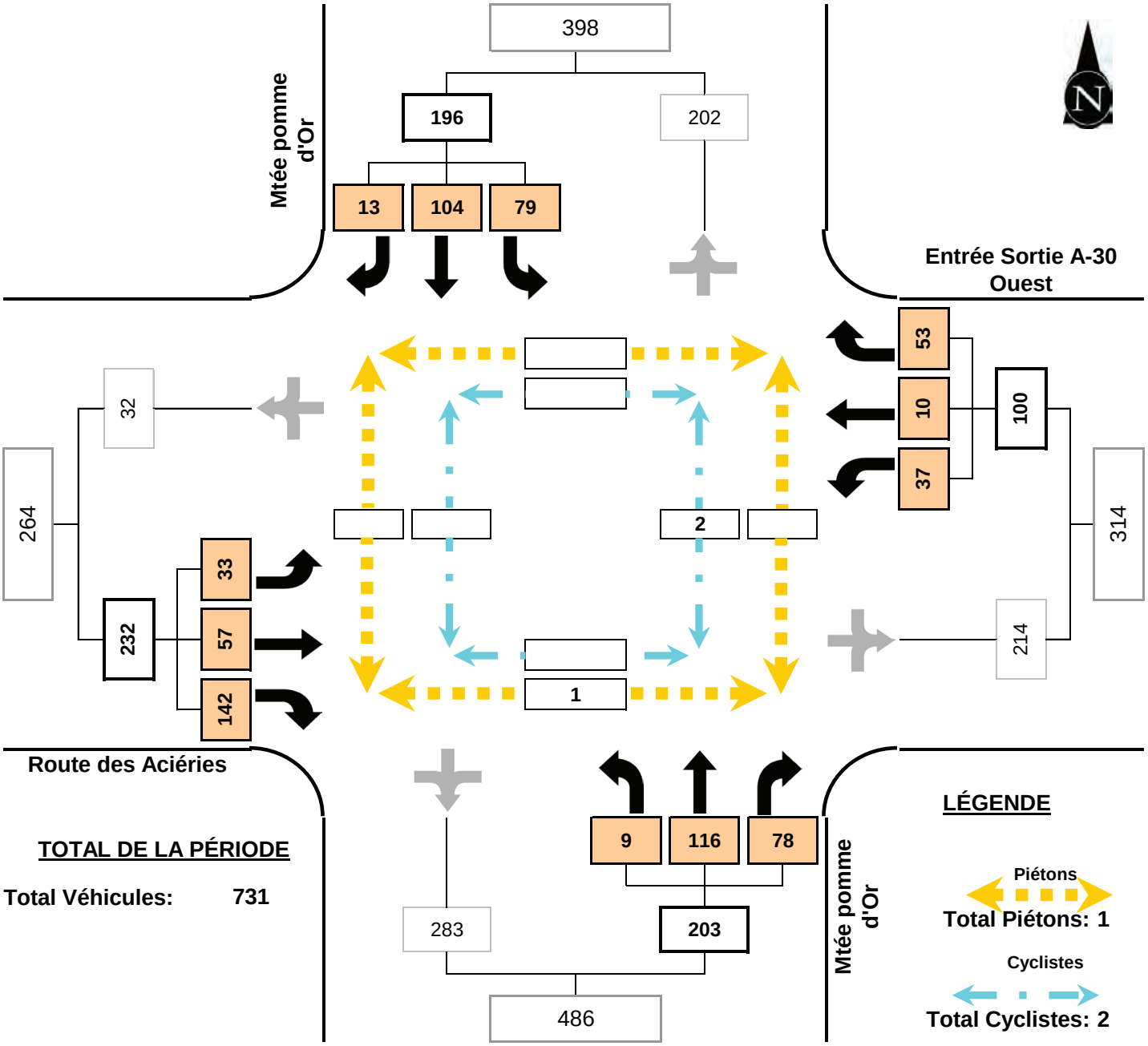
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 10 May 2017
Jour: mercredi

Intersection: Mtée pomme d'Or et Entrée Sortie A-30 Oues

PM

Période: 15:45 à 16:45



TOTAL DE LA PÉRIODE

Total Véhicules: 731

LÉGENDE

Piétons
Total Piétons: 1

Cyclistes
Total Cyclistes: 2

Compilation Data Traffic

Titre: 0317-55-3

Comptage

Ville ou Arrondissement: Contrecoeur

Intersection: Mtée Pomme D'or et N/A

Approche Nord	Mtée Pomme D'or
Approche Est	N/A
Approche Sud	Mtée Pomme D'or
Approche Ouest	Entrée / Sortie A-30 Est

Classification

Automobiles, Piétons et Cyclistes

Camions,Autobus

Articulés



Date: 10 mai 2017
Jour: mercredi

Conditions climatiques: Nuageux
Température: 11°C

Période(s) de comptage	AM	Midi	PM	Soir
Début	6:00	11:00	15:00	
Fin	9:00	13:00	18:00	
Durée	3:00	2:00	3:00	

Durée du comptage 8:00

Géolocalisation:

Lien hypertexte de localisation:

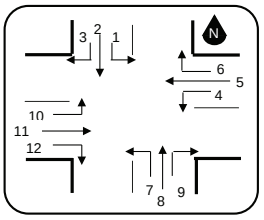
Observation:

Remarque:

Comptages

0317-55-3

Date: May 10, 2017
Jour: mercredi



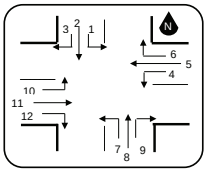
TOTAL Véhicules, Piétons et Cyclistes

Période		Mtée Pomme D'or						N/A						Mtée Pomme D'or						Entrée / Sortie A-30 Est						Grand Total
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9		10	11	12				
de	à			←	↑	→				←	↑	→				←	↑	→		←	↑	→				
0:00	1:00																									
1:00	2:00																									
2:00	3:00																									
3:00	4:00																									
4:00	5:00																									
5:00	6:00																									
6:00	7:00				38	30	68									22	295		317			70		13	83	468
7:00	8:00				73	86	159	1								21	411		432			131		14	145	736
8:00	9:00				43	48	91	1								21	208		229			92		17	109	429
9:00	10:00																									
10:00	11:00																									
11:00	12:00				46	61	107		1							13	93		106			54		15	69	282
12:00	13:00				68	49	117									10	127		137			37		19	56	310
13:00	14:00																									
14:00	15:00																									
15:00	16:00				69	104	173									10	96		106			87		36	123	402
16:00	17:00				102	176	278		2							14	118		132			90		61	151	561
17:00	18:00				82	72	154									24	106		130			93		59	152	436
18:00	19:00																									
19:00	20:00																									
20:00	21:00																									
21:00	22:00																									
22:00	23:00																									
23:00	0:00																									
TOTAL		**0**	**0**	**0**	**521**	**626**	**1147**	**2**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**135**	**1454**	**0**	**1589**	**0**	**0**	**654**	**0**	**234**	**888**	3624

Comptages

0317-55-3

Date: May 10, 2017
Jour: mercredi



TOTAL Véhicules, Piétons et Cyclistes

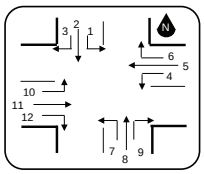
Période		Mtée Pomme D'or						N/A						Mtée Pomme D'or						Entrée / Sortie A-30 Est						Grand Total
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30																									
0:30	0:45																									
0:45	1:00																									
1:00	1:15																									
1:15	1:30																									
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2:15	2:30																									
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4:30	4:45																									
4:45	5:00																									
5:00	5:15																									
5:15	5:30																									
5:30	5:45																									
5:45	6:00																									
6:00	6:15				3	6	**9**									4	57		**61**			11		1	**12**	82
6:15	6:30				4	3	**7**									5	75		**80**			13		5	**18**	105
6:30	6:45				7	9	**16**									7	75		**82**			24		3	**27**	125
6:45	7:00				24	12	**36**									6	88		**94**			22		4	**26**	156
7:00	7:15				11	9	**20**									3	108		**111**			22		4	**26**	157
7:15	7:30				12	8	**20**									6	121		**127**			33		3	**36**	183
7:30	7:45				13	12	**25**	*1*								7	90		**97**			40		6	**46**	168
7:45	8:00				37	57	**94**									5	92		**97**			36		1	**37**	228
8:00	8:15				13	16	**29**									8	70		**78**			34		5	**39**	146
8:15	8:30				12	11	**23**									6	56		**62**			22		3	**25**	110
8:30	8:45				7	12	**19**	*1*								4	45		**49**			23		5	**28**	96
8:45	9:00				11	9	**20**									3	37		**40**			13		4	**17**	77
9:00	9:15																									
9:15	9:30																									
9:30	9:45																									
9:45	10:00																									
10:00	10:15																									
10:15	10:30																									
10:30	10:45																									
10:45	11:00																									
11:00	11:15				9	13	**22**		*1*							5	19		**24**			8		4	**12**	58
11:15	11:30				9	21	**30**									1	22		**23**			16		4	**20**	73
11:30	11:45				17	16	**33**									2	27		**29**			15		6	**21**	83
11:45	12:00				11	11	**22**									5	25		**30**			15		1	**16**	68
12:00	12:15				24	14	**38**									2	33		**35**			14		8	**22**	95
12:15	12:30				14	16	**30**									2	26		**28**			8		4	**12**	70
12:30	12:45				13	7	**20**									3	34		**37**			8		2	**10**	67
12:45	13:00				17	12	**29**									3	34		**37**			7		5	**12**	78
13:00	13:15																									
13:15	13:30																									
13:30	13:45																									
13:45	14:00																									
14:00	14:15																									
14:15	14:30																									
14:30	14:45																									
14:45	15:00																									
15:00	15:15				12	20	**32**									3	22		**25**			18		5	**23**	80
15:15	15:30				14	27	**41**									1	24		**25**			26		9	**35**	101
15:30	15:45				21	23	**44**									3	24		**27**			22		11	**33**	104
15:45	16:00				22	34	**56**									3	26		**29**			21		11	**32**	117
16:00	16:15				26	72	**98**									2	32		**34**			20		24	**44**	176
16:15	16:30				23	40	**63**		*1*							1	27		**28**			23		17	**40**	131
16:30	16:45				26	44	**70**		*1*							9	37		**46**			21		10	**31**	147
16:45	17:00				27	20	**47**									2	22		**24**			26		10	**36**	107
17:00	17:15				23	24	**47**									5	27		**32**			28		19	**47**	126
17:15	17:30				25	15	**40**									8	30		**38**			30		11	**41**	119
17:30	17:45				16	18	**34**									8	23		**31**			17		14	**31**	96
17:45	18:00				18	15	**33**									3	26		**29**			18		15	**33**	95
18:00	18:15																									
18:15	18:30																									
18:30	18:45																									
18:45	19:00																									
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22:30	22:45																									
22:45	23:00																									
23:00	23:15																									
23:15	23:30																									
23:30	23:45																									
23:45	0:00																									
TOTAL		*0*	*0*	**0**	**521**	**626**	**1147**	*2*	*3*	**0**	**0**	**0**	**0**	*0*	*0*	**135**	**1454**	**0**	**1589**	*0*	*0*	**654**	**0**	**234**	**888**	3624

Comptages

0317-55-3

Date: May 10, 2017
Jour: mercredi





Automobiles, Piétons et Cyclistes

Période		Mtée Pomme D'or						N/A						Mtée Pomme D'or						Entrée / Sortie A-30 Est						Grand total Autos
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
0:30	0:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
0:45	1:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:00	1:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:15	1:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:30	1:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
1:45	2:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
2:00	2:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
2:15	2:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
2:30	2:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
2:45	3:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
3:00	3:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
3:15	3:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
3:30	3:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
3:45	4:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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5:00	5:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
5:15	5:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
5:30	5:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
5:45	6:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
6:00	6:15				3	4	7									4	55		59			10		1	11	77
6:15	6:30				4	3	7									5	74		79			8		2	10	96
6:30	6:45				7	5	12									7	74		81			20		2	22	115
6:45	7:00				24	6	30									6	88		94			19		3	22	146
7:00	7:15				10	8	18									2	96		98			20		2	22	138
7:15	7:30				10	5	15									4	114		118			26		3	29	162
7:30	7:45				11	4	15	1								7	85		92			36		5	41	148
7:45	8:00				34	53	87									4	89		93			31			31	211
8:00	8:15				13	11	24									6	70		76			30		4	34	134
8:15	8:30				12	5	17									5	51		56			16		2	18	91
8:30	8:45				7	7	14	1								4	42		46			18		4	22	82
8:45	9:00				11	2	13									3	36		39			11		2	13	65
9:00	9:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
9:15	9:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
9:30	9:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
9:45	10:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
10:00	10:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
10:15	10:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
10:30	10:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
10:45	11:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
11:00	11:15				9	7	16		1							4	16		20			6		3	9	45
11:15	11:30				8	5	13									1	20		21			8		4	12	46
11:30	11:45				15	8	23									2	25		27			6		5	11	61
11:45	12:00				9	8	17									4	24		28			10		1	11	56
12:00	12:15				24	7	31									2	32		34			8		6	14	79
12:15	12:30				14	6	20									2	24		26			7		2	9	55
12:30	12:45				11	2	13									1	30		31			6			6	50
12:45	13:00				16	4	20									3	31		34			2		5	7	61
13:00	13:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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15:00	15:15				11	15	26									3	20		23			14		5	19	68
15:15	15:30				14	23	37									1	22		23			20		9	29	89
15:30	15:45				20	21	41									3	22		25			19		11	30	96
15:45	16:00				22	30	52									3	24		27			17		11	28	107
16:00	16:15				25	69	94									2	32		34			14		24	38	166
16:15	16:30				21	34	55		1							1	27		28			23		17	40	123
16:30	16:45				25	39	64		1							8	37		45			18		10	28	137
16:45	17:00				26	19	45									2	21		23			22		10	32	100
17:00	17:15				22	23	45									5	27		32			25		19	44	121
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17:30	17:45				15	15	30									8	23		31			16		13	29	90
17:45	18:00				18	14	32									3	22		25			15		13	28	85
18:00	18:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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18:30	18:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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20:15	20:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
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23:00	23:15	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
23:15	23:30	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
23:30	23:45	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
23:45	0:00	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	0	0	0	0		
TOTAL		**0**	**0**	**0**	**495**	**475**	**970**	**2**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**122**	**1382**	**0**	**1504**	**0**	**0**	**526**	**0**	**209**	**735**	3209

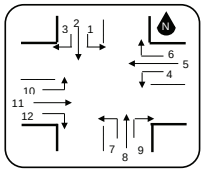
Comptages

Date: May 10, 2017
Jour: mercredi

0317-55-3



Camions,Autobus

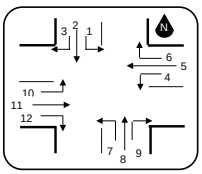


Période		Mtée Pomme D'or						N/A						Mtée Pomme D'or						Entrée / Sortie A-30 Est						Grand
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						total
		'	'	Gauche	Tout Droit	Droite	Total	'	'	Gauche	Tout Droit	Droite	Total	'	'	Gauche	Tout Droit	Droite	Total	'	'	Gauche	Tout Droit	Droite	Total	Légers
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30			0	0	0				0	0	0				0	0	0				0	0	0		
0:30	0:45			0	0	0				0	0	0				0	0	0				0	0	0		
0:45	1:00			0	0	0				0	0	0				0	0	0				0	0	0		
1:00	1:15			0	0	0				0	0	0				0	0	0				0	0	0		
1:15	1:30			0	0	0				0	0	0				0	0	0				0	0	0		
1:30	1:45			0	0	0				0	0	0				0	0	0				0	0	0		
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2:30	2:45			0	0	0				0	0	0				0	0	0				0	0	0		
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3:30	3:45			0	0	0				0	0	0				0	0	0				0	0	0		
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6:30	6:45					1	1										1		1							2
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7:00	7:15					1	1									1	6		7			1			1	9
7:15	7:30				2		2										3		3			1			1	6
7:30	7:45					3	3																	1	1	4
7:45	8:00				1		1										1		1			1			1	3
8:00	8:15					2	2									2			2			1			1	5
8:15	8:30																3		3							3
8:30	8:45					3	3										2		2			2			2	7
8:45	9:00					3	3															1			1	4
9:00	9:15			0	0	0				0	0	0				0	0	0				0	0	0		
9:15	9:30			0	0	0				0	0	0				0	0	0				0	0	0		
9:30	9:45			0	0	0				0	0	0				0	0	0				0	0	0		
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10:00	10:15			0	0	0				0	0	0				0	0	0				0	0	0		
10:15	10:30			0	0	0				0	0	0				0	0	0				0	0	0		
10:30	10:45			0	0	0				0	0	0				0	0	0				0	0	0		
10:45	11:00			0	0	0				0	0	0				0	0	0				0	0	0		
11:00	11:15					3	3									1	1		2							5
11:15	11:30				1	6	7										1		1							8
11:30	11:45					4	4										1		1							5
11:45	12:00					2	2										1		1							3
12:00	12:15					2	2																			2
12:15	12:30					5	5																	1	1	6
12:30	12:45					2	2									1	1		2					2	2	6
12:45	13:00				1	3	4										2		2			1			1	7
13:00	13:15			0	0	0				0	0	0				0	0	0				0	0	0		
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13:30	13:45			0	0	0				0	0	0				0	0	0				0	0	0		
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14:00	14:15			0	0	0				0	0	0				0	0	0				0	0	0		
14:15	14:30			0	0	0				0	0	0				0	0	0				0	0	0		
14:30	14:45			0	0	0				0	0	0				0	0	0				0	0	0		
14:45	15:00			0	0	0				0	0	0				0	0	0				0	0	0		
15:00	15:15					2	2															1			1	3
15:15	15:30					1	1										1		1			1			1	3
15:30	15:45				1	1	2																			2
15:45	16:00					1	1										1		1			1			1	3
16:00	16:15				1		1															3			3	4
16:15	16:30				2	4	6																			6
16:30	16:45				1	2	3									1			1			2			2	6
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17:30	17:45																									
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18:00	18:15			0	0	0				0	0	0				0	0	0				0	0	0		
18:15	18:30			0	0	0				0	0	0				0	0	0				0	0	0		
18:30	18:45			0	0	0				0	0	0				0	0	0				0	0	0		
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19:00	19:15			0	0	0				0	0	0				0	0	0				0	0	0		
19:15	19:30			0	0	0				0	0	0				0	0	0				0	0	0		
19:30	19:45			0	0	0				0	0	0				0	0	0				0	0	0		
19:45	20:00			0	0	0				0	0	0				0	0	0				0	0	0		
20:00	20:15			0	0	0				0	0	0				0	0	0				0	0	0		
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20:30	20:45			0	0	0				0	0	0				0	0	0				0	0	0		
20:45	21:00			0	0	0				0	0	0				0	0	0				0	0	0		
21:00	21:15			0	0	0				0	0	0				0	0	0				0	0	0		
21:15	21:30			0	0	0				0	0	0				0	0	0				0	0	0		
21:30	21:45			0	0	0				0	0	0				0	0	0				0	0	0		
21:45	22:00			0	0	0				0	0	0				0	0	0				0	0	0		
22:00	22:15			0	0	0				0	0	0				0	0	0				0	0	0		
22:15	22:30			0	0	0				0	0	0				0	0	0				0	0	0		
22:30	22:45			0	0	0				0	0	0				0	0	0				0	0	0		
22:45	23:00			0	0	0				0	0	0				0	0	0				0	0	0		
23:00	23:15			0	0	0				0	0	0				0	0	0				0	0	0		
23:15	23:30			0	0	0				0	0	0				0	0	0				0	0	0		
23:30	23:45			0	0	0				0	0	0				0	0	0				0	0	0		
23:45	0:00			0	0	0				0	0	0				0	0	0				0	0	0		
TOTAL		*0*	*0*	**0**	**12**	**54**	**66**	*0*	*0*	**0**	**0**	**0**	**0**	*0*	*0*	**6**	**30**	**0**	**36**	*0*	*0*	**20**	**0**	**5**	**25**	127

Comptages

0317-55-3

Date: May 10, 2017
Jour: mercredi



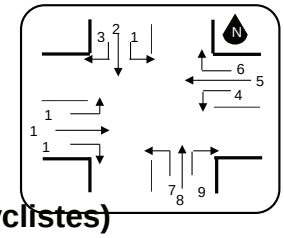
Articulés

Période		Mtée Pomme D'or						N/A						Mtée Pomme D'or						Entrée / Sortie A-30 Est						Grand total Lourds
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Virage en U		Gauche	Tout Droit	Droite	Total	Virage en U		Gauche	Tout Droit	Droite	Total	Virage en U		Gauche	Tout Droit	Droite	Total	Virage en U		Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
0:30	0:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
0:45	1:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
1:00	1:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
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2:15	2:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
2:30	2:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
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3:45	4:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
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5:45	6:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
6:00	6:15					2	**2**										1		**1**			1			**1**	4
6:15	6:30																					3		3	**6**	6
6:30	6:45					3	**3**															4		1	**5**	8
6:45	7:00					5	**5**															3		1	**4**	9
7:00	7:15				1		**1**										6		**6**			1		2	**3**	10
7:15	7:30					3	**3**									2	4		**6**			6			**6**	15
7:30	7:45				2	5	**7**										5		**5**			4			**4**	16
7:45	8:00				2	4	**6**									1	2		**3**			4		1	**5**	14
8:00	8:15					3	**3**															3		1	**4**	7
8:15	8:30					6	**6**									1	2		**3**			6		1	**7**	16
8:30	8:45					2	**2**										1		**1**			3		1	**4**	7
8:45	9:00					4	**4**										1		**1**			1		2	**3**	8
9:00	9:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
9:15	9:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
9:30	9:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
9:45	10:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:00	10:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:15	10:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:30	10:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
10:45	11:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
11:00	11:15					3	**3**										2		**2**			2		1	**3**	8
11:15	11:30					10	**10**										1		**1**			8			**8**	19
11:30	11:45				2	4	**6**										1		**1**			9		1	**10**	17
11:45	12:00				2	1	**3**									1			**1**			5			**5**	9
12:00	12:15					5	**5**										1		**1**			6		2	**8**	14
12:15	12:30					5	**5**										2		**2**			1		1	**2**	9
12:30	12:45				2	3	**5**									1	3		**4**			2			**2**	11
12:45	13:00					5	**5**										1		**1**			4			**4**	10
13:00	13:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:15	13:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:30	13:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
13:45	14:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:00	14:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:15	14:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:30	14:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
14:45	15:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
15:00	15:15				1	3	**4**										2		**2**			3			**3**	9
15:15	15:30					3	**3**										1		**1**			5			**5**	9
15:30	15:45					1	**1**										2		**2**			3			**3**	6
15:45	16:00					3	**3**										1		**1**			3			**3**	7
16:00	16:15					3	**3**															3			**3**	6
16:15	16:30					2	**2**																			2
16:30	16:45					3	**3**															1			**1**	4
16:45	17:00					1	**1**															2			**2**	3
17:00	17:15				1		**1**															3			**3**	4
17:15	17:30					1	**1**									1			**1**			5			**5**	7
17:30	17:45				1	3	**4**															1		1	**2**	6
17:45	18:00					1	**1**										3		**3**			3		1	**4**	8
18:00	18:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:15	18:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:30	18:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
18:45	19:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:00	19:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:15	19:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:30	19:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
19:45	20:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:00	20:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:15	20:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:30	20:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
20:45	21:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:00	21:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:15	21:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:30	21:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
21:45	22:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:00	22:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:15	22:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:30	22:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
22:45	23:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:00	23:15	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:15	23:30	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:30	23:45	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
23:45	0:00	0		0	0	0		0		0	0	0		0		0	0	0		0		0	0	0		
TOTAL		**0**	**0**	**0**	**14**	**97**	**111**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**42**	**0**	**49**	**0**	**0**	**108**	**0**	**20**	**128**	288

Compilation des heures de pointes

0317-55-3

Date: May 10, 2017
Jour: mercredi



Heure de pointe du réseau

AM 7:00 à 8:00 - (Ensemble des véhicules, piétons et cyclistes)

Période		Mtée Pomme D'or						N/A						Mtée Pomme D'or						Entrée / Sortie A-30 Est						Grand total véhicules
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
7:00	7:15				11	9	**20**									3	108		**111**			22		4	**26**	**157**
7:15	7:30				12	8	**20**									6	121		**127**			33		3	**36**	**183**
7:30	7:45				13	12	**25**	*1*								7	90		**97**			40		6	**46**	**168**
7:45	8:00				37	57	**94**									5	92		**97**			36		1	**37**	**228**
TOTAL					**73**	**86**	**159**	***1***								**21**	**411**		**432**			**131**		**14**	**145**	**736**
% Légers				0.0%	4.1%	4.7%	4.4%			0.0%	0.0%	0.0%	0.0%			4.8%	2.4%	0.0%	2.5%			2.3%	0.0%	7.1%	2.8%	3.0%
% Lourds				0.0%	6.8%	14.0%	10.7%			0.0%	0.0%	0.0%	0.0%			14.3%	4.1%	0.0%	4.6%			11.5%	0.0%	21.4%	12.4%	7.5%
PHF					**0.49**	**0.38**	**0.42**									**0.75**	**0.85**		**0.85**			**0.82**		**0.58**	**0.79**	**0.81**

Midi 11:15 à 12:15 - (Ensemble des véhicules, piétons et cyclistes)

Période		Mtée Pomme D'or						N/A						Mtée Pomme D'or						Entrée / Sortie A-30 Est						Grand total véhicules
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
11:15	11:30				9	21	**30**									1	22		**23**			16		4	**20**	**73**
11:30	11:45				17	16	**33**									2	27		**29**			15		6	**21**	**83**
11:45	12:00				11	11	**22**									5	25		**30**			15		1	**16**	**68**
12:00	12:15				24	14	**38**									2	33		**35**			14		8	**22**	**95**
TOTAL					**61**	**62**	**123**									**10**	**107**		**117**			**60**		**19**	**79**	**319**
% Légers				0.0%	1.6%	22.6%	12.2%			0.0%	0.0%	0.0%	0.0%			0.0%	2.8%	0.0%	2.6%			0.0%	0.0%	0.0%	0.0%	5.6%
% Lourds				0.0%	6.6%	32.3%	19.5%			0.0%	0.0%	0.0%	0.0%			10.0%	2.8%	0.0%	3.4%			46.7%	0.0%	15.8%	39.2%	18.5%
PHF					**0.64**	**0.74**	**0.81**									**0.50**	**0.81**		**0.84**			**0.94**		**0.59**	**0.90**	**0.84**

PM 15:45 à 16:45 - (Ensemble des véhicules, piétons et cyclistes)

Période		Mtée Pomme D'or						N/A						Mtée Pomme D'or						Entrée / Sortie A-30 Est						Grand total véhicules
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
15:45	16:00				22	34	**56**									3	26		**29**			21		11	**32**	**117**
16:00	16:15				26	72	**98**									2	32		**34**			20		24	**44**	**176**
16:15	16:30				23	40	**63**		*1*							1	27		**28**			23		17	**40**	**131**
16:30	16:45				26	44	**70**		*1*							9	37		**46**			21		10	**31**	**147**
TOTAL					**97**	**190**	**287**		***2***							**15**	**122**		**137**			**85**		**62**	**147**	**571**
% Légers				0.0%	4.1%	3.7%	3.8%			0.0%	0.0%	0.0%	0.0%			6.7%	0.8%	0.0%	1.5%			7.1%	0.0%	0.0%	4.1%	3.3%
% Lourds				0.0%	0.0%	5.8%	3.8%			0.0%	0.0%	0.0%	0.0%			0.0%	0.8%	0.0%	0.7%			8.2%	0.0%	0.0%	4.8%	3.3%
PHF					**0.93**	**0.66**	**0.73**									**0.42**	**0.82**		**0.74**			**0.92**		**0.65**	**0.84**	**0.81**

Soir 0:00 à 1:00 - (Ensemble des véhicules, piétons et cyclistes)

Période		Mtée Pomme D'or						N/A						Mtée Pomme D'or						Entrée / Sortie A-30 Est						Grand total véhicules
		Approche Nord						Approche Est						Approche Sud						Approche Ouest						
		Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	Piétons	Cyclistes	Gauche	Tout Droit	Droite	Total	
				1	2	3				4	5	6				7	8	9				10	11	12		
de	à			←	↑	→				←	↑	→				←	↑	→				←	↑	→		
0:00	0:15																									
0:15	0:30																									
0:30	0:45																									
0:45	1:00																									
TOTAL																										
% Légers				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%	0.0%
% Lourds				0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%	0.0%
PHF																										

Diagramme de compilation

0317-55-3

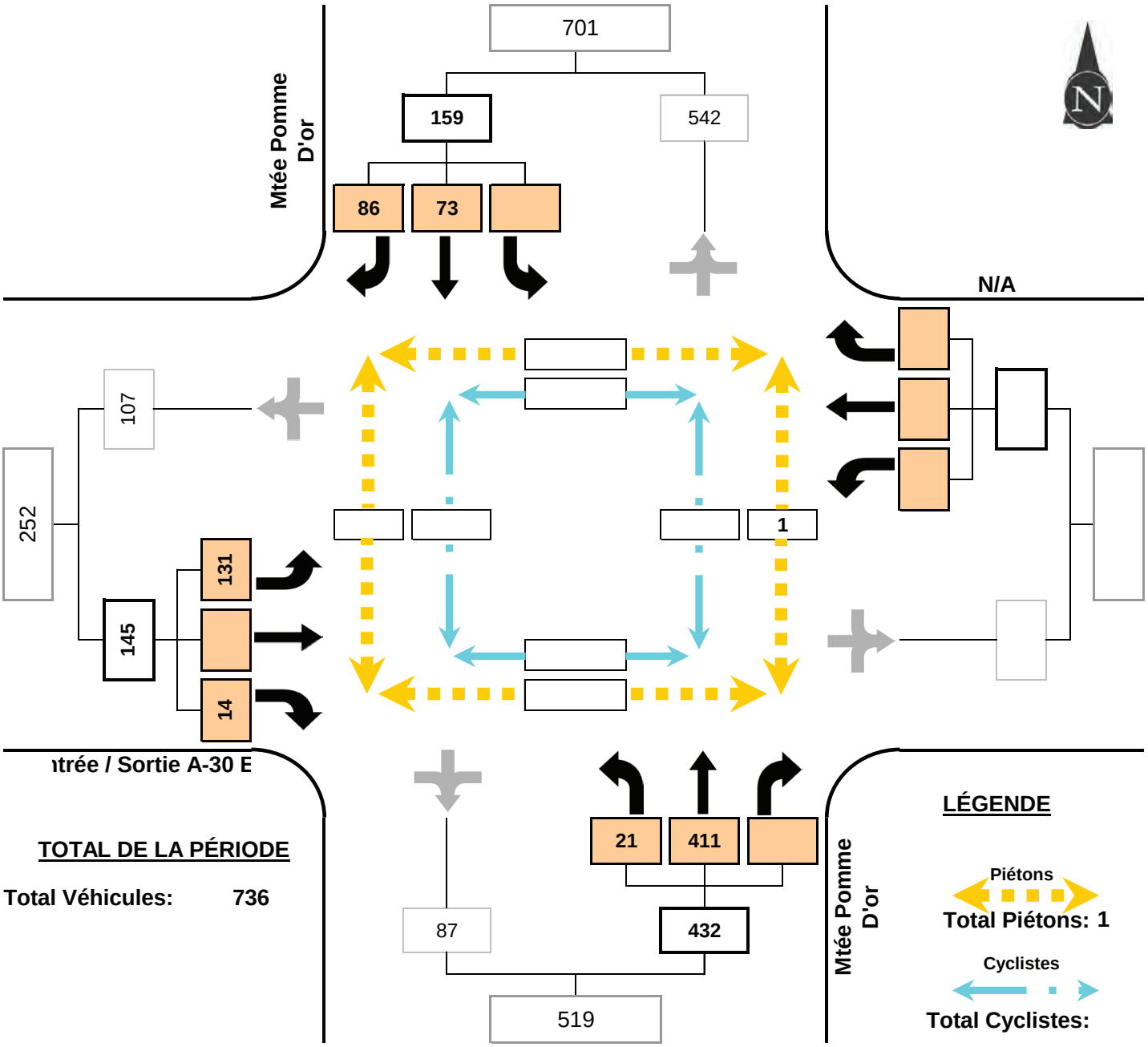
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 10 May 2017
Jour: mercredi

Intersection: Mtée Pomme D'or et N/A

AM

Période: 7:00 à 8:00



TOTAL DE LA PÉRIODE

Total Véhicules: 736

LÉGENDE

Piétons
Total Piétons: 1

Cyclistes
Total Cyclistes:

Diagramme de compilation

0317-55-3

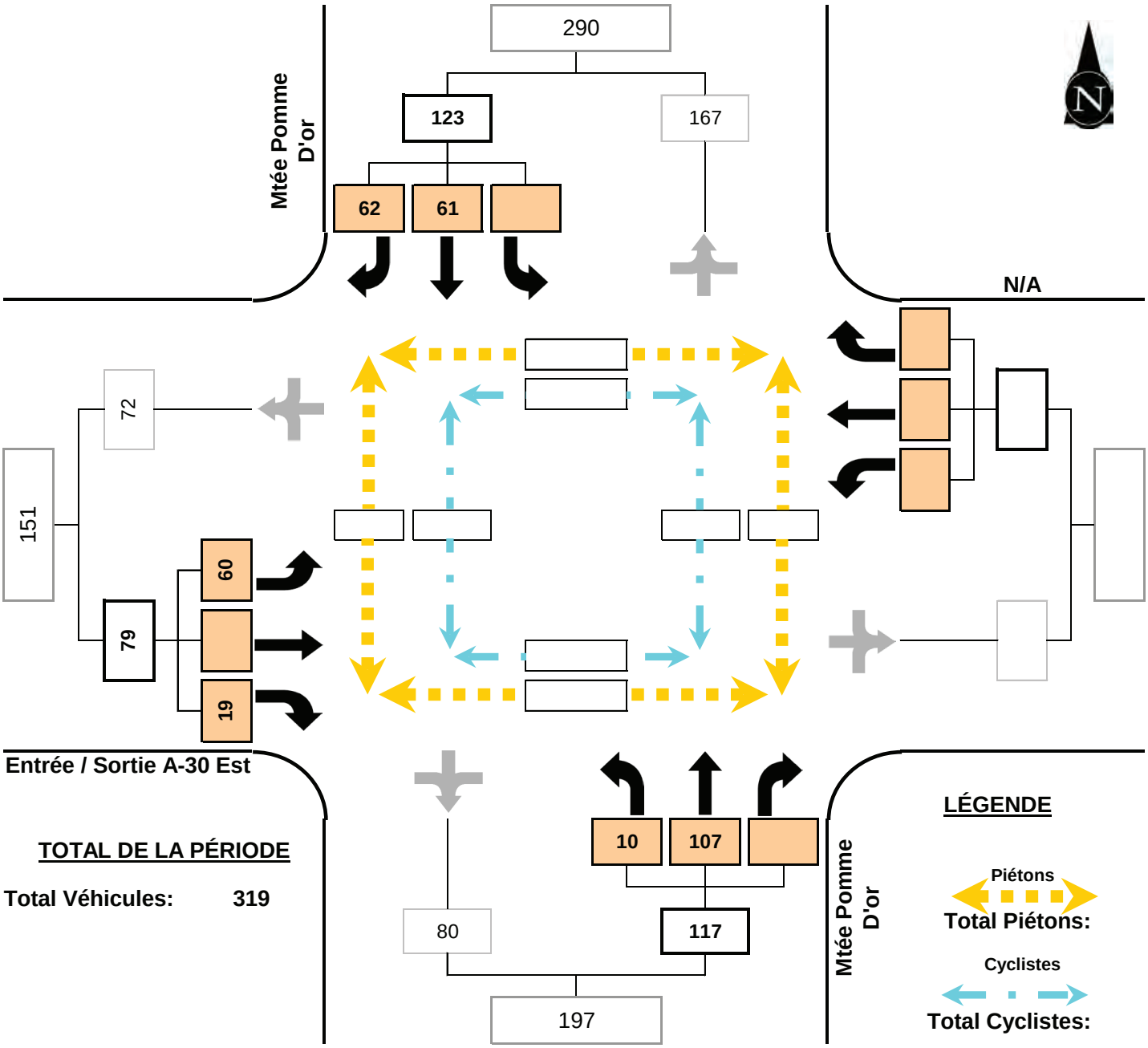
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 10 May 2017
Jour: mercredi

Intersection: Mtée Pomme D'or et N/A

Midi

Période: 11:15 à 12:15



TOTAL DE LA PÉRIODE

Total Véhicules: **319**

Diagramme de compilation

0317-55-3

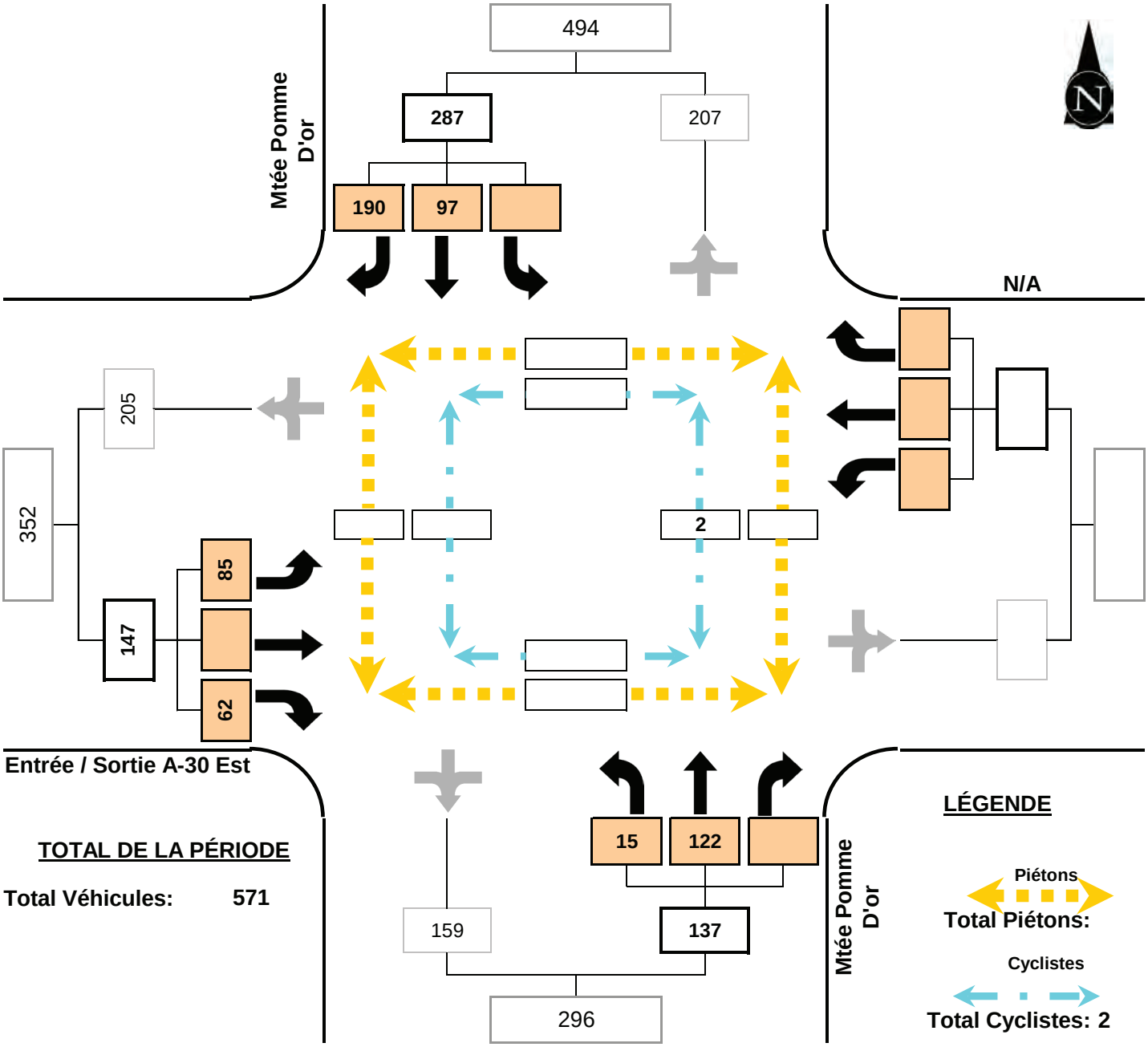
Ville ou Arrondissement: **Contrecoeur**

Date du comptage: 10 May 2017
Jour: mercredi

Intersection: Mtée Pomme D'or et N/A

PM

Période: 15:45 à 16:45



TOTAL DE LA PÉRIODE

Total Véhicules: 571

LÉGENDE

Piétons
Total Piétons:

Cyclistes
Total Cyclistes: 2

ANNEXE B :

DÉFINITION DES NIVEAUX DE SERVICE (FEU DE CIRCULATION ET ARRÊT)

DESCRIPTION DES NIVEAUX DE SERVICE AUX CARREFOURS AVEC ARRÊTS



Les niveaux de service qualifient la fluidité de la circulation. C'est une mesure quantitative servant à décrire les conditions qui prévalent dans un courant de circulation et leur perception par les usagers. Il existe six niveaux de service désignés chacun par une lettre de A à F. Le niveau de service A décrit les meilleurs conditions d'opération et le niveau de service F les pires conditions.

Niveau de service	Description détaillée	Description du retard
A	Retard très court, moins de 10 secondes par véhicule. Le niveau de service correspond à un écoulement libre de la circulation. Ces conditions sont très favorables.	Aucun ou négligeable
B	Retard moyen entre 10 et 15 secondes par véhicule. Le niveau de service représente un écoulement stable mais légèrement diminué dû à des caractéristiques de la circulation plus contraignantes. Ces conditions sont fluides.	Court
C	Retard moyen entre 15 et 25 secondes par véhicule. Le niveau de service se situe également dans une zone d'écoulement stable mais la plupart des usagers de la route se sentent quelque peu gênés.	Moyen
D	Retard moyen entre 25 et 35 secondes par véhicule. Le niveau de service se rapproche de l'écoulement instable. Les conducteurs ont une liberté de manœuvre très réduite et la congestion se fait sentir. Le retard moyen plus long peut résulter d'un ratio débit/capacité élevé.	Long
E	Retard moyen entre 35 et 50 secondes par véhicule. Le niveau de service représente une circulation qui atteint le point d'instabilité. Le volume de circulation est pratiquement à capacité et il est considéré comme la limite acceptable de retard. Le retard élevé résulte d'un ratio débit/capacité très élevé.	Très long
F	Retard moyen dépassant 50 secondes par véhicule. Le niveau de service est à congestion jusqu'à sursaturation. Les conditions sont considérées inacceptables par la majorité des conducteurs. Le flot de véhicules qui arrive excède la capacité de l'intersection.	Débit > capacité, inacceptable

Source : Les temps en secondes proviennent: HCM (HIGHWAY CAPACITY MANUAL 2010), chap. 19 Two-Way Stop-Controlled Intersections

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DESCRIPTION DES NIVEAUX DE SERVICE AUX CARREFOURS AVEC FEUX



Les niveaux de service qualifient la fluidité de la circulation. C'est une mesure qualitative servant à décrire les conditions qui prévalent dans un courant de circulation et leur perception par les usagers. Il existe six niveaux de service désignés chacun par une lettre de A à F. Le niveau de service A décrit les meilleurs conditions d'opération et le niveau de service F les pires conditions.

Niveau de service	Description détaillée	Description du retard
A	Retard très court, moins de 10 secondes par véhicule. Le niveau de service correspond à un écoulement libre de la circulation. Ces conditions sont très favorables et la plupart des véhicules arrivent durant la phase de vert.	Aucun ou négligeable
B	Retard moyen entre 10 et 20 secondes par véhicule. Le niveau de service représente un écoulement stable mais légèrement diminué dû à des caractéristiques de la circulation plus contraignantes. Ces conditions sont fluides.	Court
C	Retard moyen entre 20 et 35 secondes par véhicule. Le niveau de service se situe également dans une zone d'écoulement stable mais la plupart des usagers de la route se sentent quelque peu gênés.	Moyen
D	Retard moyen entre 35 et 55 secondes par véhicule. Le niveau de service se rapproche de l'écoulement instable. Les conducteurs ont une liberté de manœuvre très réduite et la congestion se fait sentir. Le retard moyen plus long peut résulter d'un ratio débit/capacité élevé.	Long
E	Retard moyen entre 55 et 80 secondes par véhicule. Le niveau de service représente une circulation qui atteint le point d'instabilité. Le volume de circulation est pratiquement à capacité et il est considéré comme la limite acceptable de retard. Le retard élevé résulte d'un ratio débit/capacité très élevé.	Très long
F	Retard moyen dépassant 80 secondes par véhicule. Le niveau de service est à congestion jusqu'à sursaturation. Les conditions sont considérées inacceptables par la majorité des conducteurs. Le flot de véhicules qui arrive excède la capacité de l'intersection.	Débit > capacité, inacceptable

Source : Les temps en secondes proviennent: HCM (HIGHWAY CAPACITY MANUAL 2010), chap. 18/Signalized Intersections

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ANNEXE C :

RÉSULTATS DÉTAILLÉS DES SIMULATIONS DE CIRCULATION – SITUATION ACTUELLE

100: montée Lapierre & route Marie-Victorin (R132) Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	0.2	0.0	0.5	0.1	3.8	0.3	2.0	0.6
Vehicles Entered	68	19	34	104	12	4	35	276
Vehicles Exited	68	19	34	105	12	4	36	278
Hourly Exit Rate	68	19	34	105	12	4	36	278
Input Volume	63	23	32	105	16	4	34	278
% of Volume	108	83	105	100	76	107	105	100

200: montée Lapierre & route des Aciéries Performance by movement

Movement	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	6.4	1.6	3.1	3.1	3.0	1.7	0.2	0.1	0.8	0.2	0.0	0.8
Vehicles Entered	1	3	7	2	19	1	31	53	30	25	1	173
Vehicles Exited	1	3	7	2	19	1	31	53	29	25	1	172
Hourly Exit Rate	1	3	7	2	19	1	31	53	29	25	1	172
Input Volume	2	2	7	3	20	1	33	55	33	25	1	182
% of Volume	50	133	100	73	96	100	94	96	87	101	100	95

300: montée Lapierre & bretelles A-30 Est Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.1	0.0	0.0	0.0	0.0	0.1
Total Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	4.7	3.6	0.4	0.2	0.1	0.0	2.7
Vehicles Entered	64	1	1	17	7	25	115
Vehicles Exited	64	1	1	17	7	25	115
Hourly Exit Rate	64	1	1	17	7	25	115
Input Volume	69	1	2	17	7	25	121
% of Volume	92	100	57	101	97	100	95

400: bretelles A-30 Ouest & route des Aciéries Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	4.1	0.2	0.1	0.1	0.4
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	0.3	0.3	0.7	0.5	4.3	3.4	1.1
Vehicles Entered	52	31	10	5	21	1	120
Vehicles Exited	51	31	10	5	21	1	119
Hourly Exit Rate	51	31	10	5	21	1	119
Input Volume	58	33	12	7	21	1	131
% of Volume	89	95	85	74	99	100	91

Total Network Performance

Denied Delay (hr)	0.0
Denied Del/Veh (s)	0.3
Total Delay (hr)	0.3
Total Del/Veh (s)	3.4
Vehicles Entered	361
Vehicles Exited	364
Hourly Exit Rate	364
Input Volume	1872
% of Volume	19

Intersection: 100: montée Lapierre & route Marie-Victorin (R132)

Movement	WB	NB
Directions Served	L	LR
Maximum Queue (m)	12.9	22.5
Average Queue (m)	1.0	9.1
95th Queue (m)	7.0	20.7
Link Distance (m)	154.4	1147.8
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 200: montée Lapierre & route des Aciéries

Movement	EB	WB	SB
Directions Served	LTR	LTR	LT
Maximum Queue (m)	8.9	22.3	12.4
Average Queue (m)	0.9	6.9	0.9
95th Queue (m)	5.3	18.6	5.9
Link Distance (m)	88.0	208.0	113.1
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 300: montée Lapierre & bretelles A-30 Est

Movement	EB
Directions Served	LR
Maximum Queue (m)	26.8
Average Queue (m)	12.1
95th Queue (m)	22.2
Link Distance (m)	228.7
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 400: bretelles A-30 Ouest & route des Aciéries

Movement	WB	NB
Directions Served	L	LR
Maximum Queue (m)	4.4	20.1
Average Queue (m)	0.2	6.2
95th Queue (m)	2.2	17.4
Link Distance (m)		51.7
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)	60.0	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 0

3: Montée Pomme d'Or & route Marie-Victorin (R132) Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.3
Denied Del/Veh (s)	0.2	2.4	3.2	0.7	0.0	0.0	0.0	1.4
Total Delay (hr)	0.0	0.0	0.2	0.1	0.3	0.0	0.3	0.9
Total Del/Veh (s)	1.7	0.4	2.8	1.8	13.8	2.7	8.0	4.4
Vehicles Entered	36	47	262	136	65	52	132	730
Vehicles Exited	36	47	262	135	66	53	132	731
Hourly Exit Rate	36	47	262	135	66	53	132	731
Input Volume	36	47	256	135	59	51	124	709
% of Volume	99	100	102	100	111	104	106	103

4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.2	0.2	0.6	0.6	3.6	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.5	0.1	0.0	0.2	1.2	0.1	0.5	0.3	0.3	0.9	0.1	0.1
Total Del/Veh (s)	28.3	31.8	3.1	20.5	20.5	4.3	10.6	8.5	4.0	17.4	7.6	3.9
Vehicles Entered	62	8	14	40	212	84	158	106	279	180	70	64
Vehicles Exited	63	8	14	40	212	84	158	106	279	179	70	64
Hourly Exit Rate	63	8	14	40	212	84	158	106	279	179	70	64
Input Volume	63	7	16	38	210	76	159	97	288	180	67	63
% of Volume	100	119	88	106	101	110	100	109	97	99	104	102

4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest Performance by movement

Movement	All
Denied Delay (hr)	0.1
Denied Del/Veh (s)	0.4
Total Delay (hr)	4.2
Total Del/Veh (s)	11.9
Vehicles Entered	1277
Vehicles Exited	1277
Hourly Exit Rate	1277
Input Volume	1264
% of Volume	101

5: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.2	0.2
Total Del/Veh (s)	1.4	1.4
Vehicles Entered	434	434
Vehicles Exited	434	434
Hourly Exit Rate	434	434
Input Volume	432	432
% of Volume	101	101

6: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.1	0.1
Total Del/Veh (s)	0.9	0.9
Vehicles Entered	466	466
Vehicles Exited	466	466
Hourly Exit Rate	466	466
Input Volume	475	475
% of Volume	98	98

7: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Est Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Denied Del/Veh (s)	0.2	0.3	3.4	0.4	0.0	0.1	0.4
Total Delay (hr)	0.3	0.0	0.0	0.1	0.0	0.0	0.4
Total Del/Veh (s)	8.2	5.1	2.7	0.5	0.2	0.6	2.0
Vehicles Entered	134	14	18	404	75	93	738
Vehicles Exited	134	14	18	404	75	93	738
Hourly Exit Rate	134	14	18	404	75	93	738
Input Volume	131	14	21	407	80	88	741
% of Volume	102	98	85	99	94	106	100

9: External Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Vehicles Entered	82	82
Vehicles Exited	82	82
Hourly Exit Rate	82	82
Input Volume	88	88
% of Volume	94	94

10: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.2	0.2
Vehicles Entered	111	111
Vehicles Exited	111	111
Hourly Exit Rate	111	111
Input Volume	109	109
% of Volume	102	102

11: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.4	0.5
Total Del/Veh (s)	1.3	4.5	3.1
Vehicles Entered	244	309	553
Vehicles Exited	244	307	551
Hourly Exit Rate	244	307	551
Input Volume	230	303	534
% of Volume	106	101	103

12: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.0	0.1
Total Del/Veh (s)	0.5	1.3	0.7
Vehicles Entered	537	114	651
Vehicles Exited	537	115	652
Hourly Exit Rate	537	115	652
Input Volume	538	114	652
% of Volume	100	101	100

13: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.0	0.1
Total Del/Veh (s)	0.7	0.2	0.6
Vehicles Entered	538	115	653
Vehicles Exited	537	115	652
Hourly Exit Rate	537	115	652
Input Volume	538	114	652
% of Volume	100	101	100

15: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.1	0.1
Total Del/Veh (s)	1.4	1.4
Vehicles Entered	201	201
Vehicles Exited	201	201
Hourly Exit Rate	201	201
Input Volume	194	194
% of Volume	103	103

606: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.9	0.9
Vehicles Entered	168	168
Vehicles Exited	166	166
Hourly Exit Rate	166	166
Input Volume	160	160
% of Volume	103	103

Total Network Performance

Denied Delay (hr)	0.5
Denied Del/Veh (s)	1.2
Total Delay (hr)	6.7
Total Del/Veh (s)	15.3
Vehicles Entered	1540
Vehicles Exited	1538
Hourly Exit Rate	1538
Input Volume	6008
% of Volume	26

Intersection: 3: Montée Pomme d'Or & route Marie-Victorin (R132)

Movement	EB	WB	NB
Directions Served	R	L	LR
Maximum Queue (m)	5.0	16.0	47.2
Average Queue (m)	0.2	4.8	17.8
95th Queue (m)	2.6	13.9	34.9
Link Distance (m)			1423.8
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)	60.0	60.0	
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	R	LT	R	LT	TR	LT	TR
Maximum Queue (m)	51.5	13.7	57.8	21.2	50.1	39.4	60.8	25.9
Average Queue (m)	11.2	1.9	29.4	9.2	20.5	14.5	22.4	8.0
95th Queue (m)	36.9	8.3	48.5	18.0	39.8	29.2	45.0	19.8
Link Distance (m)	92.4	92.4	153.9		132.2		91.0	91.0
Upstream Blk Time (%)							0	
Queuing Penalty (veh)							0	
Storage Bay Dist (m)				50.0		85.0		
Storage Blk Time (%)			1					
Queuing Penalty (veh)			0					

Intersection: 7: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Est

Movement	EB	NB	SB
Directions Served	LR	L	TR
Maximum Queue (m)	34.3	12.6	4.4
Average Queue (m)	15.1	1.0	0.2
95th Queue (m)	27.6	6.3	2.5
Link Distance (m)	126.5		
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)		25.0	85.0
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 1

100: montée Lapierre & route Marie-Victorin (R132) Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	0.2	0.0	0.9	0.1	4.9	0.2	1.8	0.5
Vehicles Entered	150	26	28	98	8	7	47	364
Vehicles Exited	149	26	28	98	8	7	48	364
Hourly Exit Rate	149	26	28	98	8	7	48	364
Input Volume	138	28	29	101	10	6	45	357
% of Volume	108	93	97	97	82	117	107	102

200: montée Lapierre & route des Aciéries Performance by movement

Movement	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	1.6	3.1	2.7	3.5	0.6	0.1	0.0	1.0	0.1	0.0	0.8
Vehicles Entered	1	13	4	6	1	51	16	32	22	5	151
Vehicles Exited	1	13	4	6	1	51	16	32	22	5	151
Hourly Exit Rate	1	13	4	6	1	51	16	32	22	5	151
Input Volume	1	12	3	9	1	47	16	36	22	5	153
% of Volume	100	111	123	65	100	108	100	89	98	105	99

300: montée Lapierre & bretelles A-30 Est Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.1	0.0	0.0	0.0	0.0	0.1
Total Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	4.9	2.7	0.2	0.2	0.2	0.0	2.3
Vehicles Entered	46	11	1	20	12	22	112
Vehicles Exited	46	11	1	20	12	23	113
Hourly Exit Rate	46	11	1	20	12	23	113
Input Volume	44	12	1	19	11	21	108
% of Volume	105	94	100	105	107	110	105

400: bretelles A-30 Ouest & route des Aciéries Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.1	4.2	0.2	0.1	0.1	1.1
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	0.5	0.4	0.6	0.1	4.0	2.2	1.0
Vehicles Entered	7	42	22	7	13	1	92
Vehicles Exited	7	42	22	7	13	1	92
Hourly Exit Rate	7	42	22	7	13	1	92
Input Volume	8	45	22	7	15	1	99
% of Volume	82	93	99	100	87	100	93

Total Network Performance

Denied Delay (hr)	0.0
Denied Del/Veh (s)	0.4
Total Delay (hr)	0.4
Total Del/Veh (s)	3.0
Vehicles Entered	443
Vehicles Exited	447
Hourly Exit Rate	447
Input Volume	2058
% of Volume	22

Intersection: 100: montée Lapierre & route Marie-Victorin (R132)

Movement	WB	NB
Directions Served	L	LR
Maximum Queue (m)	18.4	25.1
Average Queue (m)	1.7	12.3
95th Queue (m)	9.6	23.3
Link Distance (m)	154.4	1147.8
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 200: montée Lapierre & route des Aciéries

Movement	EB	WB	SB
Directions Served	LTR	LTR	LT
Maximum Queue (m)	4.9	21.6	18.0
Average Queue (m)	0.2	5.0	1.1
95th Queue (m)	2.5	15.8	7.4
Link Distance (m)	88.0	208.0	113.1
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 300: montée Lapierre & bretelles A-30 Est

Movement	EB
Directions Served	LR
Maximum Queue (m)	24.0
Average Queue (m)	12.5
95th Queue (m)	24.3
Link Distance (m)	228.7
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 400: bretelles A-30 Ouest & route des Aciéries

Movement	WB	NB
Directions Served	L	LR
Maximum Queue (m)	5.7	19.4
Average Queue (m)	0.3	4.2
95th Queue (m)	2.6	14.3
Link Distance (m)		51.7
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)	60.0	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 0

3: Montée Pomme d'Or & route Marie-Victorin (R132) Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.2
Denied Del/Veh (s)	0.2	0.2	3.4	0.4	0.0	0.0	0.0	0.8
Total Delay (hr)	0.2	0.0	0.1	0.0	0.1	0.0	0.4	0.8
Total Del/Veh (s)	3.7	1.8	2.3	0.9	10.8	0.6	7.7	4.4
Vehicles Entered	153	68	134	79	33	4	183	654
Vehicles Exited	155	70	135	79	34	5	181	659
Hourly Exit Rate	155	70	135	79	34	5	181	659
Input Volume	158	65	131	86	32	6	174	652
% of Volume	98	107	103	92	106	91	104	101

4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.2	0.2	0.3	0.3	4.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.2	0.3	0.2	0.2	0.0	0.1	0.0	0.2	0.0	0.2	0.2	0.0
Total Del/Veh (s)	17.9	17.7	4.9	19.4	18.2	4.1	5.7	4.6	1.9	7.5	5.1	2.2
Vehicles Entered	35	56	154	31	7	57	8	130	72	82	122	13
Vehicles Exited	35	56	154	31	7	57	9	129	72	83	122	13
Hourly Exit Rate	35	56	154	31	7	57	9	129	72	83	122	13
Input Volume	33	57	151	37	10	53	9	126	78	79	117	13
% of Volume	106	98	102	84	68	107	100	102	93	105	104	102

4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest Performance by movement

Movement	All
Denied Delay (hr)	0.1
Denied Del/Veh (s)	0.4
Total Delay (hr)	1.5
Total Del/Veh (s)	7.1
Vehicles Entered	767
Vehicles Exited	768
Hourly Exit Rate	768
Input Volume	764
% of Volume	101

5: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	1.2	1.2
Vehicles Entered	28	28
Vehicles Exited	28	28
Hourly Exit Rate	28	28
Input Volume	32	32
% of Volume	88	88

6: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.1	0.1
Total Del/Veh (s)	1.1	1.1
Vehicles Entered	212	212
Vehicles Exited	212	212
Hourly Exit Rate	212	212
Input Volume	214	214
% of Volume	99	99

7: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Est Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.2	4.0	0.2	0.0	0.0	0.2
Total Delay (hr)	0.2	0.1	0.0	0.0	0.0	0.0	0.3
Total Del/Veh (s)	6.5	3.7	4.0	0.1	0.1	0.8	1.8
Vehicles Entered	82	59	15	120	103	193	572
Vehicles Exited	83	59	15	120	103	192	572
Hourly Exit Rate	83	59	15	120	103	192	572
Input Volume	85	62	15	122	100	195	578
% of Volume	97	95	100	98	104	99	99

9: External Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Vehicles Entered	160	160
Vehicles Exited	159	159
Hourly Exit Rate	159	159
Input Volume	159	159
% of Volume	100	100

10: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.3	0.3
Vehicles Entered	208	208
Vehicles Exited	208	208
Hourly Exit Rate	208	208
Input Volume	210	210
% of Volume	99	99

11: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.2	0.3
Total Del/Veh (s)	1.1	3.1	2.1
Vehicles Entered	217	205	422
Vehicles Exited	216	206	422
Hourly Exit Rate	216	206	422
Input Volume	206	196	402
% of Volume	105	105	105

12: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.0	0.1	0.1
Total Del/Veh (s)	0.2	1.1	0.7
Vehicles Entered	204	294	498
Vehicles Exited	204	294	498
Hourly Exit Rate	204	294	498
Input Volume	207	292	500
% of Volume	98	101	100

13: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.1
Total Del/Veh (s)	0.5	0.3	0.4
Vehicles Entered	202	294	496
Vehicles Exited	204	294	498
Hourly Exit Rate	204	294	498
Input Volume	207	292	500
% of Volume	98	101	100

15: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.1	0.1
Total Del/Veh (s)	2.0	2.0
Vehicles Entered	113	113
Vehicles Exited	112	112
Hourly Exit Rate	112	112
Input Volume	118	118
% of Volume	95	95

606: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.1	0.1
Total Del/Veh (s)	1.3	1.3
Vehicles Entered	336	336
Vehicles Exited	337	337
Hourly Exit Rate	337	337
Input Volume	332	332
% of Volume	101	101

Total Network Performance

Denied Delay (hr)	0.3
Denied Del/Veh (s)	0.9
Total Delay (hr)	3.3
Total Del/Veh (s)	10.6
Vehicles Entered	1073
Vehicles Exited	1082
Hourly Exit Rate	1082
Input Volume	4462
% of Volume	24

Intersection: 3: Montée Pomme d'Or & route Marie-Victorin (R132)

Movement	EB	EB	WB	NB
Directions Served	T	R	L	LR
Maximum Queue (m)	1.3	1.3	24.0	30.0
Average Queue (m)	0.0	0.0	6.1	15.8
95th Queue (m)	1.0	1.0	16.8	25.5
Link Distance (m)	1927.0			1424.2
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (m)		60.0	60.0	
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	R	LT	R	LT	TR	LT	TR
Maximum Queue (m)	34.0	27.6	24.0	21.1	24.8	18.4	30.2	23.5
Average Queue (m)	14.2	12.8	8.3	8.8	6.8	4.8	10.9	5.2
95th Queue (m)	27.4	22.4	19.5	17.1	16.3	12.5	23.6	16.0
Link Distance (m)	93.4	93.4	154.8		132.2		90.3	90.3
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (m)				50.0		85.0		
Storage Blk Time (%)								
Queuing Penalty (veh)								

Intersection: 7: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Est

Movement	EB	NB	SB
Directions Served	LR	L	TR
Maximum Queue (m)	29.8	13.0	1.3
Average Queue (m)	13.7	2.0	0.0
95th Queue (m)	23.8	8.7	1.0
Link Distance (m)	126.8		
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)		25.0	85.0
Storage Blk Time (%)		0	
Queuing Penalty (veh)		0	

Network Summary

Network wide Queuing Penalty: 0

100: montée Lapierre & route Marie-Victorin (R132) Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	0.2	0.0	0.5	0.1	4.1	0.3	2.5	1.0
Vehicles Entered	44	13	34	58	8	3	61	221
Vehicles Exited	44	13	34	58	9	3	60	221
Hourly Exit Rate	44	13	34	58	9	3	60	221
Input Volume	48	12	33	61	9	3	52	218
% of Volume	92	108	102	95	97	100	115	101

200: montée Lapierre & route des Aciéries Performance by movement

Movement	EBT	WBT	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	6.9	5.1	2.4	0.2	0.0	0.9	0.4	0.7
Vehicles Entered	1	2	13	60	12	31	22	141
Vehicles Exited	1	2	13	60	12	31	22	141
Hourly Exit Rate	1	2	13	60	12	31	22	141
Input Volume	1	2	10	56	10	32	18	128
% of Volume	100	100	130	108	123	98	124	110

300: montée Lapierre & bretelles A-30 Est Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.1	0.0	0.0	0.0	0.0	0.1
Total Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	5.1	3.8	0.3	0.2	0.2	0.0	3.1
Vehicles Entered	55	1	1	14	9	11	91
Vehicles Exited	55	1	1	14	9	11	91
Hourly Exit Rate	55	1	1	14	9	11	91
Input Volume	48	1	2	13	8	8	79
% of Volume	115	100	57	106	120	142	115

400: bretelles A-30 Ouest & route des Aciéries Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.6	4.2	0.1	0.2	0.7
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	0.4	0.3	0.7	0.1	4.3	0.7
Vehicles Entered	13	38	6	8	7	72
Vehicles Exited	13	39	6	8	7	73
Hourly Exit Rate	13	39	6	8	7	73
Input Volume	14	34	7	5	6	67
% of Volume	91	114	86	152	117	109

Total Network Performance

Denied Delay (hr)	0.0
Denied Del/Veh (s)	0.3
Total Delay (hr)	0.3
Total Del/Veh (s)	4.2
Vehicles Entered	262
Vehicles Exited	262
Hourly Exit Rate	262
Input Volume	1331
% of Volume	20

Intersection: 100: montée Lapierre & route Marie-Victorin (R132)

Movement	WB	NB
Directions Served	L	LR
Maximum Queue (m)	11.9	31.0
Average Queue (m)	0.4	13.2
95th Queue (m)	4.1	25.1
Link Distance (m)	154.4	1147.8
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 200: montée Lapierre & route des Aciéries

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LT	LT
Maximum Queue (m)	7.2	21.9	1.3	9.8
Average Queue (m)	0.3	5.4	0.0	0.7
95th Queue (m)	2.9	17.4	1.0	5.5
Link Distance (m)	88.0	208.0	83.1	113.1
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (m)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 300: montée Lapierre & bretelles A-30 Est

Movement	EB
Directions Served	LR
Maximum Queue (m)	34.6
Average Queue (m)	14.6
95th Queue (m)	27.9
Link Distance (m)	228.7
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 400: bretelles A-30 Ouest & route des Aciéries

Movement	WB	NB
Directions Served	L	LR
Maximum Queue (m)	4.5	19.4
Average Queue (m)	0.2	3.2
95th Queue (m)	2.5	13.4
Link Distance (m)		51.7
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)	60.0	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 0

3: Montée Pomme d'Or & route Marie-Victorin (R132) Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
Denied Del/Veh (s)	0.2	0.1	3.4	0.4	0.0	0.0	0.0	0.9
Total Delay (hr)	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.4
Total Del/Veh (s)	2.2	1.3	1.6	0.9	9.3	1.1	5.7	3.1
Vehicles Entered	67	55	104	71	29	9	122	457
Vehicles Exited	66	56	104	71	29	9	121	456
Hourly Exit Rate	66	56	104	71	29	9	121	456
Input Volume	64	56	106	72	31	9	113	450
% of Volume	104	100	98	99	94	97	107	101

4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.1	0.1	0.2	0.4	4.1	0.0	0.0	0.0	0.1	0.0	0.0
Total Delay (hr)	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0
Total Del/Veh (s)	14.6	17.8	4.1	16.5	16.9	4.1	5.5	3.3	1.7	6.9	2.8	1.7
Vehicles Entered	35	16	33	27	5	40	29	80	84	64	92	33
Vehicles Exited	35	16	33	27	5	40	29	80	84	64	92	33
Hourly Exit Rate	35	16	33	27	5	40	29	80	84	64	92	33
Input Volume	35	16	35	26	8	40	28	74	76	61	95	33
% of Volume	99	102	95	104	65	101	104	109	111	104	97	101

4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest Performance by movement

Movement	All
Denied Delay (hr)	0.1
Denied Del/Veh (s)	0.4
Total Delay (hr)	0.8
Total Del/Veh (s)	5.5
Vehicles Entered	538
Vehicles Exited	538
Hourly Exit Rate	538
Input Volume	526
% of Volume	102

5: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.7	0.7
Vehicles Entered	67	67
Vehicles Exited	68	68
Hourly Exit Rate	68	68
Input Volume	68	68
% of Volume	99	99

6: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	1.0	1.0
Vehicles Entered	164	164
Vehicles Exited	165	165
Hourly Exit Rate	165	165
Input Volume	153	153
% of Volume	108	108

7: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Est Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.1	4.0	0.2	0.0	0.0	0.2
Total Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	5.9	2.8	2.3	0.1	0.1	0.2	0.9
Vehicles Entered	37	18	7	148	85	48	343
Vehicles Exited	37	18	7	149	85	48	344
Hourly Exit Rate	37	18	7	149	85	48	344
Input Volume	38	19	10	135	84	49	335
% of Volume	97	94	72	110	101	98	103

9: External Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Vehicles Entered	98	98
Vehicles Exited	98	98
Hourly Exit Rate	98	98
Input Volume	100	100
% of Volume	98	98

10: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Vehicles Entered	55	55
Vehicles Exited	55	55
Hourly Exit Rate	55	55
Input Volume	59	59
% of Volume	94	94

11: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.0	0.1	0.2
Total Del/Veh (s)	1.0	2.9	2.0
Vehicles Entered	149	160	309
Vehicles Exited	150	160	310
Hourly Exit Rate	150	160	310
Input Volume	144	162	306
% of Volume	104	99	101

12: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0
Total Del/Veh (s)	0.1	1.1	0.5
Vehicles Entered	186	128	314
Vehicles Exited	187	129	316
Hourly Exit Rate	187	129	316
Input Volume	173	129	302
% of Volume	108	100	105

13: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0
Total Del/Veh (s)	0.4	0.1	0.3
Vehicles Entered	186	129	315
Vehicles Exited	186	129	315
Hourly Exit Rate	186	129	315
Input Volume	173	129	302
% of Volume	107	100	104

15: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.1	0.1
Total Del/Veh (s)	2.3	2.3
Vehicles Entered	100	100
Vehicles Exited	100	100
Hourly Exit Rate	100	100
Input Volume	103	103
% of Volume	97	97

606: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.9	0.9
Vehicles Entered	187	187
Vehicles Exited	187	187
Hourly Exit Rate	187	187
Input Volume	176	176
% of Volume	106	106

Total Network Performance

Denied Delay (hr)	0.2
Denied Del/Veh (s)	0.9
Total Delay (hr)	1.7
Total Del/Veh (s)	8.5
Vehicles Entered	713
Vehicles Exited	717
Hourly Exit Rate	717
Input Volume	2880
% of Volume	25

Intersection: 3: Montée Pomme d'Or & route Marie-Victorin (R132)

Movement	EB	WB	NB
Directions Served	R	L	LR
Maximum Queue (m)	2.8	15.6	33.0
Average Queue (m)	0.1	3.0	14.8
95th Queue (m)	2.0	10.4	27.4
Link Distance (m)			1426.8
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)	60.0	60.0	
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	R	LT	R	LT	TR	LT	TR
Maximum Queue (m)	35.2	19.6	22.4	22.1	28.2	19.1	32.7	16.2
Average Queue (m)	12.4	6.9	6.6	8.3	6.7	5.0	8.7	3.3
95th Queue (m)	28.5	18.0	16.6	19.8	19.1	13.2	24.4	11.5
Link Distance (m)	93.4	93.4	154.6		132.2		87.6	87.6
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (m)				50.0		85.0		
Storage Blk Time (%)								
Queuing Penalty (veh)								

Intersection: 7: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Est

Movement	EB	NB
Directions Served	LR	L
Maximum Queue (m)	29.3	5.4
Average Queue (m)	11.6	0.1
95th Queue (m)	24.5	1.9
Link Distance (m)	126.8	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		25.0
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 0

ANNEXE D :

RÉSULTATS DÉTAILLÉS DES SIMULATIONS DE CIRCULATION – SITUATION PROJETÉE - CONSTRUCTION

100: montée Lapierre & route Marie-Victorin (R132) Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.3
Total Del/Veh (s)	0.4	0.1	0.7	0.4	6.6	8.9	3.7	7.0	2.8
Vehicles Entered	67	22	31	108	13	48	37	39	365
Vehicles Exited	66	22	30	108	14	47	37	39	363
Hourly Exit Rate	66	22	30	108	14	47	37	39	363
Input Volume	63	23	32	105	16	47	34	43	364
% of Volume	104	96	93	103	89	99	108	90	100

200: montée Lapierre & route des Aciéries Performance by movement

Movement	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	6.2	1.5	6.2	3.8	3.5	1.1	0.3	0.1	1.2	0.3	0.0	1.1
Vehicles Entered	2	3	5	2	43	1	57	60	45	51	1	270
Vehicles Exited	2	3	5	2	43	1	57	60	45	51	1	270
Hourly Exit Rate	2	3	5	2	43	1	57	60	45	51	1	270
Input Volume	2	2	7	3	42	1	56	55	54	50	1	274
% of Volume	100	133	71	67	103	100	101	109	84	101	100	99

300: montée Lapierre & bretelles A-30 Est Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.1	0.0	0.0	0.0	0.0	0.1
Total Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	5.3	4.9	0.8	0.4	0.3	0.1	2.9
Vehicles Entered	94	1	11	20	6	48	180
Vehicles Exited	93	1	11	20	6	48	179
Hourly Exit Rate	93	1	11	20	6	48	179
Input Volume	90	1	12	17	8	47	175
% of Volume	103	100	92	119	73	102	102

400: bretelles A-30 Ouest & route des Aciéries Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.1	3.9	0.2	0.1	0.6	0.4
Total Delay (hr)	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Total Del/Veh (s)	0.4	0.4	0.7	0.5	4.6	3.4	1.5
Vehicles Entered	60	50	12	6	41	1	170
Vehicles Exited	60	49	12	6	42	1	170
Hourly Exit Rate	60	49	12	6	42	1	170
Input Volume	59	54	12	7	43	1	175
% of Volume	102	91	102	89	98	100	97

Total Network Performance

Denied Delay (hr)	0.0
Denied Del/Veh (s)	0.3
Total Delay (hr)	0.9
Total Del/Veh (s)	7.0
Vehicles Entered	480
Vehicles Exited	480
Hourly Exit Rate	480
Input Volume	2428
% of Volume	20

Intersection: 100: montée Lapierre & route Marie-Victorin (R132)

Movement	EB	WB	WB	NB	SB
Directions Served	R	L	T	LTR	T
Maximum Queue (m)	3.3	16.5	2.5	32.4	27.2
Average Queue (m)	0.2	1.3	0.1	17.1	12.8
95th Queue (m)	2.5	7.7	1.3	26.9	26.6
Link Distance (m)	157.6	152.3	152.3	1147.7	80.3
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 200: montée Lapierre & route des Aciéries

Movement	EB	WB	SB
Directions Served	LTR	LTR	LT
Maximum Queue (m)	9.2	25.0	16.9
Average Queue (m)	1.2	10.5	2.4
95th Queue (m)	6.0	23.2	11.0
Link Distance (m)	88.0	208.0	113.1
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 300: montée Lapierre & bretelles A-30 Est

Movement	EB	NB
Directions Served	LR	LT
Maximum Queue (m)	28.3	6.1
Average Queue (m)	16.4	0.3
95th Queue (m)	26.2	2.6
Link Distance (m)	228.7	95.0
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 400: bretelles A-30 Ouest & route des Aciéries

Movement	WB	NB
Directions Served	L	LR
Maximum Queue (m)	6.0	25.2
Average Queue (m)	0.4	10.1
95th Queue (m)	3.1	22.5
Link Distance (m)		51.7
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)	60.0	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 0

100: montée Lapierre & route Marie-Victorin (R132) Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.3
Total Del/Veh (s)	0.5	0.1	1.0	0.4	5.6	10.2	3.5	7.2	2.6
Vehicles Entered	139	29	28	99	11	41	51	47	445
Vehicles Exited	139	29	28	99	11	41	51	47	445
Hourly Exit Rate	139	29	28	99	11	41	51	47	445
Input Volume	138	28	29	101	10	44	45	43	438
% of Volume	101	104	97	98	113	93	114	109	102

200: montée Lapierre & route des Aciéries Performance by movement

Movement	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)		5.4	3.2	4.4	0.5	0.3	0.0	1.3	0.5	0.0	1.4
Vehicles Entered	0	12	6	33	2	73	17	62	46	6	257
Vehicles Exited	0	12	6	33	2	73	17	62	46	6	257
Hourly Exit Rate	0	12	6	33	2	73	17	62	46	6	257
Input Volume	1	12	6	31	1	70	16	57	48	5	246
% of Volume	0	102	109	106	200	104	106	108	96	126	104

300: montée Lapierre & bretelles A-30 Est Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.1		0.0	0.0	0.0	0.1
Total Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	5.2	2.7		0.3	0.3	0.0	2.6
Vehicles Entered	69	11	0	20	11	44	155
Vehicles Exited	69	11	0	20	11	44	155
Hourly Exit Rate	69	11	0	20	11	44	155
Input Volume	65	12	1	19	13	43	153
% of Volume	106	94	0	105	83	102	101

400: bretelles A-30 Ouest & route des Aciéries Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	4.1	0.1	0.1	0.1	0.6
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	0.6	0.6	0.8	0.2	4.4	1.8	1.6
Vehicles Entered	9	70	21	8	38	1	147
Vehicles Exited	9	71	21	8	38	1	148
Hourly Exit Rate	9	71	21	8	38	1	148
Input Volume	8	66	22	7	37	1	142
% of Volume	112	107	94	114	103	100	105

Total Network Performance

Denied Delay (hr)	0.0
Denied Del/Veh (s)	0.3
Total Delay (hr)	1.0
Total Del/Veh (s)	6.8
Vehicles Entered	535
Vehicles Exited	533
Hourly Exit Rate	533
Input Volume	2582
% of Volume	21

Intersection: 100: montée Lapierre & route Marie-Victorin (R132)

Movement	EB	WB	WB	NB	SB
Directions Served	R	L	T	LTR	T
Maximum Queue (m)	6.2	18.6	2.7	38.9	31.3
Average Queue (m)	0.3	2.2	0.1	17.3	15.2
95th Queue (m)	3.0	10.1	1.4	29.8	28.2
Link Distance (m)	157.5	152.4	152.4	1147.7	124.6
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 200: montée Lapierre & route des Aciéries

Movement	EB	WB	SB
Directions Served	LTR	LTR	LT
Maximum Queue (m)	3.2	23.8	24.5
Average Queue (m)	0.1	10.9	3.3
95th Queue (m)	1.7	24.3	14.4
Link Distance (m)	88.0	208.0	113.1
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 300: montée Lapierre & bretelles A-30 Est

Movement	EB
Directions Served	LR
Maximum Queue (m)	31.8
Average Queue (m)	15.6
95th Queue (m)	27.3
Link Distance (m)	228.7
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 400: bretelles A-30 Ouest & route des Aciéries

Movement	WB	NB
Directions Served	L	LR
Maximum Queue (m)	6.1	27.2
Average Queue (m)	0.5	10.4
95th Queue (m)	3.7	23.7
Link Distance (m)		51.7
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)	60.0	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 0

100: montée Lapierre & route Marie-Victorin (R132) Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.3
Total Del/Veh (s)	0.4	0.0	0.6	0.4	9.0	9.1	3.5	7.3	3.6
Vehicles Entered	46	16	34	58	7	51	59	43	314
Vehicles Exited	46	17	34	58	7	50	60	43	315
Hourly Exit Rate	46	17	34	58	7	50	60	43	315
Input Volume	48	12	33	61	9	47	52	43	306
% of Volume	96	142	102	95	76	106	115	99	103

200: montée Lapierre & route des Aciéries Performance by movement

Movement	EBT	WBT	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	9.7	4.7	3.4	0.3	0.1	1.3	0.3	1.1
Vehicles Entered	1	4	36	85	12	51	50	239
Vehicles Exited	1	4	36	85	12	51	50	239
Hourly Exit Rate	1	4	36	85	12	51	50	239
Input Volume	1	4	32	77	10	53	45	222
% of Volume	100	94	112	110	123	97	111	108

300: montée Lapierre & bretelles A-30 Est Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.1		0.0	0.0	0.0	0.1
Total Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Total Del/Veh (s)	5.1	2.5		0.2	0.1	0.0	2.9
Vehicles Entered	75	2	0	16	9	34	136
Vehicles Exited	76	2	0	16	9	34	137
Hourly Exit Rate	76	2	0	16	9	34	137
Input Volume	69	1	2	13	10	30	125
% of Volume	110	200	0	121	92	113	110

400: bretelles A-30 Ouest & route des Aciéries Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.4	3.9	0.1	0.2	0.3
Total Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	0.5	0.5	0.3	0.5	4.4	1.6
Vehicles Entered	16	54	3	6	32	111
Vehicles Exited	16	54	3	6	32	111
Hourly Exit Rate	16	54	3	6	32	111
Input Volume	16	55	7	5	28	112
% of Volume	102	98	43	114	113	100

Total Network Performance

Denied Delay (hr)	0.0
Denied Del/Veh (s)	0.2
Total Delay (hr)	0.9
Total Del/Veh (s)	8.7
Vehicles Entered	359
Vehicles Exited	365
Hourly Exit Rate	365
Input Volume	1862
% of Volume	20

Intersection: 100: montée Lapierre & route Marie-Victorin (R132)

Movement	WB	WB	NB	SB
Directions Served	L	T	LTR	T
Maximum Queue (m)	15.8	1.4	34.5	32.9
Average Queue (m)	0.7	0.0	17.7	14.0
95th Queue (m)	5.8	1.0	26.1	28.5
Link Distance (m)	152.3	152.3	1147.7	92.3
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (m)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 200: montée Lapierre & route des Aciéries

Movement	EB	WB	SB
Directions Served	LTR	LTR	LT
Maximum Queue (m)	7.4	26.4	18.9
Average Queue (m)	0.3	10.5	2.4
95th Queue (m)	3.1	24.8	11.2
Link Distance (m)	88.0	208.0	113.1
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 300: montée Lapierre & bretelles A-30 Est

Movement	EB
Directions Served	LR
Maximum Queue (m)	32.2
Average Queue (m)	16.7
95th Queue (m)	29.1
Link Distance (m)	228.7
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 400: bretelles A-30 Ouest & route des Aciéries

Movement	NB
Directions Served	LR
Maximum Queue (m)	33.9
Average Queue (m)	9.5
95th Queue (m)	24.6
Link Distance (m)	51.7
Upstream Blk Time (%)	0
Queuing Penalty (veh)	0
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 0

ANNEXE E :

RÉSULTATS DÉTAILLÉS DES SIMULATIONS DE CIRCULATION – SITUATION PROJETÉE - OPÉRATION

1: Bend Performance by approach

Approach	EB	WB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.4	0.0	0.2
Total Delay (hr)	0.3	0.4	0.7
Total Del/Veh (s)	2.5	2.2	2.3
Vehicles Entered	417	640	1057
Vehicles Exited	417	641	1058
Hourly Exit Rate	417	641	1058
Input Volume	410	648	1058
% of Volume	102	99	100

2: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	1.2	0.4	1.6
Total Del/Veh (s)	8.1	2.7	5.4
Vehicles Entered	524	553	1077
Vehicles Exited	530	554	1084
Hourly Exit Rate	530	554	1084
Input Volume	529	552	1081
% of Volume	100	100	100

3: Montée Pomme d'Or & route Marie-Victorin (R132) Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Total Delay (hr)	0.9	0.2	2.1	0.9	1.9	0.0	0.1	6.2
Total Del/Veh (s)	22.2	2.7	26.9	12.3	18.2	1.2	2.9	14.7
Vehicles Entered	147	271	280	262	378	11	155	1504
Vehicles Exited	147	271	282	262	378	11	156	1507
Hourly Exit Rate	147	271	282	262	378	11	156	1507
Input Volume	144	266	286	255	393	13	138	1495
% of Volume	102	102	99	103	96	85	113	101

4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.2	0.3	0.2	0.0	0.0
Denied Del/Veh (s)	0.1	0.1	0.2	0.5	0.6	2.0	8.3	1.9	3.0	2.4	0.4	1.6
Total Delay (hr)	0.2	0.1	0.1	0.3	2.3	0.3	2.4	3.9	2.3	3.6	0.8	0.2
Total Del/Veh (s)	43.4	46.2	4.6	32.3	35.0	6.5	51.1	40.0	26.0	40.3	14.7	11.3
Vehicles Entered	18	7	68	39	234	175	164	345	319	319	186	72
Vehicles Exited	18	7	69	39	236	176	166	347	323	321	187	73
Hourly Exit Rate	18	7	69	39	236	176	166	347	323	321	187	73
Input Volume	18	8	70	42	234	175	177	353	321	321	181	70
% of Volume	99	90	99	92	101	101	94	98	101	100	103	104

4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest Performance by movement

Movement	All
Denied Delay (hr)	1.2
Denied Del/Veh (s)	2.3
Total Delay (hr)	16.6
Total Del/Veh (s)	30.3
Vehicles Entered	1946
Vehicles Exited	1962
Hourly Exit Rate	1962
Input Volume	1970
% of Volume	100

5: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.3	0.3
Total Del/Veh (s)	2.6	2.6
Vehicles Entered	474	474
Vehicles Exited	474	474
Hourly Exit Rate	474	474
Input Volume	481	481
% of Volume	99	99

6: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.4	0.4
Total Del/Veh (s)	2.5	2.5
Vehicles Entered	651	651
Vehicles Exited	652	652
Hourly Exit Rate	652	652
Input Volume	650	650
% of Volume	100	100

7: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Est Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.1	0.0	0.0	0.2
Denied Del/Veh (s)	0.3	0.2	2.5	0.7	0.0	0.2	0.5
Total Delay (hr)	1.7	0.1	0.1	1.7	0.2	0.2	3.9
Total Del/Veh (s)	30.9	22.7	13.1	9.8	4.5	5.0	12.2
Vehicles Entered	190	16	20	618	156	156	1156
Vehicles Exited	190	16	20	618	155	157	1156
Hourly Exit Rate	190	16	20	618	155	157	1156
Input Volume	199	16	23	635	158	150	1181
% of Volume	96	100	88	97	98	104	98

8: Bend Performance by approach

Approach	EB	WB	All
Denied Delay (hr)	0.0	0.1	0.1
Denied Del/Veh (s)	0.0	0.4	0.3
Total Delay (hr)	0.2	0.2	0.5
Total Del/Veh (s)	2.9	1.4	1.9
Vehicles Entered	303	542	845
Vehicles Exited	302	542	844
Hourly Exit Rate	302	542	844
Input Volume	282	541	823
% of Volume	107	100	103

9: External Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.1	0.1
Total Del/Veh (s)	1.6	1.6
Vehicles Entered	135	135
Vehicles Exited	135	135
Hourly Exit Rate	135	135
Input Volume	138	138
% of Volume	98	98

10: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.7	0.7
Vehicles Entered	177	177
Vehicles Exited	177	177
Hourly Exit Rate	177	177
Input Volume	173	173
% of Volume	102	102

11: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.5	3.2	3.7
Total Del/Veh (s)	3.5	20.0	12.1
Vehicles Entered	524	554	1078
Vehicles Exited	524	558	1082
Hourly Exit Rate	524	558	1082
Input Volume	529	552	1081
% of Volume	99	101	100

12: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	1.4	0.2	1.5
Total Del/Veh (s)	6.0	2.1	5.0
Vehicles Entered	809	273	1082
Vehicles Exited	809	273	1082
Hourly Exit Rate	809	273	1082
Input Volume	834	273	1107
% of Volume	97	100	98

13: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.9	0.0	1.0
Total Del/Veh (s)	4.1	0.5	3.2
Vehicles Entered	808	273	1081
Vehicles Exited	809	273	1082
Hourly Exit Rate	809	273	1082
Input Volume	834	273	1107
% of Volume	97	100	98

15: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.7	0.7
Total Del/Veh (s)	3.7	3.7
Vehicles Entered	641	641
Vehicles Exited	641	641
Hourly Exit Rate	641	641
Input Volume	648	648
% of Volume	99	99

606: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.1	0.1
Total Del/Veh (s)	0.8	0.8
Vehicles Entered	302	302
Vehicles Exited	302	302
Hourly Exit Rate	302	302
Input Volume	282	282
% of Volume	107	107

Total Network Performance

Denied Delay (hr)	1.5
Denied Del/Veh (s)	2.3
Total Delay (hr)	37.3
Total Del/Veh (s)	52.4
Vehicles Entered	2435
Vehicles Exited	2466
Hourly Exit Rate	2466
Input Volume	13274
% of Volume	19

Intersection: 1: Bend

Movement	WB	WB
Directions Served	T	
Maximum Queue (m)	4.9	5.3
Average Queue (m)	0.2	0.2
95th Queue (m)	2.6	2.8
Link Distance (m)	114.0	114.0
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 3: Montée Pomme d'Or & route Marie-Victorin (R132)

Movement	EB	WB	WB	NB	NB	B2	B11	B11
Directions Served	T	L	T	L	R	T	T	
Maximum Queue (m)	50.1	91.4	66.6	138.2	26.8	15.6	27.0	13.2
Average Queue (m)	18.1	34.4	22.6	75.4	10.8	0.7	1.6	0.7
95th Queue (m)	35.6	71.8	48.5	122.6	22.4	6.4	13.1	6.5
Link Distance (m)	114.0		139.2	118.0	118.0	1299.2	83.0	83.0
Upstream Blk Time (%)				1				
Queuing Penalty (veh)				2				
Storage Bay Dist (m)		60.0						
Storage Blk Time (%)	0	6	0					
Queuing Penalty (veh)	0	18	0					

Intersection: 4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest

Movement	EB	EB	WB	WB	NB	NB	B12	B13	B13	SB	SB	B11
Directions Served	LT	R	LT	R	LT	TR	T	T		L	TR	T
Maximum Queue (m)	24.4	20.7	80.3	47.4	151.4	144.5	117.6	50.9	30.8	111.0	89.6	186.1
Average Queue (m)	5.0	5.0	42.9	20.5	84.7	73.0	20.6	7.2	3.8	62.0	36.0	32.5
95th Queue (m)	17.7	16.5	71.6	38.3	148.8	143.4	109.1	50.5	28.5	113.4	70.5	204.6
Link Distance (m)	406.6	406.6	504.3		132.2	132.2	152.2	130.2	130.2	83.0	83.0	1299.2
Upstream Blk Time (%)					6	3	3	0		13	1	
Queuing Penalty (veh)					25	15	23	2		35	2	
Storage Bay Dist (m)				50.0								
Storage Blk Time (%)			7	0								
Queuing Penalty (veh)			13	0								

Intersection: 4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest

Movement	B2	B2
Directions Served	T	
Maximum Queue (m)	41.1	24.3
Average Queue (m)	1.8	1.2
95th Queue (m)	18.1	9.8
Link Distance (m)	118.0	118.0
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 7: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Est

Movement	EB	NB	NB	SB	SB
Directions Served	LR	L	T	T	TR
Maximum Queue (m)	98.4	36.9	121.5	48.0	79.9
Average Queue (m)	40.5	5.5	50.4	10.3	19.0
95th Queue (m)	83.0	23.2	96.0	27.4	52.7
Link Distance (m)	243.5		353.7	130.2	
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)		25.0			85.0
Storage Blk Time (%)		0	14		0
Queuing Penalty (veh)		0	3		0

Network Summary

Network wide Queuing Penalty: 137

1: Bend Performance by approach

Approach	EB	WB	All
Denied Delay (hr)	0.1	0.0	0.1
Denied Del/Veh (s)	0.5	0.0	0.3
Total Delay (hr)	0.4	0.1	0.5
Total Del/Veh (s)	2.7	1.4	2.3
Vehicles Entered	508	270	778
Vehicles Exited	509	270	779
Hourly Exit Rate	509	270	779
Input Volume	509	290	799
% of Volume	100	93	98

2: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.4	0.2	0.6
Total Del/Veh (s)	4.7	2.0	3.1
Vehicles Entered	307	420	727
Vehicles Exited	306	420	726
Hourly Exit Rate	306	420	726
Input Volume	324	412	736
% of Volume	95	102	99

3: Montée Pomme d'Or & route Marie-Victorin (R132) Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	0.5	0.2	0.3	0.1	0.7	0.0	0.3	2.2
Total Del/Veh (s)	7.3	2.2	8.2	3.5	21.9	1.6	5.0	6.9
Vehicles Entered	241	268	152	148	120	1	187	1117
Vehicles Exited	241	269	151	148	121	1	187	1118
Hourly Exit Rate	241	269	151	148	121	1	187	1118
Input Volume	244	265	147	160	130	2	194	1142
% of Volume	99	102	103	92	93	57	96	98

4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.1	0.1	0.3	0.3	2.1	0.1	0.0	0.0	0.0	0.1	0.0
Total Delay (hr)	0.2	0.3	0.2	0.2	0.1	0.1	0.0	0.5	0.1	0.4	0.9	0.0
Total Del/Veh (s)	20.5	19.3	4.6	21.5	18.3	4.0	11.3	9.1	4.4	8.8	11.2	10.1
Vehicles Entered	34	61	171	35	11	83	7	197	81	158	273	12
Vehicles Exited	35	61	172	36	11	83	7	197	81	158	272	12
Hourly Exit Rate	35	61	172	36	11	83	7	197	81	158	272	12
Input Volume	37	63	168	41	11	85	9	210	87	156	264	14
% of Volume	95	97	103	88	102	98	78	94	93	101	103	86

4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest Performance by movement

Movement	All
Denied Delay (hr)	0.1
Denied Del/Veh (s)	0.2
Total Delay (hr)	3.0
Total Del/Veh (s)	9.6
Vehicles Entered	1123
Vehicles Exited	1125
Hourly Exit Rate	1125
Input Volume	1144
% of Volume	98

5: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	1.6	1.6
Vehicles Entered	29	29
Vehicles Exited	29	29
Hourly Exit Rate	29	29
Input Volume	34	34
% of Volume	86	86

6: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.2	0.2
Total Del/Veh (s)	2.1	2.1
Vehicles Entered	301	301
Vehicles Exited	301	301
Hourly Exit Rate	301	301
Input Volume	306	306
% of Volume	98	98

7: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Est Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.3	0.3	3.9	0.2	0.0	0.0	0.2
Total Delay (hr)	0.7	0.2	0.0	0.2	0.2	0.4	1.7
Total Del/Veh (s)	20.6	11.0	9.6	3.9	4.7	4.7	7.5
Vehicles Entered	119	76	14	158	157	310	834
Vehicles Exited	119	76	14	158	157	310	834
Hourly Exit Rate	119	76	14	158	157	310	834
Input Volume	130	69	17	168	147	309	840
% of Volume	92	110	84	94	107	100	99

8: Bend Performance by approach

Approach	EB	WB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.3	0.1
Total Delay (hr)	0.3	0.0	0.3
Total Del/Veh (s)	2.1	0.5	1.5
Vehicles Entered	427	300	727
Vehicles Exited	426	300	726
Hourly Exit Rate	426	300	726
Input Volume	438	307	745
% of Volume	97	98	97

9: External Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.1	0.1
Total Del/Veh (s)	1.1	1.1
Vehicles Entered	228	228
Vehicles Exited	228	228
Hourly Exit Rate	228	228
Input Volume	211	211
% of Volume	108	108

10: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.5	0.5
Vehicles Entered	324	324
Vehicles Exited	324	324
Hourly Exit Rate	324	324
Input Volume	326	326
% of Volume	99	99

11: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.7	0.9
Total Del/Veh (s)	1.7	5.9	4.2
Vehicles Entered	307	420	727
Vehicles Exited	307	421	728
Hourly Exit Rate	307	421	728
Input Volume	324	412	736
% of Volume	95	102	99

12: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.0	0.2	0.3
Total Del/Veh (s)	0.3	1.9	1.3
Vehicles Entered	277	460	737
Vehicles Exited	276	461	737
Hourly Exit Rate	276	461	737
Input Volume	298	451	749
% of Volume	93	102	98

13: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.1	0.2
Total Del/Veh (s)	1.1	0.7	0.8
Vehicles Entered	277	461	738
Vehicles Exited	277	461	738
Hourly Exit Rate	277	461	738
Input Volume	298	451	749
% of Volume	93	102	99

15: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.1	0.1
Total Del/Veh (s)	1.5	1.5
Vehicles Entered	270	270
Vehicles Exited	270	270
Hourly Exit Rate	270	270
Input Volume	290	290
% of Volume	93	93

606: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.1	0.1
Total Del/Veh (s)	0.7	0.7
Vehicles Entered	426	426
Vehicles Exited	426	426
Hourly Exit Rate	426	426
Input Volume	438	438
% of Volume	97	97

Total Network Performance

Denied Delay (hr)	0.2
Denied Del/Veh (s)	0.5
Total Delay (hr)	10.1
Total Del/Veh (s)	21.9
Vehicles Entered	1609
Vehicles Exited	1611
Hourly Exit Rate	1611
Input Volume	9244
% of Volume	17

Intersection: 3: Montée Pomme d'Or & route Marie-Victorin (R132)

Movement	EB	WB	WB	NB	NB
Directions Served	T	L	T	L	R
Maximum Queue (m)	35.1	39.9	25.7	54.1	33.2
Average Queue (m)	12.8	14.1	7.2	23.9	15.3
95th Queue (m)	28.8	29.4	19.4	44.2	26.3
Link Distance (m)	101.0		139.3	116.0	116.0
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)		60.0			
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest

Movement	EB	EB	WB	WB	NB	NB	SB	SB	B11	B2	B2
Directions Served	LT	R	LT	R	LT	TR	L	TR	T	T	
Maximum Queue (m)	33.2	25.2	25.7	26.3	32.7	29.3	54.5	91.1	2.7	5.6	5.9
Average Queue (m)	14.3	12.7	9.0	10.2	11.4	10.8	17.6	31.4	0.2	0.2	0.2
95th Queue (m)	27.3	21.3	20.3	20.3	25.1	23.4	37.2	70.6	2.8	4.1	4.3
Link Distance (m)	406.6	406.6	504.3		132.2	132.2	99.1	99.1	1283.0	116.0	116.0
Upstream Blk Time (%)								0			
Queuing Penalty (veh)								0			
Storage Bay Dist (m)				50.0							
Storage Blk Time (%)											
Queuing Penalty (veh)											

Intersection: 7: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Est

Movement	EB	NB	NB	SB	SB	B12	B12
Directions Served	LR	L	T	T	TR	T	
Maximum Queue (m)	56.6	14.0	23.1	26.6	73.2	11.2	4.3
Average Queue (m)	25.7	2.2	9.6	10.2	23.8	0.4	0.2
95th Queue (m)	44.4	8.6	20.8	23.3	50.4	5.0	3.1
Link Distance (m)	126.4		186.3	130.1		132.2	132.2
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (m)		25.0			85.0		
Storage Blk Time (%)		0	0		0		
Queuing Penalty (veh)		0	0		0		

Network Summary

Network wide Queuing Penalty: 0

2: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.9	0.2	1.1
Total Del/Veh (s)	7.1	2.1	4.9
Vehicles Entered	416	342	758
Vehicles Exited	424	344	768
Hourly Exit Rate	424	344	768
Input Volume	414	342	756
% of Volume	103	101	102

3: Montée Pomme d'Or & route Marie-Victorin (R132) Performance by movement

Movement	EBT	EBR	WBL	WBT	NBL	NBT	NBR	All
Denied Delay (hr)	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2
Denied Del/Veh (s)	0.7	2.6	0.0	0.0	0.3	0.0	0.0	0.7
Total Delay (hr)	0.9	0.3	0.5	0.4	1.7	0.0	0.2	4.0
Total Del/Veh (s)	20.3	4.4	15.9	8.8	20.5	1.3	5.9	13.1
Vehicles Entered	154	222	121	169	305	15	120	1106
Vehicles Exited	155	221	121	169	304	15	120	1105
Hourly Exit Rate	155	221	121	169	304	15	120	1105
Input Volume	162	224	118	171	287	16	126	1104
% of Volume	96	99	103	99	106	91	95	100

4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.3	0.1	0.1
Denied Del/Veh (s)	0.2	0.1	0.1	0.7	0.7	2.0	0.0	0.0	0.0	7.1	1.5	5.7
Total Delay (hr)	0.3	0.2	0.0	0.2	0.1	0.3	0.3	1.7	0.3	0.6	1.2	0.3
Total Del/Veh (s)	29.5	32.8	2.1	27.4	33.6	5.4	28.3	26.9	13.6	13.4	19.6	23.2
Vehicles Entered	39	24	37	26	11	170	33	221	85	162	215	41
Vehicles Exited	39	24	37	27	11	170	33	219	85	163	214	40
Hourly Exit Rate	39	24	37	27	11	170	33	219	85	163	214	40
Input Volume	39	20	39	29	9	164	32	222	85	153	223	37
% of Volume	99	122	95	92	122	104	104	99	100	107	96	109

4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest Performance by movement

Movement	All
Denied Delay (hr)	0.6
Denied Del/Veh (s)	2.0
Total Delay (hr)	5.4
Total Del/Veh (s)	18.3
Vehicles Entered	1064
Vehicles Exited	1062
Hourly Exit Rate	1062
Input Volume	1051
% of Volume	101

5: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	1.4	1.4
Vehicles Entered	85	85
Vehicles Exited	85	85
Hourly Exit Rate	85	85
Input Volume	78	78
% of Volume	110	110

6: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.2	0.2
Total Del/Veh (s)	2.5	2.5
Vehicles Entered	272	272
Vehicles Exited	274	274
Hourly Exit Rate	274	274
Input Volume	258	258
% of Volume	106	106

7: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Est Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.4	0.3	3.8	0.2	0.0	0.0	0.2
Total Delay (hr)	0.8	0.1	0.0	0.3	0.1	0.1	1.4
Total Del/Veh (s)	19.2	12.1	9.0	5.6	4.1	3.6	8.9
Vehicles Entered	151	22	10	174	85	132	574
Vehicles Exited	152	22	10	174	85	132	575
Hourly Exit Rate	152	22	10	174	85	132	575
Input Volume	149	21	11	178	93	131	582
% of Volume	102	105	93	98	92	101	99

8: Bend Performance by approach

Approach	EB	WB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.3	0.1
Total Delay (hr)	0.2	0.1	0.3
Total Del/Veh (s)	3.1	0.8	1.9
Vehicles Entered	274	289	563
Vehicles Exited	275	289	564
Hourly Exit Rate	275	289	564
Input Volume	288	289	576
% of Volume	96	100	98

9: External Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.9	0.9
Vehicles Entered	104	104
Vehicles Exited	103	103
Hourly Exit Rate	103	103
Input Volume	110	110
% of Volume	94	94

10: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.6	0.6
Vehicles Entered	142	142
Vehicles Exited	141	141
Hourly Exit Rate	141	141
Input Volume	142	142
% of Volume	99	99

11: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.4	0.6	0.9
Total Del/Veh (s)	3.2	5.7	4.3
Vehicles Entered	415	344	759
Vehicles Exited	416	344	760
Hourly Exit Rate	416	344	760
Input Volume	414	342	756
% of Volume	101	101	101

12: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.0	0.2	0.2
Total Del/Veh (s)	0.4	2.7	1.3
Vehicles Entered	326	210	536
Vehicles Exited	326	211	537
Hourly Exit Rate	326	211	537
Input Volume	327	220	547
% of Volume	100	96	98

13: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.0	0.2
Total Del/Veh (s)	1.5	0.6	1.1
Vehicles Entered	325	211	536
Vehicles Exited	326	213	539
Hourly Exit Rate	326	213	539
Input Volume	327	220	547
% of Volume	100	97	98

15: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.7	0.7
Total Del/Veh (s)	5.4	5.4
Vehicles Entered	473	473
Vehicles Exited	474	474
Hourly Exit Rate	474	474
Input Volume	458	458
% of Volume	104	104

606: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.1	0.1
Total Del/Veh (s)	1.0	1.0
Vehicles Entered	275	275
Vehicles Exited	275	275
Hourly Exit Rate	275	275
Input Volume	288	288
% of Volume	96	96

Total Network Performance

Denied Delay (hr)	0.9
Denied Del/Veh (s)	2.1
Total Delay (hr)	14.6
Total Del/Veh (s)	35.1
Vehicles Entered	1436
Vehicles Exited	1452
Hourly Exit Rate	1452
Input Volume	7252
% of Volume	20

Intersection: 3: Montée Pomme d'Or & route Marie-Victorin (R132)

Movement	EB	WB	WB	NB	NB	B2	B11	B11
Directions Served	T	L	T	L	R	T	T	
Maximum Queue (m)	42.1	42.1	36.1	117.2	81.5	20.5	20.4	15.3
Average Queue (m)	14.5	13.7	12.4	60.0	23.2	1.0	2.1	1.1
95th Queue (m)	33.8	30.7	27.0	100.8	57.6	15.8	12.4	8.5
Link Distance (m)	746.5		139.3	116.1	116.1	1291.7	90.4	90.4
Upstream Blk Time (%)				1	0			
Queuing Penalty (veh)				1	0			
Storage Bay Dist (m)		60.0						
Storage Blk Time (%)	0							
Queuing Penalty (veh)	1							

Intersection: 4: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Ouest

Movement	EB	EB	WB	WB	NB	NB	SB	SB	B11
Directions Served	LT	R	LT	R	LT	TR	L	TR	T
Maximum Queue (m)	46.4	19.2	36.3	72.3	77.6	75.7	92.5	89.3	7.2
Average Queue (m)	16.3	4.2	9.0	21.3	35.0	27.8	21.5	37.6	0.4
95th Queue (m)	36.0	15.0	22.8	49.9	63.2	58.1	67.5	72.0	4.5
Link Distance (m)	406.6	406.6	504.3		132.2	132.2	90.4	90.4	1291.7
Upstream Blk Time (%)					0		0	1	
Queuing Penalty (veh)					0		0	2	
Storage Bay Dist (m)				50.0					
Storage Blk Time (%)			0	1					
Queuing Penalty (veh)			0	0					

Intersection: 7: Montée Pomme d'Or & Route des Acières / Bretelle A-30 Est

Movement	EB	NB	NB	SB	SB
Directions Served	LR	L	T	T	TR
Maximum Queue (m)	102.8	14.1	33.6	15.7	57.6
Average Queue (m)	39.6	2.1	12.8	5.3	18.8
95th Queue (m)	78.7	9.2	27.4	14.0	43.2
Link Distance (m)	126.5		83.4	130.1	
Upstream Blk Time (%)	0				
Queuing Penalty (veh)	0				
Storage Bay Dist (m)		25.0			85.0
Storage Blk Time (%)		0	1		
Queuing Penalty (veh)		0	0		

Network Summary

Network wide Queuing Penalty: 5

ANNEXE F :

JUSTIFICATION DES FEUX DE CIRCULATION

SIGNAUX LUMINEUX

Transports Québec

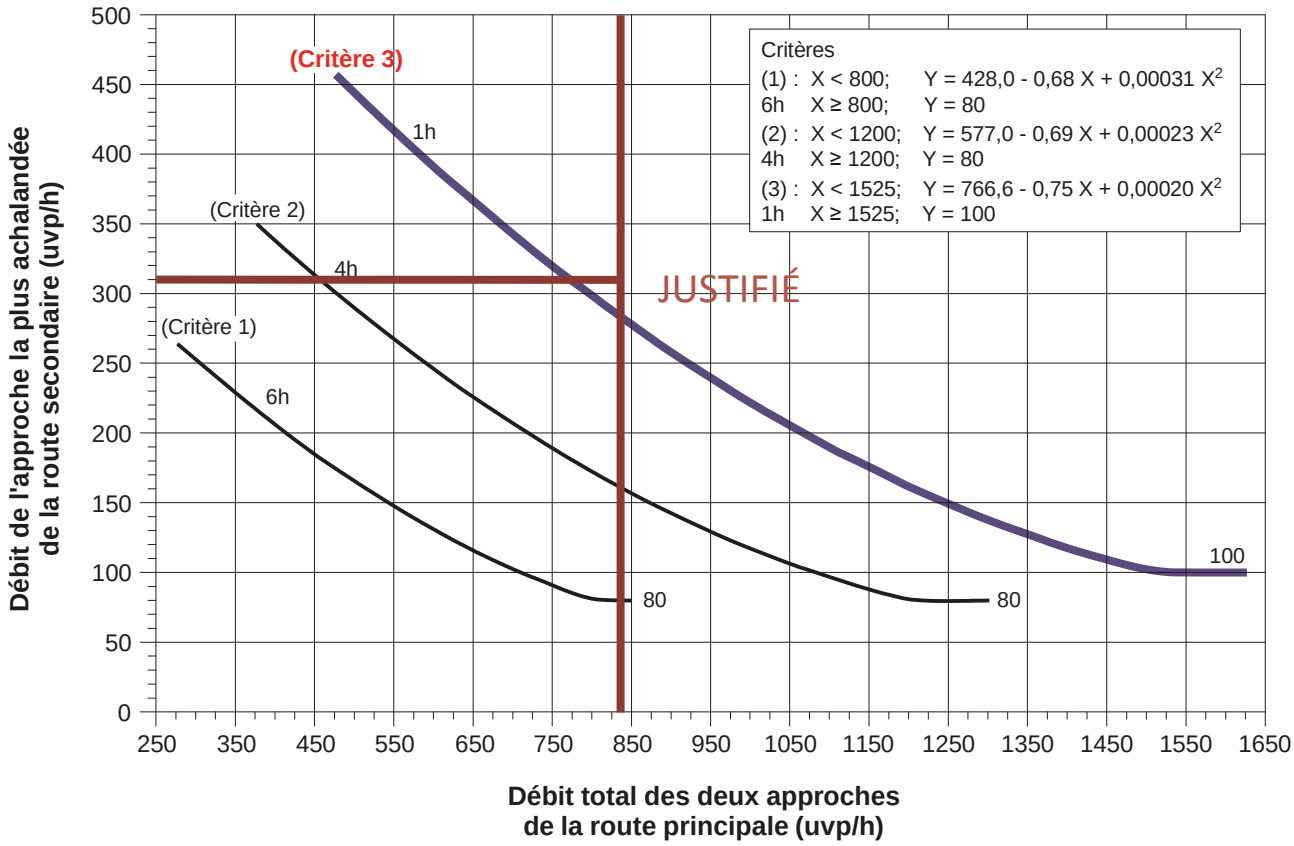
NORME

Montée de la pomme d'Or / Bretelle A-30 Est

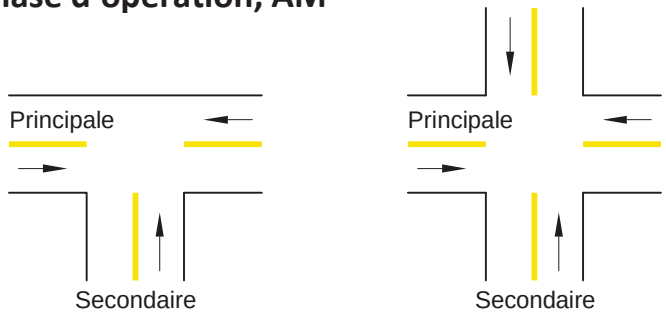
route principale
route secondaire

Abaque 8.5–9
Critères 1, 2, 3 – Intersection (1 x 1)
Vitesse ≥ 70 km/h

Débit : 844 uvp



Débits de la phase d'opération, AM



Note :

Les courbes présentées à cet abaque sont établies en fonction de la vitesse au 85e centile et du nombre de voies.

Une voie de virage dans la route principale ne doit pas être comptée comme une voie. Tandis que dans la route secondaire, le nombre de voies de circulation est déterminé non pas selon la géométrie théorique mais bien selon le partage des voies observé sur les lieux.

Contenu normatif

SIGNAUX LUMINEUX

Transports Québec

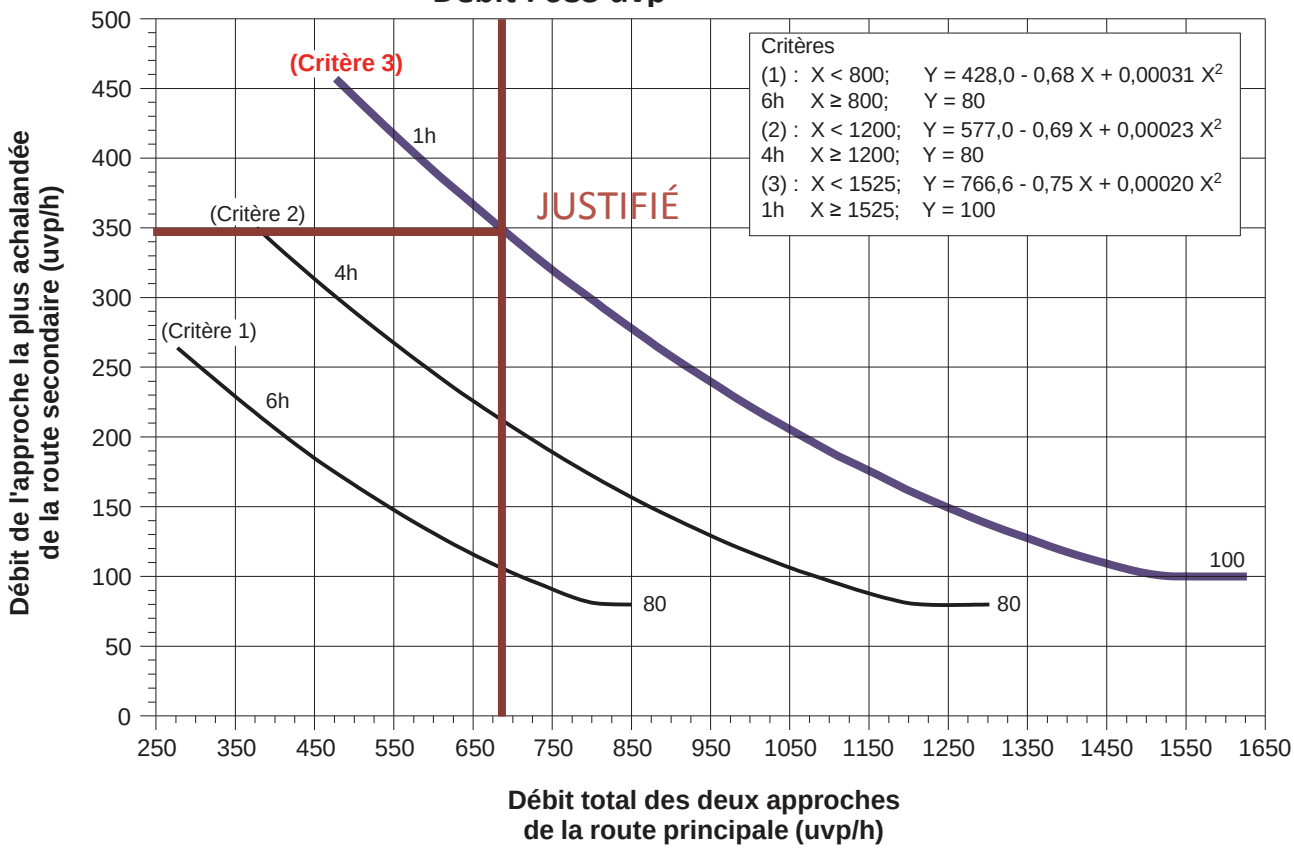
NORME

Montée de la pomme d'Or / Route Marie-Victorin

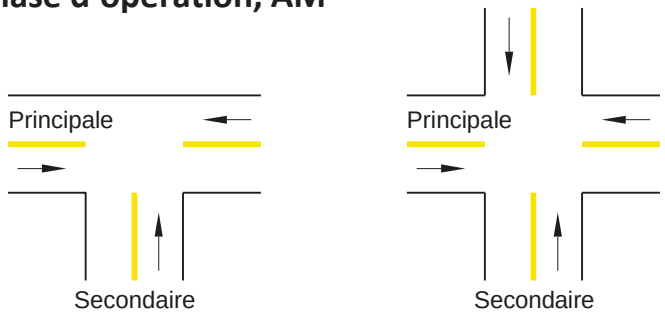
route principale
route secondaire

Abaque 8.5–9
Critères 1, 2, 3 – Intersection (1 x 1)
Vitesse ≥ 70 km/h

Débit : 683 uvp



Débits de la phase d'opération, AM



Note :

Les courbes présentées à cet abaque sont établies en fonction de la vitesse au 85e centile et du nombre de voies.

Une voie de virage dans la route principale ne doit pas être comptée comme une voie. Tandis que dans la route secondaire, le nombre de voies de circulation est déterminé non pas selon la géométrie théorique mais bien selon le partage des voies observé sur les lieux.

Contenu normatif

ANNEXE G :

PROGRAMMATION ACTUELLE FEU DE CIRCULATION

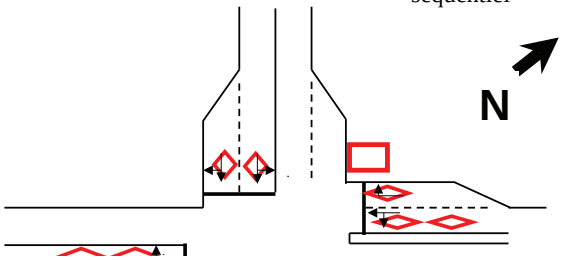
PLAN DE PHASAGE ET DE MINUTAGE

Route Est-Ouest : Sortie 158 de l'A 30 et chemin des aciéries
Route Nord-Sud : Montée Pomme d'Or
No Plan : TF- 02-5371-07

Municipalité : Contrecoeur
Préparé par : Manal Shehata, M.ing.
Date : 2002-03-25

PHASE	ϕ1	ϕ2	ϕ3	ϕ4	ϕ5	ϕ6	ϕ7	ϕ8
Cycle (s)	**Max.1 = 70,0**	**Max. 3 = 0,0**		**Max. 2 = 0,0**				
Mode		Impulsion		Présence				
Détecteur		A1, A2		B1, B2				
Période	1 2 3 4				1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
Vert MINIMUM (s)		10,0		7,0				
Vert MAXIMUM (s)		31,0		26,0				
Extension véhiculaire		4,0		3,0				
Dégagement : jaune		4,0		5,0				
: R/R		2,0		2,0				
DÉCALAGE[1] : (s)								
(%)								
RECALL	OFF	ON		OFF	OFF	OFF	OFF	OFF

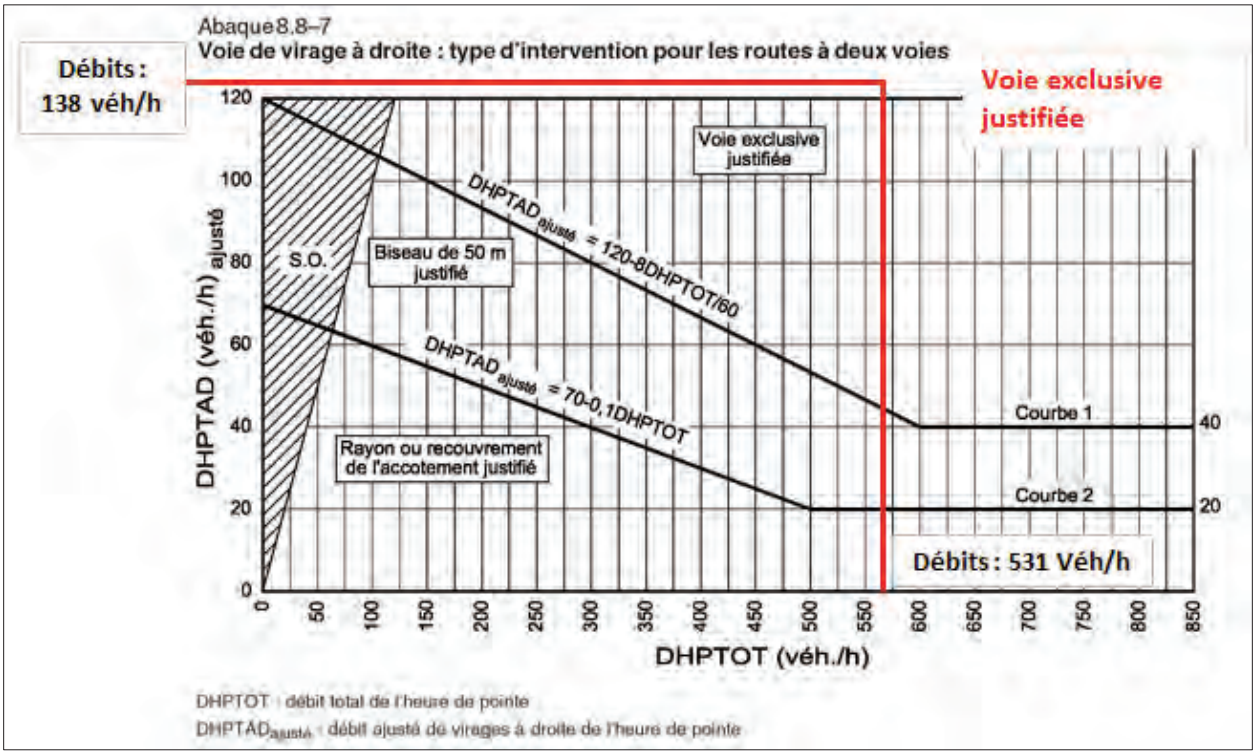
séquentiel



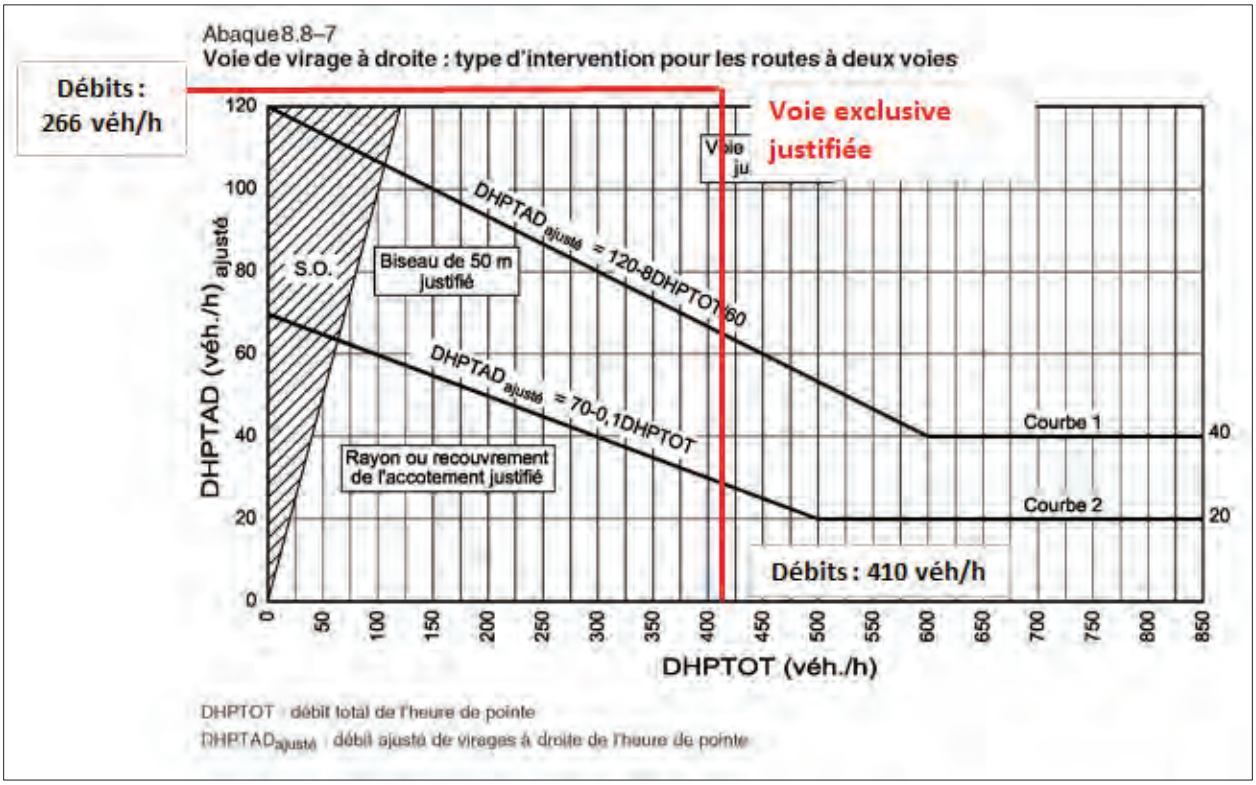
ANNEXE H :

JUSTIFICATION BAIES DE VIRAGES

Montée de la pomme d'Or / Route Marie-Victorin (Approche Sud)



Montée de la pomme d'Or / Route Marie-Victorin (Approche Ouest)



Étude sectorielle No. 33

Étude de dispersion atmosphérique. Agrandissement du terminal portuaire de Contrecœur



SNC·LAVALIN

Agrandissement du terminal portuaire de Contrecœur

Étude de dispersion atmosphérique

Administration portuaire de Montréal



Environnement et géosciences

juillet | 2017

Rapport final > Rev. 00
Ref. Client 201853757 > Ref. Interne 643872

SNC-Lavalin GEM Québec inc.
360, rue Saint-Jacques Ouest, 16e étage
Montréal (Québec) Canada H2Y 1P5
514.393.1000 514.392.4758

Agrandissement du terminal portuaire de Contrecœur

Étude de dispersion atmosphérique

Administration portuaire de Montréal
2100, avenue Pierre-Dupuy, aile 1
Montréal (Québec) H3C 3R5

<Original signé par>

<Original signé par>

Éric Delisle, B.Sc.A.
Spécialiste sénior – Qualité de l'air
Environnement et géosciences
Ingénierie des infrastructures

Jenny Vieira, ing.
Directrice adjointe - Qualité de l'air
Environnement et géosciences
Ingénierie des infrastructures

V/Dossier n°: 201853757
N/Dossier n°: 643872
N/Document n°: Rapport final, Rév. 00

Juillet 2017

Distribution : Nathalee Loubier, Claude Deschambault

SNC-Lavalin GEM Québec inc.
360, rue Saint-Jacques Ouest, 16e étage
Montréal (Québec) Canada H2Y 1P5
514.393.1000 514.392.4758

Montréal, le 19 juillet 2017

Madame Nathalee Loubier
Administration portuaire de Montréal
2100, avenue Pierre-Dupuy, aile 1
Montréal (Québec) H3C 3R5

Objet : Agrandissement du terminal portuaire de Contrecoeur
Étude de disperison atmosphérique
Contrecoeur, Québec
V/Dossier n° : 2018537
N/Dossier n° : 643872
N/Document n° : Rapport final, Rév. 00

Madame,

Veuillez trouver ci-joint le rapport final concernant l'étude de dispersion atmosphérique (modélisation) réalisée par SNC-Lavalin Environnement et géosciences (« SNC-Lavalin »), opérant sous l'entité légale SNC-Lavalin GEM Québec inc., dans le cadre de l'Étude d'impact sur l'environnement pour le projet d'agrandissement du terminal portuaire de Contrecoeur.

Nous espérons le tout à votre entière satisfaction et vous prions d'agréer, Madame, l'expression de nos sentiments les meilleurs.

<Original signé par>

Éric Delisle
Chargé de projet
Environnement et géosciences
Ingénierie des infrastructures

ED/cpm

p.j.

Avis au lecteur

Le présent rapport a été préparé, et les travaux qui y sont mentionnés ont été réalisés par SNC-Lavalin GEM Québec inc., (SNC-Lavalin), exclusivement à l'intention de l'**Administration portuaire de Montréal** (le Client), qui fut partie prenante à l'élaboration de l'énoncé des travaux et en comprend les limites. La méthodologie, les conclusions, les recommandations et les résultats cités au présent rapport sont fondés uniquement sur l'énoncé des travaux et assujettis aux exigences en matière de temps et de budget, telles que décrites dans l'offre de services et/ou dans le contrat en vertu duquel le présent rapport a été émis. L'utilisation de ce rapport, le recours à ce dernier ou toute décision fondée sur son contenu par un tiers est la responsabilité exclusive de ce dernier. SNC-Lavalin n'est aucunement responsable de tout dommage subi par un tiers du fait de l'utilisation de ce rapport ou de toute décision fondée sur son contenu.

Les conclusions, les recommandations et les résultats cités au présent rapport (i) ont été élaborés conformément au niveau de compétence normalement démontré par des professionnels exerçant des activités dans des conditions similaires de ce secteur, et (ii) sont déterminés selon le meilleur jugement de SNC-Lavalin en tenant compte de l'information disponible au moment de la préparation du présent rapport. Les services professionnels fournis au Client et les conclusions, les recommandations et les résultats cités au présent rapport ne font l'objet d'aucune autre garantie, explicite ou implicite. Les conclusions et les résultats cités au présent rapport sont valides uniquement à la date du rapport et peuvent être fondés, en partie, sur de l'information fournie par des tiers. En cas d'information inexacte, de la découverte de nouveaux renseignements ou de changements aux paramètres du projet, des modifications au présent rapport pourraient s'avérer nécessaires.

Le présent rapport doit être considéré dans son ensemble, et ses sections ou ses parties ne doivent pas être vues ou comprises hors contexte. Si des différences venaient à se glisser entre la version préliminaire (ébauche) et la version définitive de ce rapport, cette dernière prévaudrait. Rien dans ce rapport n'est mentionné avec l'intention de fournir ou de constituer un avis juridique.

Engagement envers la qualité

Afin de démontrer son engagement envers l'importance de la qualité, sa priorité à satisfaire les exigences de ses clients et son engagement à l'amélioration continue, l'unité d'exploitation SNC-Lavalin GEM Québec inc., de SNC-Lavalin inc. s'est dotée d'une politique qualité et d'un système de gestion de la qualité adaptés à ses activités.

Chez SNC-Lavalin GEM Québec inc., nous tenons en haute estime nos clients ainsi que l'environnement et les communautés au sein desquelles nous travaillons. Nous appliquons rigoureusement et améliorons continuellement notre système de gestion de la qualité afin de répondre et de surpasser les exigences de nos clients. Ainsi, nous reconnaissons que, la qualité de notre prestation est souvent jugée selon les indicateurs suivants :

- Des travaux de terrain réalisés en toute sécurité;
- Une cueillette d'information (inventaires, relevés, recherches) précise et complète;
- La qualité technique et linguistique des livrables soumis;
- Le respect des échéanciers;
- Le respect des budgets;
- Une facturation rapide, claire et précise;
- La compétence de notre équipe de travail.

Chez SNC-Lavalin GEM Québec inc., nous comprenons que la satisfaction de nos clients est indispensable à la réussite de nos affaires et nous voulons être perçus par eux comme un partenaire privilégié pour réaliser des projets durables.

Notre système de gestion de la qualité repose sur cette politique qui est revue annuellement lors de la revue de direction qualité. Tout le personnel de SNC-Lavalin GEM Québec inc est sensibilisé à cette déclaration et comprend l'importance de son application dans les activités de l'entreprise.

Équipe de travail

Administration portuaire de Montréal

Claude Deschambault, ing.	Directeur de projet
Nathalee Loubier, ing., M.Sc.	Chargé de projet

SNC-Lavalin GEM Québec inc.

Yves Comtois, B.A, M.Sc.	Directeur de projet
Éric Delisle, B.Sc.A.	Chargé de projet Rédacteur
Niloofar Sokhandan, M.Sc.	Modélisation
Alain Chouinard	Cartographie
Jenny Vieira, ing.	Révision
Claudia Paz-Miller	Édition

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Liste des annexes

Annexe A

Estimation des émissions atmosphériques durant la construction

Annexe B

Estimation des émissions fugitives de matières particulaires durant l'exploitation

Liste des abréviations

AERMOD	***A**merican Meteorological Society and **E**nvironmental Protection Agency **R**egulatory Air Dispersion **Mod**el*
AP-42	*Compilation of Air Pollutant Emission Factors (AP-42)*
ACEE	Agence canadienne d'évaluation environnementale
APM	Administration portuaire de Montréal
BaP	Benzo-(a)-pyrène
BaP_{ET}	Hydrocarbures aromatiques polycycliques totaux en équivalent toxique (ET) du BaP.
CO	Monoxyde de carbone
COV	Composés organiques volatils
ÉIE	Étude d'impact environnementale
EVP	Équivalent vingt pieds (conteneur)
FET	Facteur d'équivalence de toxicité
GES	Gaz à effet de serre
GNL	Gaz naturel liquéfié
HAP	Hydrocarbures aromatiques polycycliques
MDDELCC	Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques
NCQAA	Norme canadienne de qualité de l'air ambiant
NH_3	Ammoniac
NO	Monoxyde d'azote
NO_2	Dioxyde d'azote
NOx	Oxydes d'azote (NO et NO_2)
OLM	*Ozone limiting method*
OMI	Organisation Maritime Internationale
PCA	Principaux contaminants atmosphériques
PM	Matières particulaires
PM_T	Matières particulaires totales
PM_{10}	Matières particulaires inférieures à 10 micromètres (µm)
$PM_{2.5}$	Matières particulaires inférieures à 2,5 micromètres (µm)
RAA	Règlement sur l'assainissement de l'atmosphère (province de Québec)
RNSPA	Réseau national de surveillance de la pollution atmosphérique
RSQAQ	Réseau de surveillance de la qualité de l'air du Québec
SO_2	Dioxyde de soufre
US-EPA	*United States Environmental Protection Agency*
UTC	*Coordinated Universal Time* (« heure de Greenwich »)
UTM	*Universal Transverse Mercator* (projection cartographique)

1 Introduction

Dans le cadre de l'Étude d'impact environnemental (ÉIE) pour le *Projet d'agrandissement du terminal portuaire de Contrecœur,* à environ 40 km à l'est de Montréal sur la rive sud du fleuve Saint-Laurent au Québec, prévoyant la construction et l'exploitation d'un nouveau terminal à conteneurs, les lignes directrices de l'Agence canadienne d'évaluation environnementale (ACEE, mars 2016) précisent que les impacts sur la qualité de l'air doivent être évalués à l'aide d'une étude de dispersion atmosphérique (modélisation) selon les exigences du *Guide de modélisation de la dispersion atmosphérique* du ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC, 2005).

Les lignes directrices précisent aussi que les impacts du projet sur la qualité de l'air doivent être évalués en considérant les normes et critères québécois de qualité de l'air (MDDELCC, 2016) et les normes canadiennes pour la qualité de l'air.

L'étude de dispersion atmosphérique a donc été réalisée pour l'aménagement et l'exploitation d'un terminal portuaire à conteneurs d'une capacité annuelle de 1,15 million de conteneurs équivalent vingt pieds (EVP) dont les principales composantes sont :

- deux postes à quai;
- une aire de manutention des conteneurs;
- une cour ferroviaire intermodale et une gare de triage;
- les installations de soutien;
- les accès ferroviaires et routiers.

Comme demandé dans les lignes directrices de l'ACEE, les contaminants à l'étude sont les principaux contaminants atmosphériques (PCA), de même que plusieurs composés toxiques de la famille des composés organiques volatils (COV), des métaux (arsenic, chrome, manganèse, mercure, nickel et plomb) et des hydrocarbures aromatiques polycycliques (HAP). Les PCA comprennent les oxydes d'azote (NOx, et plus particulièrement le dioxyde d'azote (NO_2)), le monoxyde de carbone (CO), le dioxyde de soufre (SO_2), l'ammoniac (NH_3) et les matières particulaires de diverses classes de diamètres (totales (PM_T), inférieures à 10 µm (PM_{10}) et inférieures à 2,5 µm ($PM_{2.5}$)). La liste complète des composés toxiques considérés dans l'étude est présentée plus loin dans ce document à la section 2.5.

L'inventaire et l'estimation des émissions annuelles de gaz à effet de serre (GES), des principaux contaminants atmosphériques (PCA) et de composés toxiques (certains COV, HAP et métaux spécifiques) liés à la combustion de carburants fossiles pour la construction et pour l'exploitation du terminal ont été réalisés dans le cadre d'un mandat spécifique (SNC-Lavalin, 2017). Les taux d'émission de contaminants liés à la combustion de carburants fossiles de cet inventaire ont été utilisés comme intrant à la modélisation de la dispersion atmosphérique.

L'exercice de modélisation de la dispersion atmosphérique tient aussi compte des émissions fugitives de matières particulaires (PM) liées au transport sur le site lors de la construction et de l'exploitation et aux activités de manutention de matériaux et à l'érosion éolienne durant la construction. Les estimations des émissions fugitives sont présentées dans le présent rapport.

Incluant la présente introduction, ce document compte cinq chapitres. Le chapitre 2 présente la méthodologie pour la modélisation de la dispersion atmosphérique. Les chapitres 3 et 4 présentent la définition des scénarios de modélisation, les paramètres d'émission des sources

et les résultats de modélisation en regard avec les normes et critères de qualité de l'air ambiant, respectivement pour les phases de construction et d'exploitation. Les estimations des émissions fugitives de PM sont présentées à l'annexe A pour la construction et à l'annexe B pour l'exploitation. Finalement, le chapitre 5 présente une analyse des incertitudes liées aux résultats de modélisation et les conclusions de l'étude de dispersion atmosphérique.

2 Méthodologie

La méthodologie utilisée pour la modélisation de la dispersion atmosphérique répond aux exigences du *Guide de la modélisation de la dispersion atmosphérique* du MDDELCC (Leduc, 2005) et tient compte des recommandations de l'US-EPA (2015, 2017) pour le modèle de dispersion sélectionné. Les sous-sections suivantes présentent les détails techniques de l'étude de dispersion atmosphérique. Les détails de modélisation propres aux phases de construction et d'exploitation, principalement la définition des sources et de leurs paramètres d'émission, sont présentés respectivement aux chapitres 3 et 4 avec les résultats de modélisation.

2.1 Modèle de dispersion

Le modèle AERMOD (« ***A****merican Meteorological Society and* ***E****nvironmental Protection Agency* ***R****egulatory Air Dispersion* ***Mod****el* », version 16216r la plus récente) a été utilisé pour cette étude. Ce modèle est régulièrement utilisé dans les études d'impact sur la qualité de l'air de projets industriels au Québec et ailleurs dans le monde. Il s'agit en fait du modèle règlementaire aux États-Unis et dans plusieurs provinces canadiennes et le modèle habituellement utilisé au Québec. D'ailleurs l'annexe H du *Règlement sur l'assainissement de l'atmosphère* (RAA) mentionne que les modèles de dispersion qui peuvent être utilisés sont ceux indiqués dans l'édition la plus récente du «*Guideline on air quality models*» de l'US-EPA (2017, Annexe W, Pt. 51). Or ce guide désigne AERMOD comme étant le modèle privilégié pour les études de dispersion à l'échelle rapprochée ou locale (<50 km).

Le modèle AERMOD est mis à jour régulièrement. Il s'agit d'un modèle de panache en régime permanent de type gaussien avancé considérant des champs météorologiques en deux dimensions (variabilité verticale et uniformité dans le plan horizontal), mais qui considère toutefois l'interaction de la topographie avec les panaches des sources d'émission de contaminants atmosphériques. AERMOD permet de tenir compte du sillage des bâtiments sur la dispersion du panache de cheminée et considère l'élévation en raison de la quantité de mouvement verticale et à la flottabilité (« buoyancy ») des gaz chauds s'échappant des cheminées. Finalement, le modèle tient aussi compte de la variation horaire des paramètres météorologiques et des inversions de température au sol ou en altitude.

Pour le terminal de Contrecœur, que ce soit pour les phases de construction ou d'exploitation, les sources de contaminants atmosphériques seront presque toutes près de la surface du sol (quelques mètres) et les impacts potentiels maximums sur la qualité de l'air surviendront donc à proximité du site du projet (échelle locale). Étant donnée l'absence de topographie importante ou d'un plan d'eau de très grande envergure (tel que les Grands Lacs ou un océan) dans la zone d'étude, l'hypothèse d'uniformité dans le plan horizontal des champs météorologiques est toute à fait justifiée et il n'est donc pas justifié d'utiliser un modèle de dispersion considérant une météorologie tridimensionnelle ou pour le transport à plus grande distance.

Les données d'entrée du modèle comprennent :

- les caractéristiques des émissions (taux d'émission des divers contaminants, vitesse de sortie des gaz, température d'émission, etc.);
- les caractéristiques des sources d'émission (position, diamètre et hauteur des cheminées, dimensions des sources de surface, etc.);
- les dimensions caractéristiques des bâtiments si les effets de sillage de bâtiments sur les panaches des cheminées sont considérés;

- les données météorologiques horaires (température, vitesse et direction du vent, indices de la stabilité atmosphérique et de la turbulence, hauteur de mélange);
- la position et l'élévation des récepteurs, c'est-à-dire les lieux où l'on désire évaluer la concentration atmosphérique du polluant;
- des paramètres contrôlant les options du modèle et les calculs statistiques à effectuer sur les concentrations calculées par le modèle.

Pour cette étude, la déposition sèche des émissions fugitives de matières particulaires a été considérée et l'option de dispersion en mode rural a été sélectionnée pour toutes les sources.

2.2 Météorologie

Les principaux paramètres météorologiques contrôlant la dispersion atmosphérique des émissions d'une cheminée ou d'un autre type de source et considérés par le modèle AERMOD sont : la vitesse et la direction du vent, les indices de la stabilité atmosphérique (vitesse de friction, longueur de Monin-Obukov) et la hauteur de mélange. Ces paramètres, de même que la température ambiante, doivent être fournis sur une base horaire au modèle. Le modèle micro-météorologique AERMET (version 16216) a été utilisé pour préparer la base de données météorologique nécessaire au modèle AERMOD. Finalement, l'option d'ajustement de la vitesse de rugosité (u*, un paramètre météorologique de la couche de surface), pour corriger une erreur conceptuelle dans AERMET par vent faible, a été utilisée, conformément aux recommandations les plus récentes de l'US-EPA (2017).

2.2.1 Données météorologiques

Une période de cinq années de données météorologiques (2008-2012) a été retenue à la suite de l'analyse des données disponibles dans la région. La station météorologique automatique de Varennes, située à 14 km au sud-ouest du site d'implantation du projet, est la plus proche du site. Les observations horaires de la température, de l'humidité relative et du vent (vitesse et direction) ont donc été utilisées et complétées par les observations horaires de couvert nuageux de l'aéroport international Pierre-Elliot Trudeau (50 km au sud-ouest du site, dans l'ouest de l'île de Montréal) pour la même période. L'aéroport de Saint-Hubert bien que plus près de Varennes, a été écarté, car les observations du couvert nuageux à l'aide d'un appareil automatique ne sont pas suffisamment fiables par rapport aux observations humaines de l'aéroport P-E Trudeau.

Les sondages aérologiques (mesure du profil vertical des paramètres météorologiques à l'aide de ballons-sondes) de la station de Maniwaki ont été utilisés pour l'estimation des hauteurs de mélange durant le jour. Bien que la station aérologique de Maniwaki soit située à 220 km au nord-ouest de la station météorologique de Varennes, elle est tout de même considérée comme représentative des conditions météorologiques en altitude de la région de Contrecœur. La station aérologique de Maniwaki est d'ailleurs la seule station dans le sud-ouest du Québec.

La figure 2.1 présente la localisation des stations météorologiques par rapport au site du projet et le tableau 2.1 présente les caractéristiques des stations sélectionnées.

Les observations horaires en surface ont été obtenues auprès des services météorologiques d'Environnement Canada et les sondages aérologiques de la « *NOAA/ESRL Radiosonde Database (www.esrl.noaa.gov/raobs)* ».

Figure 2.1 Localisation des stations météorologiques et de qualité de l'air



Pour les données horaires en surface, les périodes de données manquantes ont été interpolées jusqu'à trois heures consécutives. Une composante aléatoire variant de -5 à +5° a été ajoutée aux observations de la direction du vent de la station de Varennes, pour tenir compte de l'arrondissement au 10° des données brutes, préalablement à l'utilisation d'AERMET. Pour les données de Montréal-Trudeau, cette composante aléatoire est ajoutée directement par AERMET. Les observations manquantes de la station de Varennes et nécessaires au modèle AERMOD sont automatiquement remplacées par celles de Montréal-Trudeau lors du traitement avec AERMET.

Un traitement de remplacement des sondages manquants ou invalides a été appliqué aux sondages aérologiques. Seuls les sondages du matin (12:00 UTC), avec une tolérance de deux heures, car certains sondages sont réalisés en avance ou en retard, sont analysés. Les sondages manquants ou invalides sont remplacés par le sondage valide de 12:00 UTC de la journée précédente ou par celui de la journée suivante. Il est ainsi possible de remplacer jusqu'à deux sondages manquants ou invalides consécutifs. Un sondage invalide est un sondage dont le niveau de surface est absent, qui ne possède que quelques niveaux de mesures ou dont les paramètres (température, pression et hauteur) sont manquants sur trop de niveaux sous 5 000 m. En fin de traitement avec AERMET, les heures manquantes ne totalisent que 24 heures sur une possibilité 43 824 heures, soit 0,05 % du temps sur l'ensemble des cinq années sélectionnées.

Tableau 2.1 Liste des stations météorologiques et paramètres utilisés (2008-2012)

Nom de la station (numéro Env. Canada)	Localisation		Type de station	Fréquence des données	Paramètres utilisés dans l'étude	% manquants
	Latitude (° nord) Longitude (°ouest) Altitude (m)	Par rapport au projet				
Varennes (702327X)	45,72 N 73,38 O 18 m	14 km au sud-ouest	Surface (automatique)	Horaire	Vitesse du vent à 10 m* Direction du vent à 10 m* Température* Humidité relative	10 à 167 heures par année 0,11 – 1,9 %
Aéroport P.– E. Trudeau (7025250)	45,47 N 73,75 O 36 m	55 km au sud-ouest	Surface (aéroport)	Horaire	Vitesse du vent à 10 m* Direction du vent à 10 m* Température* Humidité relative Pression Plafond Opacité du ciel*	0 à 3 heures par année 0,00 -0,034 %
Maniwaki (7034480)	46,3 N 76,0 O 189 m	220 km au nord-ouest	Altitude	2 fois par jours	Profils verticaux de température le matin*	0 à 7 sondages du matin par année 0,0 – 1,9 %

* : paramètres nécessaires au modèle de dispersion AERMOD.

2.2.2 Rose des vents

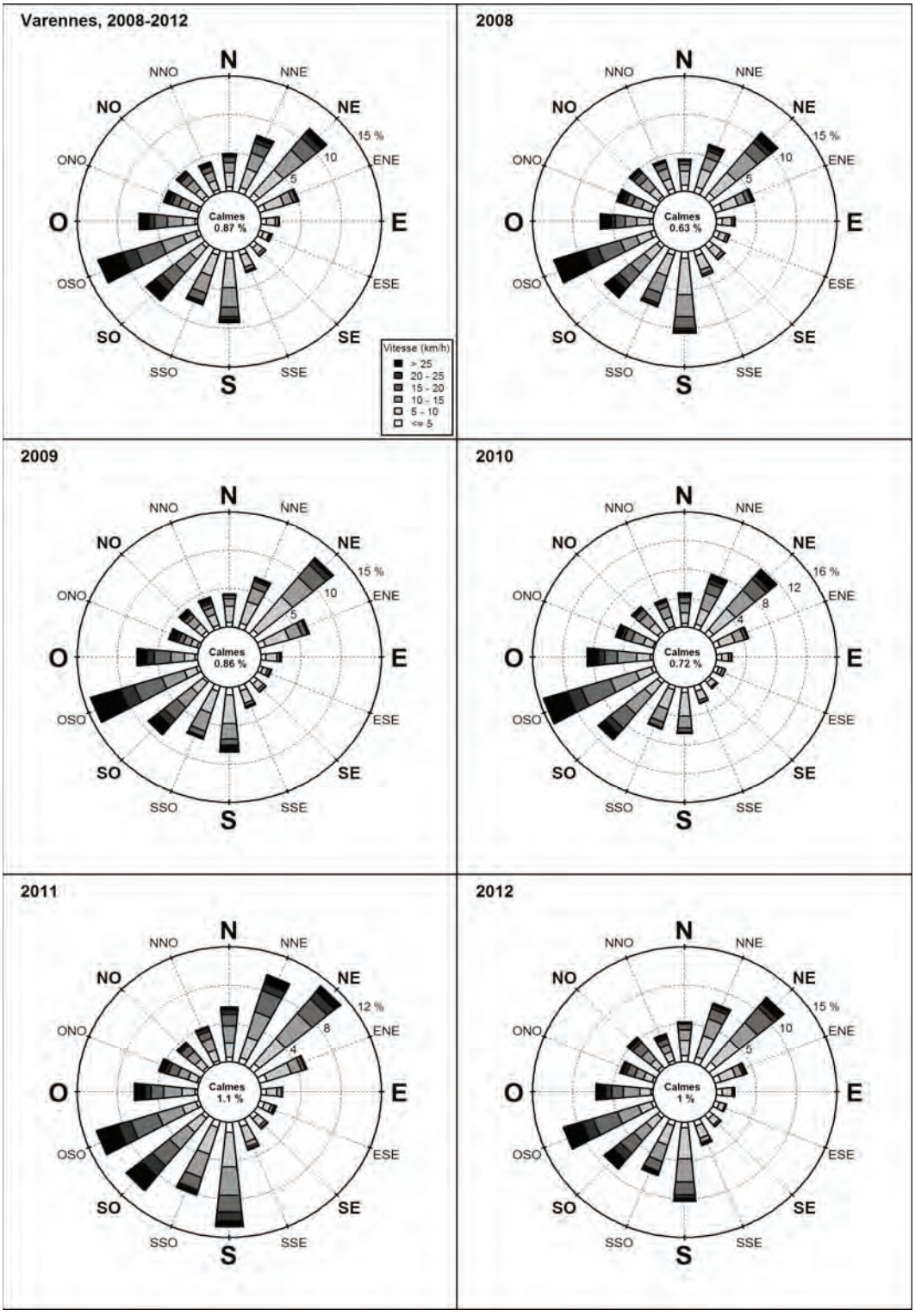
Les roses des vents illustrant la fréquence de la provenance du vent par classe de vitesse à Varennes de 2008 à 2012 sont présentées à la figure 2.2. Les roses des vents illustrent l'effet de canalisation (axe SO-NE) des vents dans la vallée du Saint-Laurent, de même que par la vallée de la rivière Richelieu et du lac Champlain (vent du sud). La vitesse moyenne du vent enregistrée à Varennes est 13,6 km/h et le vent est calme moins de 1 % du temps.

2.2.3 Paramètres de surface

Lors de la préparation des données météorologiques avec AERMET, l'usager doit estimer certains paramètres de surface pour le site de mesure météorologique. Ces paramètres de surface sont utilisés par le modèle météorologique AERMET pour estimer les paramètres micro-météorologiques décrivant la couche limite atmosphérique (vitesse de friction, longueur de Monin-Obukov, hauteur de mélange) à partir des observations météorologiques courantes : vitesse du vent, température, couvert nuageux. Ces paramètres de surface sont :

- La longueur de rugosité (z_0) est fonction de la hauteur des obstacles à l'écoulement du vent. Il s'agit de la hauteur théorique à laquelle la vitesse du vent horizontal tend vers zéro.
- L'albédo (α) représente la fraction du rayonnement solaire incident réfléchie par la surface à midi.
- Le rapport de Bowen (B_o) est le rapport entre le flux de chaleur sensible et le flux de chaleur latente durant le jour. Il représente l'humidité de la surface.

Figure 2.2 Rose des vents – Varennes (2008-2012)



Selon la dernière version du guide d'application d'AERMOD par l'US-EPA (US-EPA, 2015), des valeurs régionales moyennes sur un domaine de 10 km par 10 km devraient être utilisées pour le rapport de Bowen et l'albédo. Pour la rugosité de la surface, des valeurs typiques selon la provenance du vent et de l'utilisation du sol dans un rayon de 1 km du site météorologique devraient être utilisées. Pour tous ces paramètres, les variations saisonnières (ou mensuelles) doivent aussi être considérées.

La couverture du sol sur un domaine de 10 km par 10 km a été déterminée à partir de l'analyse et de l'interprétation d'images satellites à haute résolution (Google Earth, Bing maps).

La carte de couverture du sol ainsi préparée est présentée à la figure 2.3. La figure 2.4 montre une image satellite du site de la station météorologique de Varennes et les deux secteurs utilisés pour définir la rugosité de la surface dans un rayon d'un kilomètre. Le tableau 2.2 présente les caractéristiques de surface saisonnières utilisées dans cette étude pour chaque catégorie d'utilisation ou de couverture du sol identifiées. Des valeurs typiques par saison et par type de couverture du sol ont été utilisées (US-EPA, 2013). La définition des saisons est principalement basée sur les normales climatiques de température moyenne journalière mensuelle et d'épaisseur de neige au sol en fin de mois à Varennes.

Dans un rayon d'un kilomètre de la station météorologique, la couverture du sol est principalement composée de terres agricoles (94,5 %). Pour le domaine de 10 km x 10 km, les terres agricoles occupent 58,3 % de la superficie et le fleuve Saint-Laurent et les milieux boisés occupent respectivement 14,2 % et 10,4 % de la surface du domaine.

Tel que recommandé par l'US-EPA (2015), les paramètres de surface moyens dans la zone d'étude ont été établis de la façon suivante :

- Albedo (α) : moyenne arithmétique régionale, sans dépendance par la distance ou la provenance du vent, pour un domaine de 10 km par 10 km centré sur le site météorologique.
- Rapport de Bowen (Bo) : moyenne géométrique régionale, sans dépendance par la distance ou la provenance du vent, pour un domaine de 10 km par 10 km centré sur le site météorologique.
- Rugosité (z_0) : moyenne géométrique pondérée par l'inverse de la distance dans un rayon d'un kilomètre du site météorologique, pour chacun des cinq secteurs de provenance du vent sélectionnés.

Le tableau 2.3 présente les résultats des calculs des paramètres de surface saisonniers utilisés comme intrants au modèle micro-météorologique AERMET.

Figure 2.3 Carte de couverture du sol sur un domaine de 10 km par 10 km centré sur le site de la station météorologique de Varennes

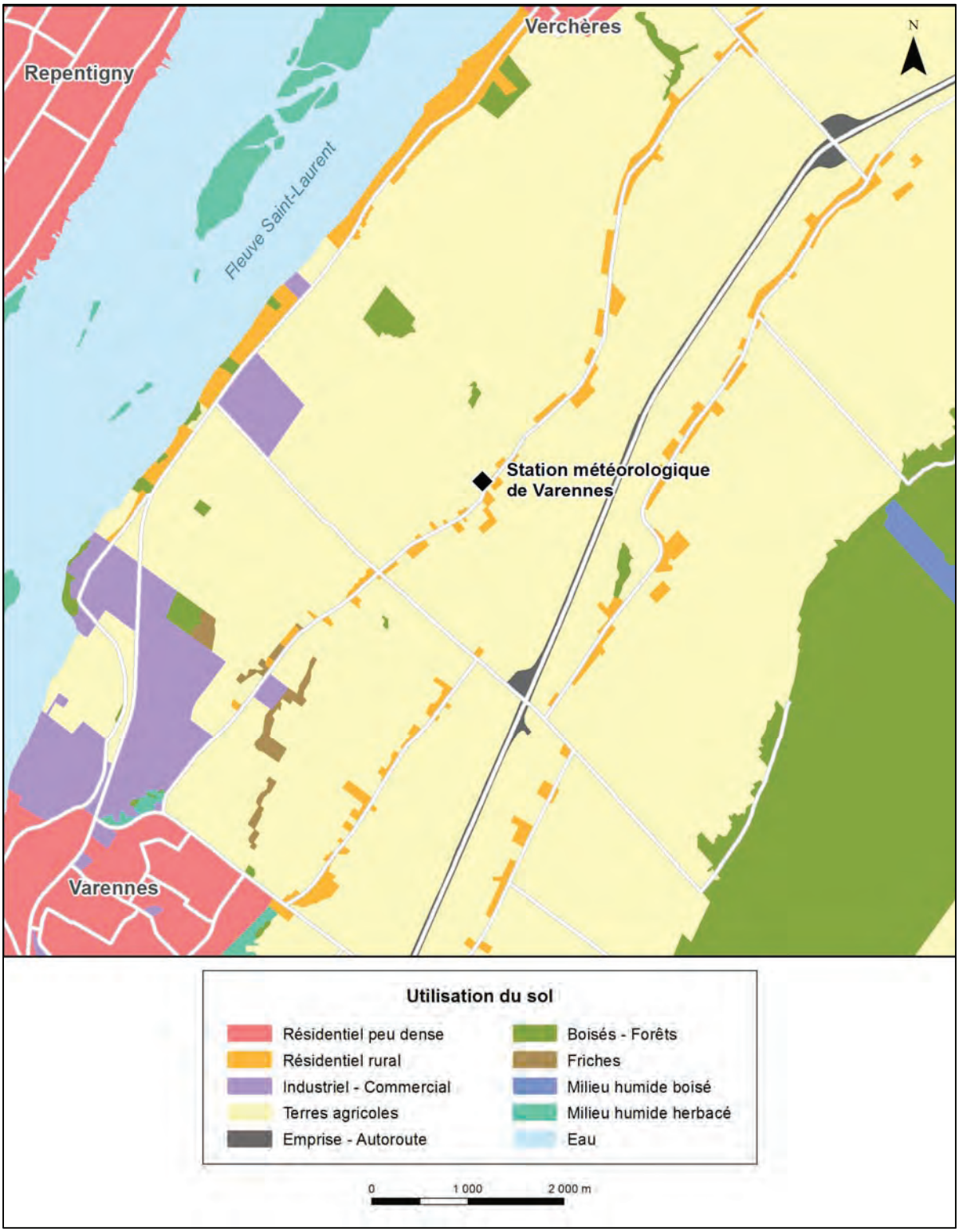
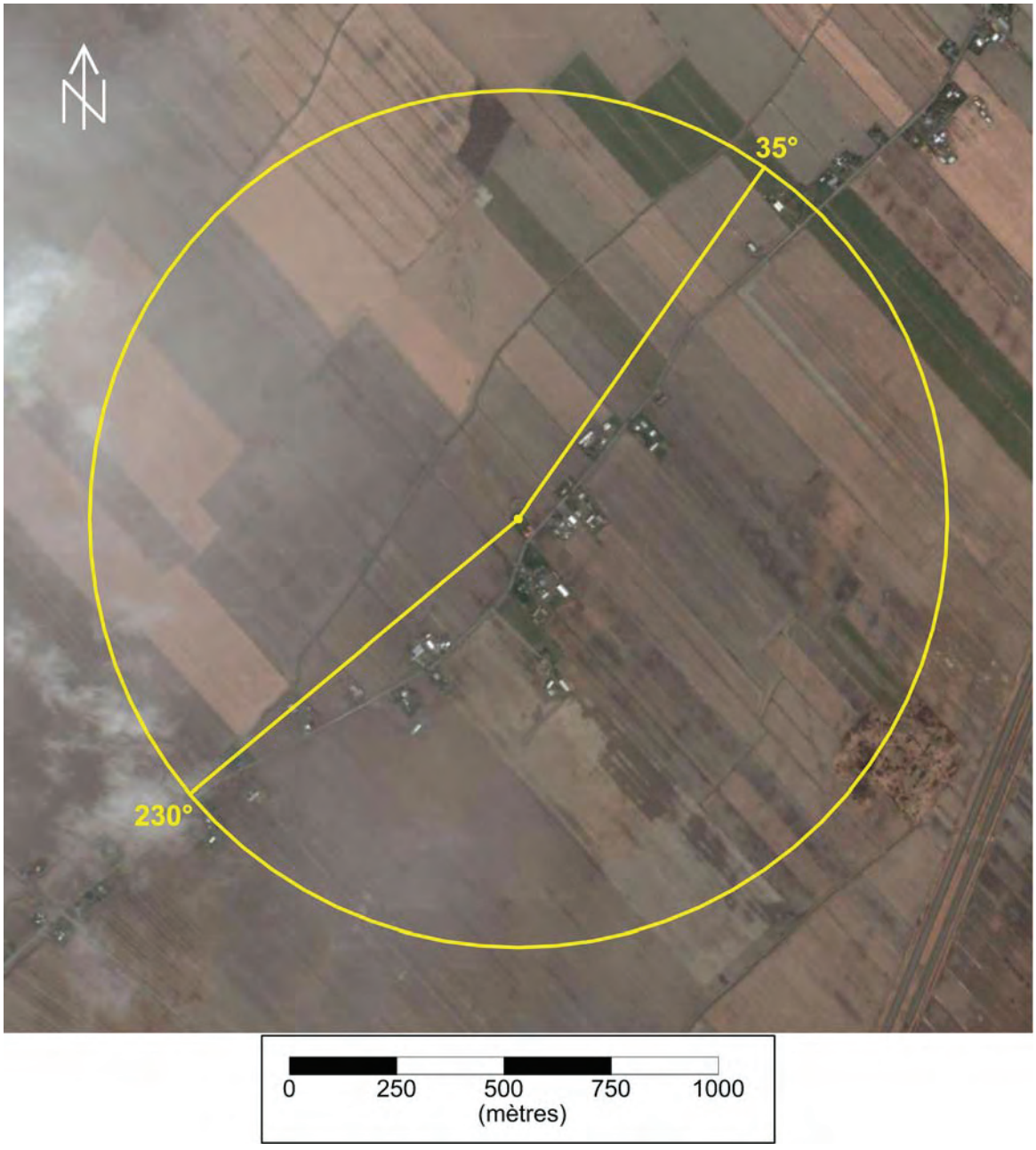


Figure 2.4 Définition des secteurs dans un rayon de 1 km de la station météorologique de Varennes utilisés pour l'estimation de la rugosité de la surface



Source : Google Maps

Tableau 2.2 Paramètres de surface par saison et par type de couverture du sol

Utilisation ou couverture du sol	% de la couverture du domaine		Rugosité (m)				Albédo				Rapport de Bowen			
	Rayon de 1 km	10 km x 10 km	E	A	H	P	E	A	H	P	E	A	H	P
Eau	0,0 %	14,2 %	0,001	0,001	0,0015	0,001	0,10	0,10	0,40	0,10	0,1	0,1	0,3	0,1
Résidentiel rural	4,8 %	3,3 %	0,54	0,50	0,50	0,52	0,16	0,18	0,45	0,16	0,8	1,0	0,5	0,8
Résidentiel peu dense	0,0 %	6,9 %	0,54	0,50	0,50	0,52	0,16	0,18	0,45	0,16	0,8	1,0	0,5	0,8
Commercial-Industriel	0,0 %	3,8 %	0,8	0,80	0,80	0,8	0,18	0,18	0,35	0,18	1,5	1,5	0,5	1,5
Transport - Emprise autoroute	0,0 %	1,1 %	0,15	0,10	0,05	0,10	0,18	0,18	0,50	0,18	1,5	1,5	0,5	1,5
Boisés - Forêts	0,6 %	10,4 %	1,3	0,95	0,9	1,15	0,14	0,14	0,42	0,14	0,3	0,9	0,5	0,7
Friches	0,0 %	0,3 %	0,05	0,02	0,01	0,02	0,18	0,18	0,50	0,18	1,0	1,5	1,0	0,8
Terres agricoles	94,5 %	58,3 %	0,20	0,02	0,01	0,03	0,20	0,18	0,60	0,14	0,5	0,7	0,5	0,3
Milieu humide boisé	0,0 %	0,3 %	0,70	0,60	0,50	0,70	0,14	0,14	0,30	0,14	0,2	0,3	0,5	0,2
Milieu humide herbacé	0,0 %	1,4 %	0,20	0,20	0,10	0,20	0,14	0,14	0,30	0,14	0,1	0,1	0,5	0,1

Tableau 2.3 Paramètres de surface utilisés dans le modèle météorologique

Saison	Albédo	Rapport de Bowen	Rugosité (m) par secteur	
			230° à 35°	35° à 230°
Été	0,17	0,41	0,203	0,234
Automne	0,16	0,57	0,021	0,033
Hiver	0,52	0,47	0,010	0,018
Printemps	0,14	0,33	0,031	0,047

Notes pour les tableaux 2.2 et 2.3 :

E : l'été comprend la période de juin à septembre.
A : l'automne (sans neige au sol et végétation minimale) comprend la période d'octobre et novembre.
H : l'hiver (neige au sol) comprend la période de décembre à mars.
P : le printemps (sans neige au sol et végétation minimale) comprend la période d'avril et mai.

2.3 Récepteurs

Les récepteurs ou points de calculs des concentrations de contaminants dans l'air ambiant ont été disposés dans le domaine de modélisation de la façon suivante :

- aux 50 m le long de la limite de la zone d'affectation industrielle dans laquelle se retrouve les équipements de l'installation du port de Montréal à Contrecœur aussi bien qu'au long de la zone de tampon de 300 m sur le fleuve Saint Laurent à partir les infrastructures portuaires du projet;
- aux 100 m dans un domaine de 2 km x 2 km centré sur le site du projet;
- aux 100 m dans un domaine de 2 km x 2 km le long de la route d'accès à l'est du port;
- aux 250 m dans un domaine de 4 km x 4 km centré sur le site du projet;
- aux 500 m dans un domaine de 10 x 10 km centré sur le site du projet englobant les secteurs résidentiels en bordure de la zone industrielle au nord (Contrecœur) et au sud (Verchères) du site du projet;
- aux récepteurs sensibles (CPE, garderie, écoles, centres d'hébergement de longue durée) et aux résidences jusqu'à 2 km du site du projet) de la zone d'étude. Les récepteurs sensibles ont été identifiés en consultant les sites internet gouvernementaux.

La topographie locale a été prise en considération dans la modélisation. Les données numériques d'élévation du Canada à l'échelle 1:50 000 d'une résolution approximative de 20 m ont été formatées au format américain et traitées à l'aide du processeur AERMAP pour extraire les élévations du terrain des récepteurs et pour calculer les pentes du terrain.

Les récepteurs sensibles sont listés au tableau 2.4 et la position des récepteurs et la topographie sont montrées à la figure 2.5 sur l'ensemble du domaine.

2.4 Effets de sillage des bâtiments

Les effets de sillage des bâtiments sur la dispersion atmosphérique et l'élévation des panaches des cheminées ont été considérés dans l'analyse. Les dimensions et hauteurs des bâtiments ont été analysées avec le programme BPIP *« Building Profile Input Program »* de l'US-EPA.

Pour ce projet, à l'exception des émissions des navires, remorqueurs et dragues, les émissions sont de natures fugitives ou sont modélisées à l'aide de sources surfaciques ou volumiques pour lesquelles les effets des bâtiments ne sont pas considérés par le modèle de dispersion. Le projet ne comporte d'ailleurs aucun bâtiment d'importance de ce point de vue. La structure même des navires porte-conteneurs, incluant les conteneurs sur le pont, à tout de même été considérée dans la modélisation comme un bâtiment pour les cheminées des navires à quai lors de la phase d'exploitation. Il en est de même pour la structure des dragues et des remorqueurs utilisés lors de la phase de construction.

Tableau 2.4 Liste des récepteurs sensibles et des résidences les plus proches

Numéros et noms des récepteurs		Coordonnées (UTM-19, WGS84)		Élévation (m)	Par rapport au centre du terminal	
		X - Est (m)	Y - Nord (m)		Distance (km)	Direction
Récepteurs sensibles						
1	C.P.E. Petit à petit	636 613	5 078 983	19	6.1	NE
2	École Mère-Marie-Rose	636 714	5 079 528	13	6.5	NE
3	Centre d'hébergement de Contrecœur	636 348	5 079 420	11	6.2	NE
4	Résidence L'Autre Jeunesse	636 465	5 079 508	11	6.3	NE
5	Maison des Gens Heureux	636 804	5 079 298	17	6.4	NE
6	École Ludger-Duverna	627 681	5 070 114	12	6.6	SO
7	Résidence Florentine-Dansereau	627 810	5 070 452	10	6.2	SO
Résidences les plus proches du projet						
8	1220, Marie-Victorin, Verchères	631 769	5 074 403	10	0.7	SSO
9	1219, Marie-Victorin, Verchères	631 556	5 074 597	10	0.6	SO
10	986, Montée Lapierre, Contrecœur	633 261	5 074 745	13	1.3	ESE
11	2001, Marie-Victorin, Contrecœur	634 446	5 076 542	13	2.9	ENE

Note : Les récepteurs sensibles et les résidences sont présentés sur une carte à la figure 2.5.

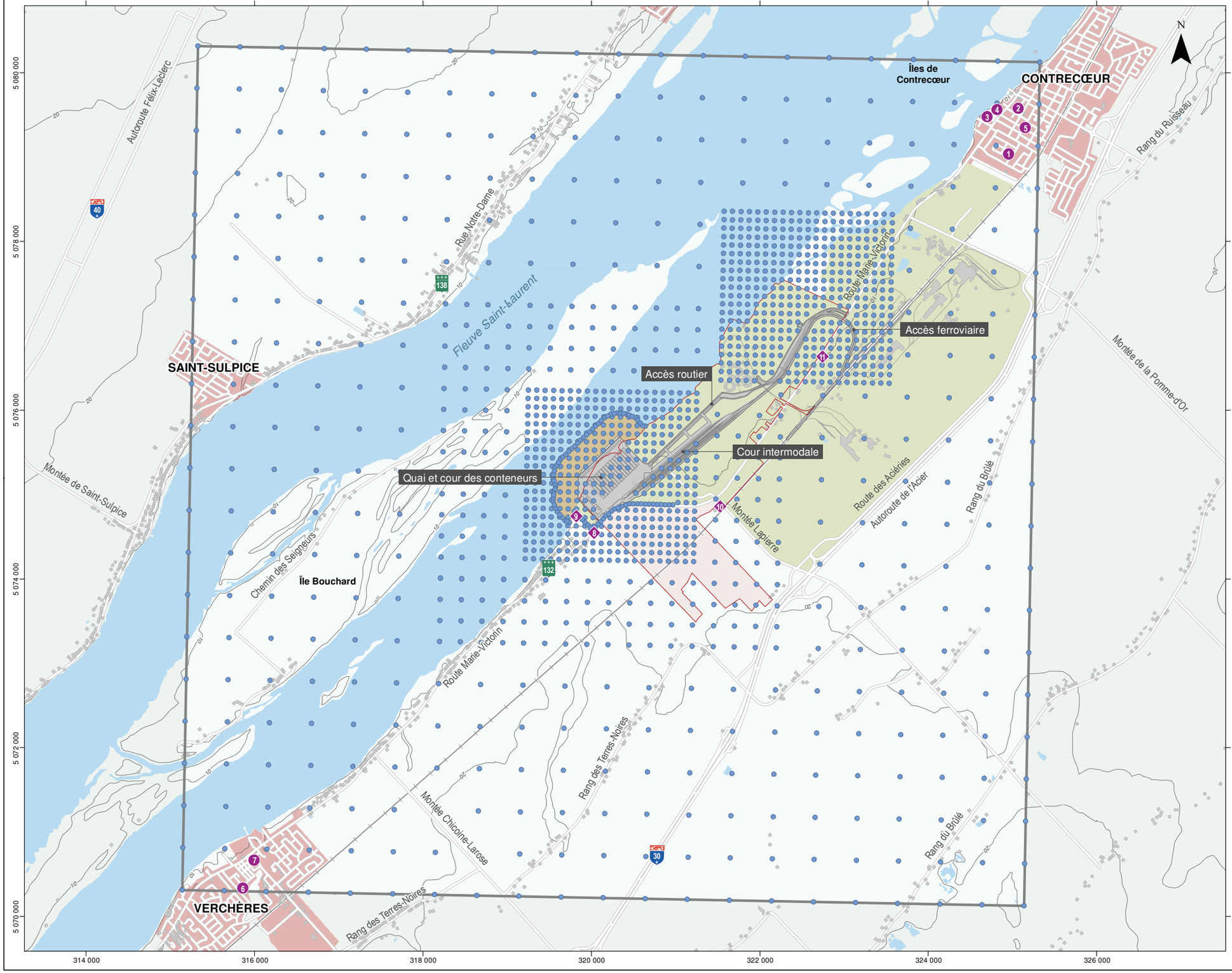
2.5 Normes de qualité de l'air ambiant et concentration initiales

Les normes du RAA et les normes canadiennes de qualité de l'air ambiant pour les PCA sont présentées au tableau 2.5. Le tableau 2.6 présente les normes, les critères et les concentrations initiales par défaut du RAA et du MDDELCC (2016) pour les contaminants toxiques considérés dans cette étude.

Le modèle de dispersion atmosphérique permet d'estimer la contribution du projet aux concentrations de contaminants dans l'air ambiant. Les concentrations initiales permettent de tenir compte de la présence de contaminants atmosphériques déjà présents dans le milieu ou provenant d'autres sources. Les concentrations initiales sont ajoutées aux résultats du modèle de dispersion atmosphérique et les concentrations résultantes sont alors comparées aux normes et critères de qualité de l'air ambiant.

Le RAA et le MDDELCC proposent des concentrations initiales par défaut pour tous les contaminants pour lesquels des normes ou des critères de qualité de l'air ambiant existent. Il s'agit en général de niveaux relativement élevés typiques des milieux urbains ou fortement industrialisés. Pour les concentrations initiales des contaminants toxiques et de l'ammoniac, les valeurs par défaut du RAA ont été considérées. Pour les PCA, les concentrations initiales ont plutôt été déterminées à partir des résultats du Réseau de surveillance de la qualité de l'air du Québec (RSQAQ) et du Réseau national de surveillance de la pollution de l'atmosphère (RNSPA) sur la période de 2013 à 2015 pour des stations jugées représentatives du site du projet, soit les stations de Varennes, de St-Anicet, de Saint-Simon et du Parc Océanie. Les concentrations initiales sont présentées au tableau 2.5 et la localisation des stations de qualité de l'air est présentée à la figure 2.1.

.



Composantes du projet

- Aire du projet - Variante 2

Modélisation atmosphérique

- Domaine de modélisation
- Récepteur
- Récepteur sensible
- Résidence

Territoires exclus de la modélisation

- Territoire de l'APM
- Affectation industrielle
- Zone tampon de 300 m du quai

Infrastructures existantes

- Chemin de fer du CN
- Autre chemin de fer
- Réseau routier

- Courbe de niveau (équidistance de 10 m)

Numéro	Récepteurs sensibles et résidences
1	C.P.E. Petit à Petit
2	École Mère-Marie-Rose
3	Centre d'hébergement de Contrecœur
4	Résidence L'Autre Jeunesse
5	Maison des Gens Heureux
6	École Ludger-Duvernay
7	Résidence Florentine-Dansereau
8	1220, Rte Marie-Victorin, Verchères
9	1219, Rte Marie-Victorin, Verchères
10	986, Montée Lapierre, Contrecœur
11	2001, Rte Marie-Victorin, Contrecœur

PORT MONTRÉAL

SNC·LAVALIN

ADMINISTRATION PORTUAIRE DE MONTRÉAL
Projet d'agrandissement du terminal de Contrecœur

Figure 2.5
Domaine de modélisation, topographie et récepteurs

Sources :
MRC Marguerite-D'Youville
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
CanVec, 1/50 000, RNCan, 2017
Composantes du projet, APM, février 2017

Projet: 643872

0 450 900 m
1/45 000
Projection MTM, fuseau 8, NAD83
Équidistance des courbes : 10 m

Rév.	aaaa/mm/jj	Description	Préparé	Vérifié
01	2017/07/07	Finale	A. Chouinard	É. Delisle
00	2017/05/25	Préliminaire	A. Chouinard	É. Delisle

Format 11x17

\\sli1877\SLEI\PROJ\639223_APM_EIE_Contrecoeur\4.7_CadDaoSig\GEOMATIQUE\interne\diffusion\produits\643872-01-Dispersion\snc643872_air_f2-5_domaine_tab_170707_pre01.mxd

Les concentrations initiales ont été déterminées selon la procédure établie par le MDDELCC de la façon suivante :

- quatre minutes, une heure et huit heures : 99^{e} centile annuel des moyennes de la période correspondante, moyenne sur trois ans. Pour la durée de quatre minutes, les mesures ont préalablement été multipliées par un facteur de 1,91, tel que mentionné à la section 2.7
- 24 heures : 98^{e} centile annuel des moyennes quotidiennes, moyenne sur trois ans.
- annuelle : moyennes sur trois ans.

Pour les $PM_{2.5}$, étant donné que la concentration initiale dérivée des mesures de 21 µg/m³ est supérieure à la valeur par défaut de 20 µg/m³ du RAA, cette dernière valeur est plutôt sélectionnée pour la concentration initiale, comme mentionné à l'article 202 du RAA.

Tableau 2.5 Normes de qualité de l'air ambiant et concentrations initiales des principaux contaminants atmosphériques

Contaminants	Périodes	Stations	Concentrations initiales (µg/m³)	Normes	
				(µg/m³)	Source
Dioxyde de soufre (SO_2)	4 minutes	Parc Océanie (RSQAQ :06760) 2013 à 2015	21	1 310	RAA (1)
	1 heure		11	170 (65 ppb) (2)	NCQAA (3)
	24 heures		5,2	288	RAA
	Annuelle		1,7	52	RAA
				11 (4 ppb)	NCQAA (3)
Dioxyde d'azote (NO_2)	1 heure	Varennes (RNSPA :052601) 2013 à 2015	40	414	RAA
	24 heures		24	207	RAA
	Annuelle		9,4	103	RAA
Monoxyde de carbone (CO)	1 heure	Saint-Anicet (RSQAQ :06804) 2014 à 2015	441	34 000	RAA
	8 heures		430	12 700	RAA
Ammoniac (NH_3)	4 minutes	NA	100 (5)	350	RAA
Particules totales (PM_T)	24 heures	Saint-Simon (RSQAQ :06641) 2013-2015	56	120	RAA
Particules fines (PM_{10})	24 heures	Parc Océanie (RSQAQ :06760) 2013 à 2015	38,7	60	NCQAA (4)
Particules fines ($PM_{2.5}$)	24 heures	Varennes (RNSPA :052601) 2013 à 2015	20 (5)	30	RAA
				28 (depuis 2015) 27 (à partir de 2020)	NCQAA (6)
	Annuelle		8,7	10 (depuis 2015) 8,8 (à partir de 2020)	NCQAA (7)

(1) Avec 99,5^e centile inférieur ou égal à 1 050 µg/m³.
(2) Norme canadienne de qualité de l'air ambiant (NCQAA) pour 2025, moyenne triennale du 99^e centile annuel des maximums quotidiens des concentrations moyennes sur une heure.
(3) Norme canadienne de qualité de l'air ambiant (NCQAA) pour 2025.
(4) Ancien standard pancanadien proposé, mais non entériné, moyenne triennale du 98^e centile annuel des concentrations quotidiennes moyennes sur 24 heures.
(5) Valeur par défaut du RAA.
(6) Norme canadienne de qualité de l'air ambiant (NCQAA) pour 2015 et 2020, moyenne triennale du 98^e centile annuel des concentrations quotidiennes moyennes sur 24 heures.
(7) Norme canadienne de qualité de l'air ambiant (NCQAA) pour 2015 et 2020, moyenne triennale des moyennes annuelles.

Tableau 2.6 Normes et critères de qualité de l'air ambiant et concentrations initiales des contaminants toxiques du RAA et du MDDELCC

Contaminants	# CAS	Périodes	Concentrations initiales (µg/m³)	Normes (µg/m³)	Norme Critère
Composés organiques volatils (COV)					
Acétaldéhyde	75-07-0	4 minutes	NA	3	C*
		Annuelle	NA	0,5	
Acroléine	107-02-8	4 minutes	NA	8,3	C*
		Annuelle	NA	0,02	
Benzène	71-43-2	24 heures	3	10	N
Éthylbenzène	100-41-4	4 minutes	140	740	N
		Annuelle	3	200	
Formaldéhyde	50-00-0	15 minutes	3	37	N
Hexane	110-54-3	4 minutes	140	5300	N
		Annuelle	3	140	
Octane (iso) (2,2,4-Triméthylpentane)	540-84-1	1 heure	0	3500	C
		Annuelle	0	350	
Styrène	100-42-5	1 heure	0	150	N
Toluène	108-88-3	4 minutes	260	600	N
Xylènes	1330-20-7	4 minutes	150	350	N
		1 heure	8	20	
Métaux					
Arsenic	7440-38-2	Annuelle	0,002	0,003	N
Chrome trivalent	16065-83-1	Annuelle	0,01	0,1	N
Chrome hexavalent	18540-29-9	Annuelle	0,002	0,004	N
Manganèse (PM_{10})	7439-96-5	Annuelle	0,02	0,025	C
Mercure	7439-97-6	Annuelle	0,002	0,005	N
Nickel (PM_{10})	7440-02-0	24 heures	0,002	0,014	N
Plomb	7439-92-1	Annuelle	0,025	0,1	N
Hydrocarbures aromatiques polycycliques (HAP)					
Benzo(a)pyrène	50-32-8	Annuelle	0,0003	0,0009	N
HAP totaux (voir tableau 2.7)		Annuelle	0,0003	0,0009	C
Naphthalène	91-20-3	4 minutes	5	200	N
		Annuelle	0	3	
Pyrène	129-00-0	Annuelle	0	13	C

* Critères provisoires du MDDELCC. Pour ces substances, il n'y a pas de concentration initiale à prendre en compte, les critères correspondent à l'ajout permis pour le projet. Les concentrations sur 4 minutes sont applicables au 99e centile sur une base annuelle.
(Référence: Courriel du 19 mai 2017 de Marie-Pier Brault, Biologiste M.E.I., MDDELCC, Direction générale du suivi de l'état de l'environnement, Direction des avis et des expertises)

Tableau 2.7 Facteurs d'équivalence de toxicité pour les HAP

HAP	# CAS	FET
Acénaphtène	83-32-9	0,001
Acénaphtylène	208-96-8	0,001
Anthracène	120-12-7	0,01
Benz(a)anthracène	56-55-3	0,1
Benzo(a)pyrène	50-32-8	1
Benzo(b)fluoranthène	205-99-2	0,1
Benzo(g,h,i)perylène	191-24-2	0,01
Benzo(k)fluoranthène	207-08-9	0,1
Chrysène	218-01-9	0,01
Fluoranthène	06-44-0	0,001
Fluorène	91-20-3	0,001
Indéno(1,2,3-c,d)pyrène	193-39-5	0,1
Naphtalène	91-20-3	0,001
Phénanthrène	85-01-8	0,001
Pyrène	129-00-0	0,001

Les HAP totaux sont exprimés en équivalent toxique du benzo(a)pyrène (BaP_{ET}) selon l'équation suivante :

$$BaP_{ET} = \sum_{i}^{n} FET_i \times [HAP]_i$$

BaP_{ET} : Concentration totale de HAP exprimée en équivalent toxique de B(a)P.
FET_i: facteur d'équivalence en toxicité par rapport au B(a)P.
$[HAP]_i$: concentration de chaque HAP

2.6 Conversion du NO en NO_2

Les émissions d'oxydes d'azote (NO_x) comprennent le monoxyde d'azote (NO) et le dioxyde d'azote (NO_2). Les proportions relatives typiques de NO et de NO_2 sont respectivement de 90 % et de 10 %. Dans l'atmosphère, le NO est converti plus ou moins rapidement en NO_2 en fonction principalement de la concentration d'ozone de l'atmosphère et des conditions météorologiques. À l'inverse, la photodissociation du NO_2 par le rayonnement solaire produit de l'ozone et du NO. Comme il n'y a pas de normes pour le NO dans l'air ambiant, ce sont donc les concentrations de NO_2 dans l'air ambiant qui sont évaluées.

Dans cette étude, l'hypothèse de la conversion totale du NO en NO_2 sera utilisée dans un premier temps. Cette hypothèse très conservatrice qui surestime grandement les concentrations de NO_2 dans l'air ambiant considère que le NO émis à l'atmosphère se transforme instantanément en NO_2 au point d'émission.

Par la suite, la méthode « *Ozone Limiting Method* » (OLM), une des méthodes recommandées par le MDDELCC (2008), a été considérée pour estimer les concentrations maximales horaires de NO_2 à partir des résultats du modèle de dispersion et des concentrations ambiantes d'ozone par défaut du RAA (130 µg/m³ sur une heure) tout en supposant que 10 % des NO_x sont émis sous la forme de NO_2 :

- Si $[O_3] > 0,9 * [NO_x]$ alors $[NO_2] = [NO_x]$ Conversion totale.
- Dans le cas contraire : $[NO_2] = [O_3] + 0,1 * [NO_x]$ Conversion partielle.

où « [ ] » représente des concentrations sur base volumique (ppm par exemple) et [NO_x] la concentration de NO_x calculée par le modèle de dispersion.

Les concentrations initiales de NO_2 sont ajoutées après le calcul de la conversion du NO en NO_2.

2.7 Concentrations pour une durée inférieure à une heure

Certaines des normes du RAA sont sur une durée inférieure à une heure (4 minutes par exemple pour le SO_2) alors que les résultats du modèle de dispersion sont représentatifs d'une durée d'une heure ou plus. La formule spécifiée dans le *Guide de modélisation* du MDDELCC et à l'annexe H du RAA sera utilisée pour estimer les concentrations maximales sur 4 minutes à partir des concentrations maximales horaires obtenues du modèle de dispersion. Les résultats maximums horaires seront donc multipliés par un facteur de 1,91 pour l'estimation d'une concentration maximale sur 4 minutes et par 1,37 pour l'estimation d'une concentration maximale sur 15 minutes.

2.8 Déposition des matières particulaires

Dans cette étude, le phénomène de déposition sèche des poussières liées aux émissions fugitives des activités de construction et aux véhicules de transport sur les routes (pavées et non pavées) lors des phases de construction et d'exploitation a été considéré dans la modélisation. Ces émissions comprennent une proportion importante de particules plus grossières (10 à 30 µm) pour lesquelles la déposition est un phénomène important. La déposition pour les émissions de matières particulaires liées à la combustion a toutefois été négligée, ce type d'émission étant dominée par les particules fines qui se déposent très lentement et à de plus grandes distances. La déposition par voie humide a aussi été négligée dans la modélisation puisqu'il s'agit d'un phénomène occasionnel.

Le modèle de dispersion requiert alors pour chacune des sources une distribution par classe de diamètre des particules de même que la masse volumique des particules de chacune de ces classes. Les facteurs d'émission d'AP-42 pour l'estimation des émissions fugitives des routes et des activités de construction permettent de définir de trois à quatre catégories de particules. Les paramètres des sources relatifs à la déposition sèche sont présentés avec les paramètres d'émission pour la modélisation en construction (chapitre 3) et en exploitation (chapitre 4).

3 Période de construction

3.1 Émissions atmosphériques lors de la construction

Les émissions atmosphériques liées aux activités de construction du projet de terminal à conteneurs à Contrecœur ont été estimées selon des méthodes reconnues (facteurs d'émission AP-42 de *l'Environmental Protection Agency* des États-Unis (US-EPA), Environnement Canada, MDDELCC) et les caractéristiques du projet.

Les sources d'émissions atmosphériques lors de la construction sont liées au transport de divers matériaux et aux activités de construction proprement dite et sont de trois types :

- la combustion de carburants fossiles par les moteurs des camions et des équipements diesels de construction (pelles mécaniques, bouteurs, compacteurs, etc.) et de dragage;
- les activités de construction (excavation, remblayage, boutage, compactage, chargement et déchargement de matériaux solides en vrac, etc.) et le transport sur route génèrent des émissions fugitives de matières particulaires;
- l'érosion éolienne sur les surfaces exposées, par exemple dans les zones de disposition des sédiments, si cette option est retenue en totalité ou en partie.

L'estimation des émissions totales des PCA et de composés toxiques (certains COV, métaux et HAP spécifiques) liées à la combustion de carburants fossiles pour la construction et l'exploitation du terminal a été réalisée dans le cadre d'un mandat spécifique (SNC-Lavalin, 2017). Selon cette étude, les émissions atmosphériques pour toute la durée de construction (4 ans) des divers contaminants liées à la combustion représentent de 3 % à 50 % des émissions annuelles prévues pour l'exploitation selon les contaminants. Sur une base annuelle, les émissions de la construction ne représentent donc que de 1 % à 13% selon les contaminants des émissions prévues pour l'exploitation. Cette conclusion n'est cependant valide que pour les émissions liées à la combustion. Lors de la construction, les émissions fugitives de matières particulaires et les émissions liées à l'érosion éolienne seront nettement supérieures aux émissions fugitives lors de l'exploitation.

3.2 Scénario de modélisation pour la construction

La période de construction s'échelonnera sur une période de quatre ans et comprend une multitude d'activités de durées et d'étendues variables. Les périodes de certaines activités se chevauchent alors que d'autres surviennent séquentiellement. Plusieurs de ces activités ne sont actuellement pas suffisamment détaillées pour permettre l'estimation des émissions fugitives de matières particulaires. Pour d'autres activités, plusieurs options sont considérées. C'est le cas notamment pour la disposition des sédiments, qui pourraient être hors site, ou à divers endroits sur le site.

Face à cette complexité, le scénario de modélisation considéré pour la construction a été établi pour les périodes de dragage des sédiments avec l'option de disposition sur le site à la zone n°4, tout en considérant l'accès au site pour 150 camions lourds par jour, soit le maximum prévu pour la période de construction (voir figure 3.1). Ce scénario a été établi à partir des critères suivants :

- Selon l'inventaire des émissions liées à la combustion, ce sont le dragage et la disposition des sédiments qui génèrent le plus d'émissions atmosphériques.

- Les distances parcourues par des camions lourds sur le site, pour le transport des sédiments vers la zone 4, sont plus importantes que pour la zone 2.
- Le dragage et la disposition des sédiments sont des activités quelque peu uniques et dont les impacts potentiels sur la qualité de l'air sont moins bien connus que pour un chantier de construction en général.
- Les détails d'exécution pour le dragage et la disposition des sédiments ont été longuement étudiés et sont suffisamment détaillés pour réaliser une étude de dispersion atmosphérique.
- La zone 4 pour la disposition des sédiments est le lieu de réalisation d'activités génératrices de poussières le plus près de la zone urbaine de Contrecœur, qui pourrait éventuellement être affectée par les poussières générées par l'érosion éolienne sur le site de disposition lors de vents forts de l'ouest ou du sud-ouest. Pour la zone 2, se serait plutôt les vents forts en provenance du nord-est qui pourraient être problématiques, mais ces derniers sont habituellement associés à du mauvais temps avec précipitations, annulant ainsi le soulèvement des poussières.

Le tableau 3.1 présente les détails des activités génératrices d'émissions atmosphériques pour le scénario de modélisation retenu pour la construction. Les sources sont également identifiées à la figure 3.1 sur une carte du site du projet.

Puisque les émissions liées à la combustion lors de la construction sont nettement inférieures aux émissions lors de l'exploitation et que les résultats de modélisation pour l'exploitation démontrent un impact marginal pour les contaminants toxiques (selon les résultats du chapitre 4), ces derniers n'ont pas été retenus pour le scénario de modélisation lors de la construction. L'emphase de l'étude de dispersion lors de la construction porte donc sur les matières particulaires et les autres PCA.

Pour les contaminants liés à la combustion, les taux d'émission ont été tirés de l'inventaire des émissions (SNC-Lavalin, 2017). Les émissions fugitives de matières particulaires ont été estimées en fonction des caractéristiques du projet et des facteurs d'émission de l'AP-42 et de la méthode suggérée par le MDDELCC (2017) pour l'érosion éolienne. Les détails des calculs pour le scénario de modélisation retenu sont présentés à l'annexe A.

Pour certaines activités émettrices, des mesures de réduction des émissions ont été considérées dans les calculs. Pour les routes non pavées, les émissions ont été estimées en considérant une teneur en silt (matériel inférieur à 75 µm libre à la surface de la route) de 8,5 %, telle que rapportée par l'US-EPA (AP-42) pour les sites de construction, tout en considérant une réduction de 90 % pour l'arrosage régulier de la surface des routes. Pour les routes pavées, la teneur en silt en surface moyenne de 7,8 g/m³ rapportée par l'US-EPA (AP-42) pour les carrières et site d'enfouissement a été réduite à 3,9 g/m² (réduction de 50 %) pour tenir compte du nettoyage régulier de la chaussée et que des stations de lavages des roues de camions seront installées à la sortie du chantier.

Les paramètres des sources définies dans le modèle AERMOD sont présentés aux tableaux 3.2 à 3.5. Les caractéristiques des émissions fugitives de matières particulaires pour lesquelles la déposition sèche a été considérée sont présentées au tableau 3.6.

Tableau 3.1 Description des activités et des sources d'émissions atmosphériques considérées dans le scénario modélisation de la dispersion atmosphérique lors de la construction

Activité	Équipements (puissance moteur)	Description	Durée	Type d'émission	Type de source dans la modélisation
Dragage des sédiments	2 remorqueurs (1 500 hp) 2 dragues (208 hp)	Les sédiments sursaturés en eau sont déposés par les dragues sur des barges. Les remorqueurs assurent le déplacement des barges entre les sites de dragage et le quai.	7 à 19 h Septembre à novembre	Gaz d'échappement	Ponctuelles
Déchargement des sédiments au quai	3 excavatrices (268 hp)	Les excavatrices (pelles mécaniques) déchargent les barges et chargent les sédiments dans des camions hors route au taux de 4 800 m³/jour.	7 à 19 h Septembre à novembre	Gaz d'échappement Poussières	Volumique
Transport des sédiments	9 camions hors route (CAT740, 500 hp)	Transport de 4 800 m³/jour de sédiments entre le quai et la zone 4 de disposition sur le site de l'APM. 0,75 km sur route non pavée (routes 2A et 2C) 2,3 km sur route pavée (route 2B) 220 chargements ou aller-retour par jour.	7 à 19 h Septembre à novembre	Gaz d'échappement Poussières	Linéaires volumiques
Déchargement et disposition des sédiments	4 bouteurs (138 hp) 1 compacteur (100 hp) 4 excavatrices (268 hp)	Transferts : Déchargement des camions Pelles mécaniques Boutage et compactage pour la construction de digues	7 à 19 h Septembre à novembre	Gaz d'échappement Poussières	Volumique
Accès au site	Camions lourds (475 hp)	Matériaux divers 150 camions (aller-retour) par jour 2,05 km sur route pavée	7 à 17 h Avril à décembre	Gaz d'échappement Poussières	Linéaires volumiques
Érosion éolienne	Aucun	Érosion éolienne sur les zones de disposition des sédiments (4A et 4B) 100 % des surfaces d'environ 200 000 m² susceptible d'émettre	Avril à novembre (couvert de neige en hiver)	Poussières	Surfacique

631 000 632 000 633 000 634 000 635 000 636 000

5 077 000 5 076 000 5 075 000 5 074 000

N

Île Bouchard

Fleuve Saint-Laurent

Route Marie-Victorin

Aire d'entreposage des déblais de dragage

Zone 4A

Zone 4B

Disposition des sédiments et construction de digues
(4 pelles mécaniques, 1 compacteur, 4 bouteurs)

Route 2B
(pavée)

Route 2C
(non pavée)

Transport des sédiments

Aire à draguer

Quai
(3 pelles mécaniques)

Drague 2

Remorqueur 2

Drague 1

Remorqueur 1

Zone 2

Aire d'entreposage
des déblais de dragage (optionnel)

Route 2A
(non pavée)

Route 1
(pavée)

Accès au chantier

Route des Aciéries

Autoroute de l'Acier

Montée Lapierre

Route Marie-Victorin

132

30

Composantes du projet

Empreinte du projet - Variante 2

Modélisation atmosphérique

Sources de contaminants atmosphériques

- Source ponctuelle
- Source linéaire volumique
- Source de surface
- Source volumique

Territoires exclus de la modélisation

- Territoire de l'APM
- Affectation industrielle
- Zone tampon de 300 m du quai

Récepteurs

- Résidence

Infrastructures existantes

- Chemin de fer du CN
- Autre chemin de fer
- Réseau routier

Courbe de niveau (équidistance de 10 m)

PORT MONTRÉAL

SNC·LAVALIN

ADMINISTRATION PORTUAIRE DE MONTRÉAL
Projet d'agrandissement du terminal de Contrecoeur

Figure 3.1
Configuration des sources de contaminants atmosphériques modélisées lors de la construction

Sources :
MRC Marguerite-D'Youville
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
CanVec, 1/50 000, RNCan, 2017
Composantes du projet, APM, février 2017

Projet: 643872

0 180 360 m
1/18 458
Projection MTM, fuseau 8, NAD83

Rév.	aaaa/mm/jj	Description	Préparé	Vérifié
01	2017/07/07	Finale	A. Chouinard	É. Delisle
00	2017/05/31	Préliminaire	A. Chouinard	É. Delisle

Format 11x17

\\sli1877\SLE\PROJ\639223_APM_EIE_Contrecoeur\4.7_CadDaoSig\GEOMATIQUE\interne\diffusion\produits\643872-01-Dispersion\snc643872_air_f3-1_sources_tab_170707_pre01.mxd

Tableau 3.2 Paramètres d'émission des sources ponctuelles représentant les activités de dragage

Paramètres	Dragues		Remorqueurs	
Température des gaz à la cheminée (°C)	130		130	
Vitesse de gaz (m/s)	15		15	
Diamètre de cheminée (m)	0,14		0,34	
Hauteur de la cheminée (m)	8		9	
Élévation à la base (m)	7		7	
Coordonnées UTM18, NAD83 (m)	**X**	**Y**	**X**	**Y**
Unité 1	631 563	5 075 221	631 600	5 075 185
Unité 2	631 841	5 075 499	631 563	5 075 221
Dimensions du bâtiment équivalent (m) (Largeur, longueur, hauteur)	4 x 4 x 7		4 x 4 x 7	
Horaire journalier (septembre à novembre)	7 à 19 h		7 à 19 h	
Taux d'émission moyen horaire (g/s)				
NO_X	0,00957		0,957	
SO_2	0,000172		0,000916	
CO	0,00467		0,255	
NH_3	0,000295		0,00351	
PM_T	0,000366		0,0191	
PM_{10}	0,000366		0,0191	
$PM_{2.5}$	0,000355		0,0176	

Tableau 3.3 Paramètres d'émission des sources volumiques représentant le chargement des camions et la disposition des sédiments

Paramètres	Déchargement/ chargement des sédiments au quai	Disposition des sédiments et construction de digues
Arête (m)	50	165
Élévation (m)	7	10
Hauteur d'émission (m) (1)	2,0	2,0
Sigma-Y (1)	11,63	38,45
Sigma-Z (1)	1,86	1,86
Horaire journalier (septembre à novembre)	7 à 19 h	7 à 19 h
Taux d'émission moyen horaire (g/s)		
NO_X	0,0370	0,0794
SO_2	0,000665	0,00144
CO	0,0154	0,0392
NH_3	0,00114	0,00246
PM_T (combustion)	0,00145	0,00309
PM_{10} (combustion)	0,00145	0,00309
$PM_{2.5}$ (combustion)	0,00141	0,00299
PM_T (fugitives)	0,0102	1,34
PM_{10} (fugitives)	0,00484	0,286
$PM_{2.5}$ (fugitives)	0,00277	0,138

(1) Arête (m) : L
Hauteur du panache (m): Hp
Hauteur d'émission (m) : Hp/2
Sigma-Y (m) : SY = L/4,3
Sigma-Z (m) : SZ = Hp/2,15

Tableau 3.4 Paramètres d'émission des sources linéaires volumiques représentant le camionnage sur le site

Paramètres	Route 1 (pavée)	Route 2A (non pavée)	Route 2B (pavée)	Route 2C (non pavée)
Activité	Accès au site	Transport des sédiments du quai à la zone 4		
Longueur (m)	1 046	441	2 277	291
Nombre de sources volumiques alternées	26	11	55	8
Élévation (m)	10 à 12	7 à 10	8 à 10	9 à 10
Largeur des segments (m)	21	21	21	21
Hauteur d'émission (m) (1)	6,8	6,8	6,8	6,8
Sigma-Y (1)	19,1	19,5	19,4	17,9
Sigma-Z (1)	3,16	3,16	3,16	3,16
Horaire journalier	7 à 17 h	7 à 19 h	7 à 19 h	7 à 19 h
Horaire mensuel	Avril à décembre	Septembre à novembre		
Taux d'émission moyen horaire (g/s) - Total sur l'ensemble des sources volumiques				
NO_X	0,0139	0,0852	0,0769	0,0450
SO_2	0,000184	0,00153	0,00138	0,000809
CO	0,00417	0,0419	0,0378	0,0221
NH_3	0,000276	0,00263	0,00237	0,00139
PM_T (combustion)	0,00315	0,00334	0,00301	0,00176
PM_{10} (combustion)	0,00315	0,00334	0,00301	0,00176
$PM_{2.5}$ (combustion)	0,000691	0,00324	0,00292	0,00171
PM_T (fugitives)	3,06	7,41	16,9	4,89
PM_{10} (fugitives)	0,587	3,13	3,25	2,07
$PM_{2.5}$ (fugitives)	0,142	0,313	0,786	0,207

(1) Propriétés de chacune des sources du segment
Hauteur des véhicules (m) : H_v
Distance de centre à centre (m) : D = 42 m
Hauteur du panache (m) : H_p=1,7*H_v
Hauteur d'émission (m) : H_p/2
Sigma-Y (m), S_Y = D/2,15, Sigma-Z (m), S_Z = H_p/2,15

Tableau 3.5 Paramètres d'émission des sources de surface représentant l'érosion éolienne sur les zones de disposition des sédiments

Paramètres	Zone 4A		Zone 4B	
Élévation (m)	8		10	
Hauteur d'émission (m)	2		2	
Surface de la zone (m^2)	48 070		149 232	
Coordonnées du centre UTM18, NAD83 (m)	**X**	**Y**	**X**	**Y**
	633 733	5 076 604	634 092	5 076 453
Taux d'émission (g/s/m²)	Si le vent est supérieur à 19,3 km/h Avril à novembre seulement (couvert de neige en hiver)			
PM_T (fugitives)	1,12E-04			
PM_{10} (fugitives)	5,62E-05			
$PM_{2.5}$ (fugitives)	8,44E-06			

Tableau 3.6 Paramètres de déposition sèche des matières particulaires fugitives

Classes de particules (µm)	**10-30**	**2,5-10**	**<2,5**	
Diamètres moyens (µm)	**20**	**6,25**	**1,25**	
Chargement des sédiments au quai				
Fractions massiques des PM_T	53%	20%	27%	
Fractions massiques des PM_{10}	NA	43%	57%	
Masse volumique des particules (g/cm³)	2,7			
Érosion éolienne aux zones de disposition des sédiments				
Fractions massiques des PM_T	50,0%	42,5%	7,5%	
Fractions massiques des PM_{10}	NA	85,0%	15,0%	
Masse volumique des particules (g/cm³)	2,7			
Routes non pavées				
Fractions massiques des PM_T	58%	38%	4%	
Fractions massiques des PM_{10}	NA	90%	10%	
Masse volumique des particules (g/cm³)	2,0			
Classes de particules (µm)	**15-30**	**10-15**	**2,5-10**	**<2,5**
Diamètres moyens (µm)	**22,5**	**12,5**	**6,25**	**1,25**
Routes pavées				
Fractions massiques des PM_T	76,2%	4,6%	14,6%	4,6%
Fractions massiques des PM_{10}	NA	NA	75,8%	24,2%
Masse volumique des particules (g/cm³)	2,0			
Disposition des sédiments et construction de digues				
Fractions massiques des PM_T	71,5%	7,2%	11,0%	10,3%
Fractions massiques des PM_{10}	NA	NA	52%	48%
Masse volumique des particules (g/cm³)	2,7			

3.3 Résultats de modélisation pour la construction

Les résultats de modélisation de la dispersion atmosphérique pour la construction sont présentés sous la forme de tableaux pour l'ensemble des contaminants à l'étude et sous la forme de cartes pour les contaminants pour lesquelles la contribution du projet par rapport aux normes de qualité de l'air ambiant serait la plus importante. Ces normes comprennent les normes du RAA, les critères du MDDELCC et les normes canadiennes (pour 2020) de qualité de l'air ambiant.

Dans les tableaux de résultats, les concentrations maximales calculées dans l'air ambiant sur l'ensemble de la période de modélisation (5 années) sont présentées et comparées aux normes et critères québécois et canadiens de qualité de l'air ambiant. Bien que les travaux de construction s'échelonneront sur quatre ans, une durée de simulation de cinq ans permet de considérer l'ensemble des conditions météorologiques possibles dans l'analyse. Ces tableaux présentent les résultats pour la contribution de la construction du terminal seul, et aussi en incluant les concentrations initiales.

Sur toutes les cartes de résultats, ce sont les concentrations maximales calculées pour le scénario de construction du terminal sur l'ensemble de la période de modélisation qui sont représentées par des courbes d'iso concentrations sur une carte de la zone d'étude. Ces maximums ne surviendraient donc pas simultanément sur l'ensemble du domaine de modélisation. Sur ces figures, les conditions de dispersion les plus défavorables sont représentées simultanément sur la même carte.

Les concentrations maximales de PCA calculées dans l'air ambiant pour la construction du terminal sont présentées au tableau 3.7. Seuls les résultats maximums sur le domaine d'applicabilité des normes de qualité de l'air ambiant sont présentés. Les normes de qualité de l'air ambiant sont applicables à l'extérieur de la propriété de l'APM et à l'extérieur de la zone industrielle. Elles sont aussi applicables à la résidence située au centre de la zone industrielle, soit au 2001, route Marie-Victorin (art. 202 du RAA).

Pour les contaminants gazeux, tous les résultats maximums sont nettement sous les normes en vigueur, que ce soit pour la contribution de la construction seule ou en ajoutant les concentrations initiales. Les résultats obtenus pour la construction sont significativement plus faibles que ceux obtenus pour l'exploitation du terminal, qui sont présentés à la section 4.3 plus loin dans ce rapport. Cette situation est tout à fait prévisible, puisque les activités générant des gaz de combustion sont très intenses durant l'exploitation que durant la construction. Les figures 3.2 à 3.5 en fin de chapitre présentent les concentrations maximales calculées de NO_2 dans l'air durant la construction sur des bases horaire, journalière et annuelle. Pour les trois périodes, les concentrations les plus élevées sont obtenues près du quai et au site de disposition des sédiments. Le tableau 3.8 présente aussi les résultats maximums de NO_2 pour les 4 résidences les plus près du projet vers l'ouest, le sud et vers l'est.

Pour les matières particulaires (tableau 3.7), les résultats comparativement aux normes sont plus élevés que pour les contaminants gazeux. En effet, les concentrations maximales calculées pour la contribution du projet en construction de particules totales (PM_T) et de particules fines (PM_{10} et $PM_{2.5}$) dépassent les normes ou critères de qualité de l'air ambiant par un facteur de trois pour les PM_T et les PM_{10}. Pour les $PM_{2.5}$, le maximum calculé est quelque peu au-dessus de la norme journalière. En tenant compte de concentrations ambiantes, des dépassements des normes journalière et annuelle sont calculées pour toutes les classes de PM.

Le tableau 3.8 présente les concentrations maximales calculées de PM pour quatre récepteurs sensibles (résidences) à proximité du projet. Les concentrations maximales discutées plus tôt et présentées au tableau 3.7 surviennent toutes à la résidence (récepteur 11 sur les cartes de résultats) dans la zone industrielle, juste à l'est de la zone de disposition des sédiments.

En laissant de côté les PM_{10}, pour lesquelles il n'y a pas de normes officielles proprement dites, de nombreux dépassements des normes journalières de PM_T et de $PM_{2.5}$ ont été calculés pour la résidence à proximité de la zone de disposition des sédiments (récepteur 11 sur les cartes), principalement à cause de l'érosion éolienne sur les sédiments qui sont considérés secs en surface en permanence dans la simulation. En ajoutant les concentrations initiales aux résultats de modélisation, quelques dépassements potentiels des normes de PM_T (2 à 4 jours par an) sont également calculés aux résidences immédiatement au sud du terminal (récepteur 8 et 9 sur les cartes de résultats). Ces dépassements sont toutefois moins importants qu'au récepteur 11. Pour ces deux mêmes récepteurs, tous les résultats obtenus pour les $PM_{2.5}$ sur une base journalière demeurent inférieurs aux normes, mais les concentrations annuelles atteignent et dépassent la norme annuelle canadienne pour 2020, principalement parce que la concentration initiale (8,7 µg/m³) atteint presque le niveau de la norme (8,8 µg/m³). D'ici la construction du terminal, le niveau ambiant moyen de $PM_{2.5}$ dans l'air ambiant sera probablement plus faible en raison des divers programmes gouvernementaux pour réduire les concentrations de $PM_{2.5}$ dans l'air ambiant.

Les figures 3.5 à 3.7 présentent les concentrations journalières maximales calculées de PM_T, de PM_{10} et de $PM_{2.5}$ sur des cartes de la région. À la figure 3.5, la zone de dépassement potentiel (en ajoutant la concentration initiale et en ignorant la résidence à proximité du site de disposition des sédiments) pour quelques dépassements par année de la norme journalière de PM_T dans l'air ambiant correspond approximativement à la courbe de 60 µg/m³ sur la figure. Cette zone s'étale jusqu'à environ un kilomètre au sud-ouest de la limite de la zone industrielle, le long de la rive du Saint-Laurent. Pour la zone de dépassement potentielle de la norme journalière de $PM_{2.5}$ dans l'air ambiant, correspondant à la courbe de 10 µg/m³ sur la figure 3.7, celle-ci s'étale jusqu'à moins de 350 m de la limite de la zone industrielle, au sud-ouest du terminal proposé. La route de transport des sédiments est la principale source contributrice, lorsque le vent est faible et en alignement avec l'axe de la route 2B.

Finalement, la figure 3.8 présente les concentrations maximales annuelles calculées de $PM_{2.5}$ dans l'air ambiant. La zone de dépassement potentielle de la norme canadienne annuelle pour 2020 correspond à la zone où la contribution annuelle du projet serait supérieure à 0,1 µg/m³. Cette zone dépasse les limites de la zone industrielle sur le fleuve St-Laurent et s'étend jusqu'à environ 1,3 km au sud-ouest du terminal. Encore une fois, cette zone de dépassement potentiel est liée au fait que la concentration ambiante avant le projet atteint déjà 99 % de la norme annuelle canadienne pour 2020.

En résumé, pour le scénario de construction considéré dans la modélisation, il appert que comparativement aux normes en vigueur, cette étape du projet n'aurait pas d'impact important sur la qualité de l'air en ce qui a trait aux contaminants gazeux. Pour les matières particulaires, des dépassements des normes ont été calculés à la résidence située dans la zone industrielle à proximité du site de disposition des sédiments n°4. Quelques dépassements potentiels des normes journalières de PM_T et de $PM_{2.5}$ ont aussi obtenus par modélisation dans une zone au sud-ouest de la zone industrielle, incluant les deux résidences les plus près. Ces dépassements potentiels ne sont toutefois pas aussi importants et pourraient survenir quelques jours par année.

Tableau 3.7 Sommaire des concentrations maximales des PCA calculées dans l'air ambiant lors de la construction du terminal

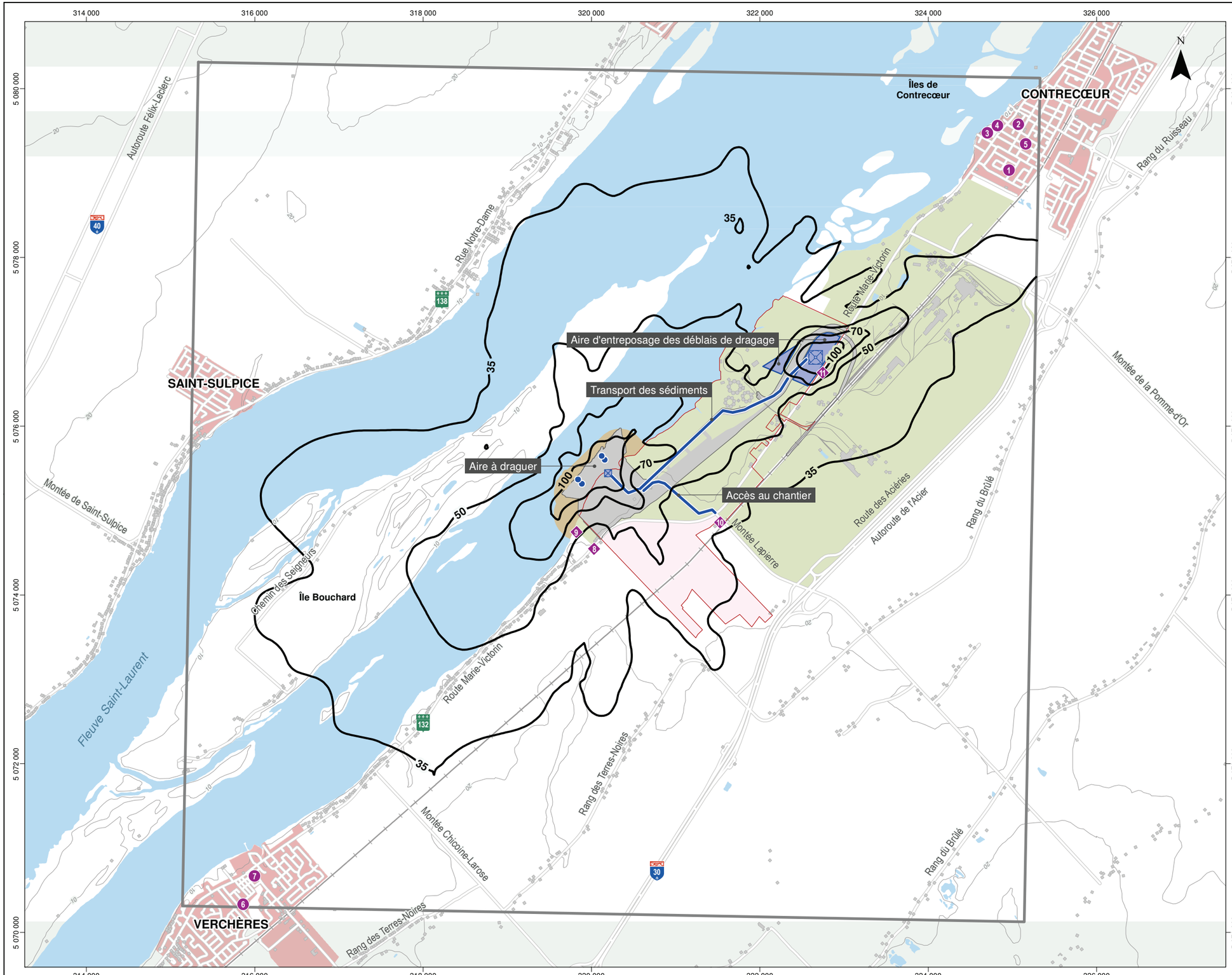
Contaminants	Périodes	Contributions maximales du terminal (1)		Concentrations initiales (2)		Concentrations totales (3)		Normes du RAA
		µg/m³	% norme	µg/m³	% norme	µg/m³	% norme	µg/m³
SO_2	4 minutes	3,5	0,27 %	21	1,6 %	25	1,9 %	1 310 (4)
	1 heure	1,8	1,1 %	11	6,5 %	13	7,6 %	170 (5)
	24 heures	0,094	0,033 %	5,2	1,8 %	5,3	1,8 %	288
	Annuelle	0,0044	0,0085 %	1,7	3,3 %	1,7	3,3 %	52
	Annuelle	0,0044	0,040 %	1,7	15 %	1,7	15 %	11 (6)
NO_2 (7)	1 heure	119	29 %	40	10 %	159	38 %	414
	24 heures	19	9,4 %	24	12 %	43	21 %	207
	Annuelle	0,74	0,72 %	9,4	9 %	10	10 %	103
CO	1 heure	50	0,15 %	441	1,3 %	491	1,4 %	34 000
	8 heures	13	0,11 %	430	3,4 %	443	3,5 %	12 700
NH_3	4 minutes	6,0	1,7 %	100	29 %	106	30 %	350
PM_T	24 heures	340	283 %	56	47 %	396	330 %	120
PM_{10}	24 heures	182	304 %	38,7	65 %	221	369 %	60 (8)
$PM_{2.5}$	24 heures	30	101 %	20	67 %	50	167 %	30
	24 heures	30	112 %	20	74 %	50	186 %	27 (9)
	Annuelle	2,1	23,9 %	8,7	99 %	11	122 %	8,8 (10)

(1) Concentrations maximales calculées à l'extérieur de la zone industrielle, de la propriété de l'APM et de la zone tampon de 300 m au-delà du terminal maritime, mais incluant les récepteurs résidentiels à l'intérieur de la zone industrielle.
(2) Concentrations initiales dérivées des mesures de suivi de la qualité de l'air ambiant (voir section 2.5), sauf pour les $PM_{2.5}$ pour lesquelles la valeur par défaut du RAA est considérée, comme spécifié à l'article 202 du RAA.
(3) Concentrations totales : sommation des concentrations maximales pour le terminal et des concentrations initiales.
(4) Avec 99,5e centile inférieur ou égal à 1 050 µg/m³.
(5) Norme canadienne de qualité de l'air ambiant (NCQAA) pour 2025, moyenne triennale du 99^{e} centile annuel des maximums quotidiens des concentrations moyennes sur une heure.
(6) Norme canadienne de qualité de l'air ambiant (NCQAA) pour 2025.
(7) Résultats pour le NO_2 en supposant une conversion totale du NO en NO_2 pour les périodes annuelle et sur 24 heures et une conversion partielle sur une base horaire (méthode OLM).
(8) Ancien standard pancanadien proposé, mais non entériné, moyenne triennale du 98^{e} centile annuel des concentrations quotidiennes moyennes sur 24 heures.
(9) Norme canadienne de qualité de l'air ambiant (NCQAA) pour 2020, moyenne triennale du 98^{e} centile annuel des concentrations quotidiennes moyennes sur 24 heures.
(10) Norme canadienne de qualité de l'air ambiant (NCQAA) pour 2020, moyenne triennale des moyennes annuelles.

Tableau 3.8 Sommaire des concentrations maximales de NO_2 et de particules calculées dans l'air ambiant à certains récepteurs sensibles lors de la construction du terminal

Récepteurs (Numéros sur les cartes)	Contaminants	Périodes	Contributions maximales du terminal (1)		Concentrations initiales (2)		Concentrations totales (3)		Dépassements des normes (Nombres maximums d'événements par année)		Normes
			µg/m³	% norme	µg/m³	% norme	µg/m³	% norme	Sans concentrations initiales	Avec concentrations initiales	µg/m³
1220, Rte Marie-Victorin, Verchères (8)	NO_2 (4)	1 heure	44	11 %	40	10 %	84	20 %	-	-	414
		24 heures	6,4	3,1 %	24	12 %	30	15 %	-	-	207
		Annuelle	0,16	0,16 %	9.4	9 %	10	9,3 %	-	-	103
	PM_T	24 heures	84	70 %	56	47 %	140	117 %		2	120
	PM_{10}	24 heures	44	73 %	38,7	65 %	83	138 %		9	60 (5)
	$PM_{2.5}$	24 heures	8,7	29 %	20	67 %	29	96 %	-	-	30
		Annuelle	0,25	3 %	8,7	99 %	9,0	102 %	-	-	8,8 (6)
1219, Rte Marie-Victorin, Verchères (9)	NO_2 (4)	1 heure	56	14 %	40	10 %	96	40 %	-	-	414
		24 heures	8,7	4,2 %	24	12 %	33	24 %	-	-	207
		Annuelle	0,24	0,23 %	9.4	9 %	10	9,4 %	-	-	103
	PM_T	24 heures	98	82 %	56	47 %	154	128 %	-	4	120
	PM_{10}	24 heures	62	103 %	38,7	65 %	101	168 %	-	10	60 (5)
	$PM_{2.5}$	24 heures	9,5	32 %	20	67 %	30	98 %	-	-	30
		Annuelle	0,28	3,2 %	8,7	99 %	9,0	102 %	-	-	8,8 (6)
986, Montée Lapierre, Contrecoeur (10)	NO_2 (4)	1 heure	38	9,1 %	40	10 %	78	19 %	-	-	414
		24 heures	3,6	1,7 %	24	12 %	28	13 %	-	-	207
		Annuelle	0,11	0,11 %	9,4	9,1 %	9,5	9,2 %	-	-	103
	PM_T	24 heures	51	42,5 %	56	47 %	107	89 %	-	-	120
	PM_{10}	24 heures	25	41,7 %	38,7	65 %	64	106 %	-	1	60 (5)
	$PM_{2.5}$	24 heures	4,0	13 %	20	67 %	24	80 %	-	-	30
		Annuelle	0,25	2,8 %	8,7	99 %	9,0	102 %	-	-	8,8 (6)
2001, Rte Marie-Victorin, Contrecœur (11)	NO_2 (4)	1 heure	101	24 %	40	10 %	141	34 %	-	-	414
		24 heures	5,3	2,6 %	24	12 %	29	14 %	-	-	207
		Annuelle	0,30	0,29 %	9,4	9,1 %	9,7	9,4 %	-	-	103
	PM_T	24 heures	340	283 %	56	47 %	396	330 %	17	45	120
	PM_{10}	24 heures	182	303 %	38,7	65 %	221	368 %	1	28	60 (5)
	$PM_{2.5}$	24 heures	30	100 %	20	67 %	50	167 %	19	57	30
		Annuelle	2,1	24 %	8,7	99 %	10,7	122 %	-	1	8,8 (6)

(1) Concentrations maximales calculées aux récepteurs sur la période de modélisation (2008-2012).
(2) Concentrations initiales dérivées des mesures de suivi de la qualité de l'air ambiant (voir section 2.5), sauf pour les $PM_{2.5}$ pour lesquelles la valeur par défaut du RAA est considérée, comme spécifié à l'article 202 du RAA.
(3) Concentrations totales : sommation des concentrations maximales pour le terminal et des concentrations initiales.
(4) NO_2 en supposant une conversion totale du NO en NO_2 pour les périodes annuelles et sur 24 heures et une conversion partielle sur une base horaire (méthode OLM).
(5) Ancien standard pancanadien proposé, mais non entériné, moyenne triennale du 98^e centile annuel des concentrations quotidiennes moyennes sur 24 heures.
(6) Norme canadienne de qualité de l'air ambiant (NCQAA) pour 2020, moyenne triennale des moyennes annuelles.



Composantes du projet

- Aire du projet - Variante 2
- Courbe de niveau (équidistance de 10 m)

Modélisation atmosphérique

- Domaine de modélisation

Sources de contaminants atmosphériques

- Source ponctuelle
- Source linéaire volumique
- Source de surface
- Source volumique

Récepteurs

- Récepteur sensible
- Résidence

Territoires exclus de la modélisation

- Territoire de l'APM
- Affectation industrielle
- Zone tampon de 300 m du quai

Concentration de NO_2

- Concentration maximale calculée dans l'air ambiant (µg/m³)

Norme du RAA : 414 µg/m³

Notes :
Les concentrations indiquées ne tiennent compte que de la contribution du projet.

Modèle de dispersion : AERMOD version 16216r
Météorologie : Varennes 2008-2012
Conversion du NO en NO_2 avec la méthode OLM.

Numéro	Récepteurs sensibles et résidences
1	C.P.E. Petit à Petit
2	École Mère-Marie-Rose
3	Centre d'hébergement de Contrecœur
4	Résidence L'Autre Jeunesse
5	Maison des Gens Heureux
6	École Ludger-Duvernay
7	Résidence Florentine-Dansereau
8	1220, Rte Marie-Victorin, Verchères
9	1219, Rte Marie-Victorin, Verchères
10	986, Montée Lapierre, Contrecœur
11	2001, Rte Marie-Victorin, Contrecœur

PORT MONTRÉAL — SNC·LAVALIN

ADMINISTRATION PORTUAIRE DE MONTRÉAL
Projet d'agrandissement du terminal de Contrecœur

Figure 3.2
Concentrations maximales horaires (µg/m³) de NO_2 calculées dans l'air ambiant lors de la construction

Sources :
MRC Marguerite-D'Youville
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
CanVec, 1/50 000, RNCan, 2017
Composantes du projet, APM, février 2017

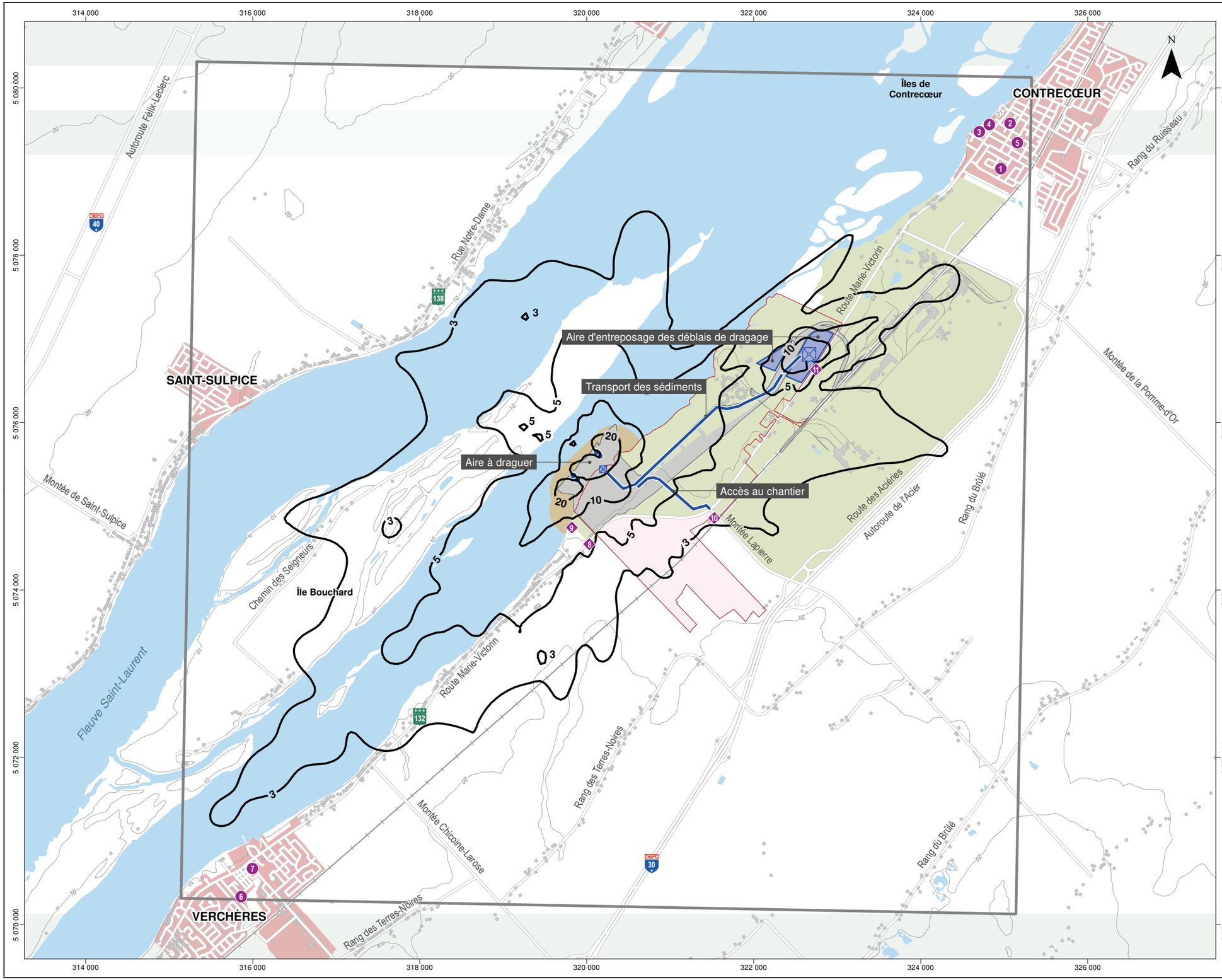
Projet: 643872

0 450 900 m
1/45 000
Projection MTM, fuseau 8, NAD83

Rév.	aaaa/mm/jj	Description	Préparé	Vérifié
01	2017/07/07	Finale	A. Chouinard	É. Delisle
00	2017/05/31	Préliminaire	A. Chouinard	É. Delisle

Format 11x17

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Composantes du projet

- Aire du projet - Variante 2
- Courbe de niveau (équidistance de 10 m)

Modélisation atmosphérique

- Domaine de modélisation

Sources de contaminants atmosphériques

- Source ponctuelle
- Source linéaire volumique
- Source de surface
- Source volumique

Récepteurs

- Récepteur sensible
- Résidence

Territoires exclus de la modélisation

- Territoire de l'APM
- Affectation industrielle
- Zone tampon de 300 m du quai

Concentration de NO_2

- Concentration maximale calculée dans l'air ambiant (µg/m³)

Norme du RAA : 207 µg/m³

Notes :
Les concentrations indiquées ne tiennent compte que de la contribution du projet.

Modèle de dispersion : AERMOD version 16216r
Météorologie : Varennes 2008-2012
Conversion totale du NO en NO_2.

Numéro	Récepteurs sensibles et résidences
1	C.P.E. Petit à Petit
2	École Mère-Marie-Rose
3	Centre d'hébergement de Contrecœur
4	Résidence L'Autre Jeunesse
5	Maison des Gens Heureux
6	École Ludger-Duvernay
7	Résidence Florentine-Dansereau
8	1220, Rte Marie-Victorin, Verchères
9	1219, Rte Marie-Victorin, Verchères
10	986, Montée Lapierre, Contrecœur
11	2001, Rte Marie-Victorin, Contrecœur

PORT MONTRÉAL

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ADMINISTRATION PORTUAIRE DE MONTRÉAL
Projet d'agrandissement du terminal de Contrecœur

Figure 3.3
Concentrations maximales journalières (µg/m³) de NO_2 calculées dans l'air ambiant lors de la construction

Sources :
MRC Marguerite-D'Youville
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
CanVec, 1/50 000, RNCan, 2017
Composantes du projet, APM, février 2017

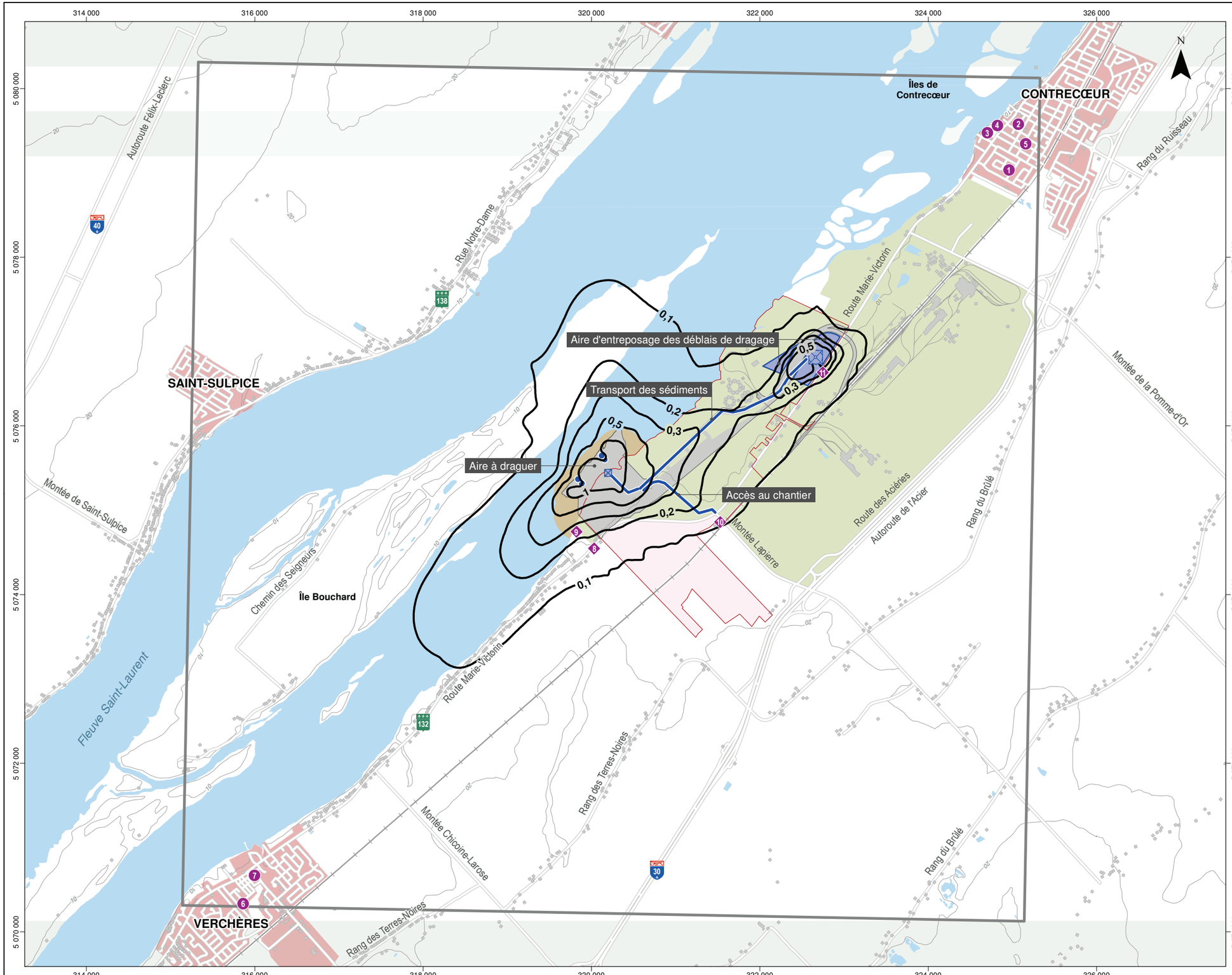
Projet: 643872

0 450 900 m
1/45 000
Projection MTM, fuseau 8, NAD83

Rév.	aaaa/mm/jj	Description	Préparé	Vérifié
01	2017/07/07	Finale	A. Chouinard	É. Delisle
00	2017/05/31	Préliminaire	A. Chouinard	É. Delisle

Format 11x17

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Composantes du projet

- Aire du projet - Variante 2
- Courbe de niveau (équidistance de 10 m)

Modélisation atmosphérique

- Domaine de modélisation

Sources de contaminants atmosphériques

- Source ponctuelle
- Source linéaire volumique
- Source de surface
- Source volumique

Récepteurs

- Récepteur sensible
- Résidence

Territoires exclus de la modélisation

- Territoire de l'APM
- Affectation industrielle
- Zone tampon de 300 m du quai

Concentration de NO_2

- Concentration maximale calculée dans l'air ambiant (µg/m³)

Norme du RAA : 103 µg/m³

Notes :
Les concentrations indiquées ne tiennent compte que de la contribution du projet.

Modèle de dispersion : AERMOD version 16216r
Météorologie : Varennes 2008-2012
Conversion totale du NO en NO_2.

Numéro	Récepteurs sensibles et résidences
1	C.P.E. Petit à Petit
2	École Mère-Marie-Rose
3	Centre d'hébergement de Contrecœur
4	Résidence L'Autre Jeunesse
5	Maison des Gens Heureux
6	École Ludger-Duvernay
7	Résidence Florentine-Dansereau
8	1220, Rte Marie-Victorin, Verchères
9	1219, Rte Marie-Victorin, Verchères
10	986, Montée Lapierre, Contrecœur
11	2001, Rte Marie-Victorin, Contrecœur

PORT MONTRÉAL

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ADMINISTRATION PORTUAIRE DE MONTRÉAL
Projet d'agrandissement du terminal de Contrecœur

Figure 3.4
Concentrations maximales annuelles (µg/m³) de NO_2 calculées dans l'air ambiant lors de la construction

Sources :
MRC Marguerite-D'Youville
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
CanVec, 1/50 000, RNCan, 2017
Composantes du projet, APM, février 2017

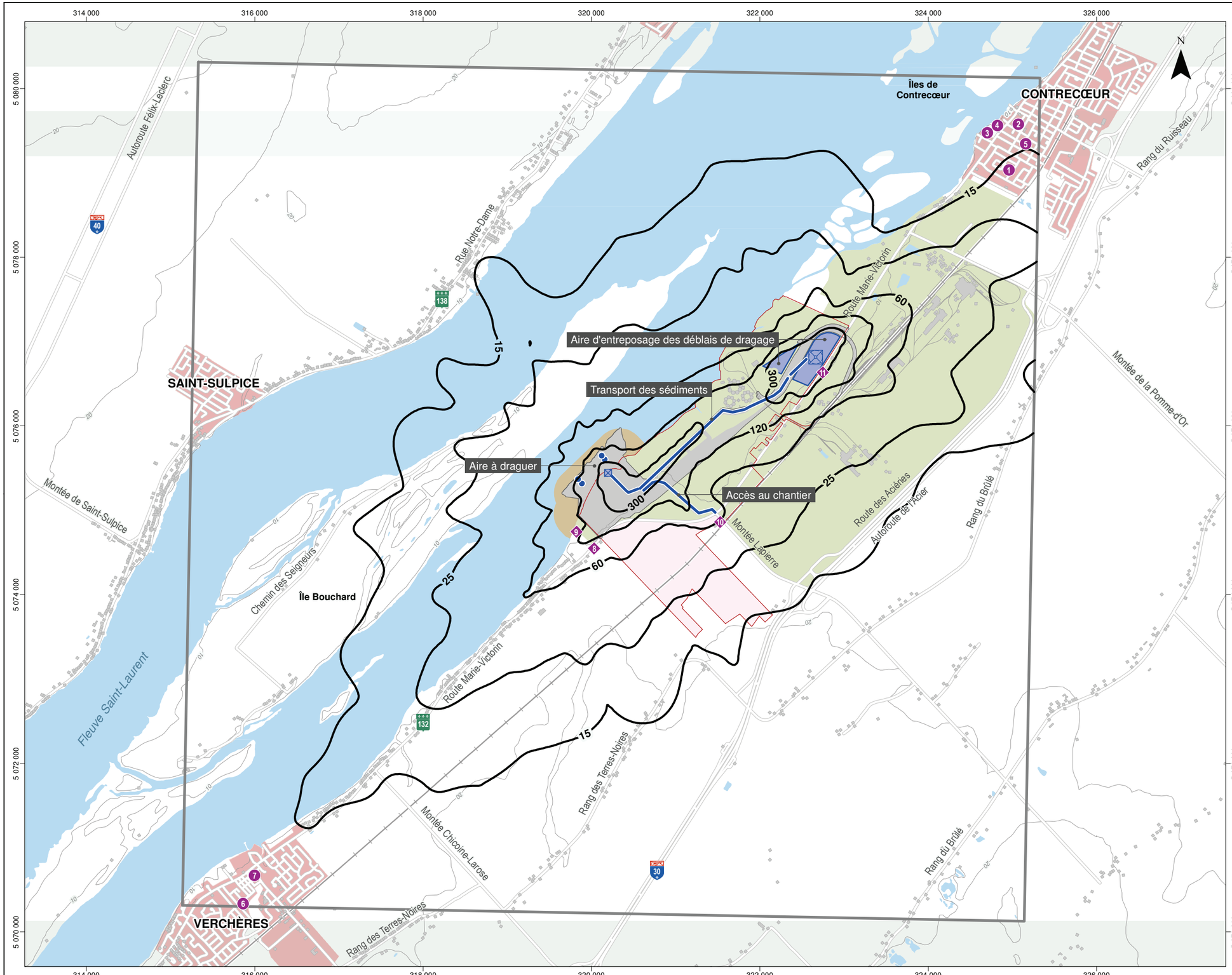
Projet: 643872

0 450 900 m
1/45 000
Projection MTM, fuseau 8, NAD83

Rév.	aaaa/mm/jj	Description	Préparé	Vérifié
01	2017/07/07	Finale	A. Chouinard	É. Delisle
00	2017/05/31	Préliminaire	A. Chouinard	É. Delisle

Format 11x17

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Composantes du projet

- Aire du projet - Variante 2
- Courbe de niveau (équidistance de 10 m)

Modélisation atmosphérique

- Domaine de modélisation

Sources de contaminants atmosphériques

- Source ponctuelle
- Source linéaire volumique
- Source de surface
- Source volumique

Récepteurs

- Récepteur sensible
- Résidence

Territoires exclus de la modélisation

- Territoire de l'APM
- Affectation industrielle
- Zone tampon de 300 m du quai

Concentration de PM_T

- Concentration maximale calculée dans l'air ambiant (µg/m³)

Norme du RAA : 120 µg/m³

Notes :
Les concentrations indiquées ne tiennent compte que de la contribution du projet.

Modèle de dispersion : AERMOD version 16216r
Météorologie : Varennes 2008-2012

Numéro	Récepteurs sensibles et résidences
1	C.P.E. Petit à Petit
2	École Mère-Marie-Rose
3	Centre d'hébergement de Contrecœur
4	Résidence L'Autre Jeunesse
5	Maison des Gens Heureux
6	École Ludger-Duvernay
7	Résidence Florentine-Dansereau
8	1220, Rte Marie-Victorin, Verchères
9	1219, Rte Marie-Victorin, Verchères
10	986, Montée Lapierre, Contrecœur
11	2001, Rte Marie-Victorin, Contrecœur

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ADMINISTRATION PORTUAIRE DE MONTRÉAL
Projet d'agrandissement du terminal de Contrecœur

Figure 3.5
Concentrations maximales journalières (µg/m³) de particules totales (PM_T) calculées dans l'air ambiant lors de la construction

Sources :
MRC Marguerite-D'Youville
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
CanVec, 1/50 000, RNCan, 2017
Composantes du projet, APM, février 2017

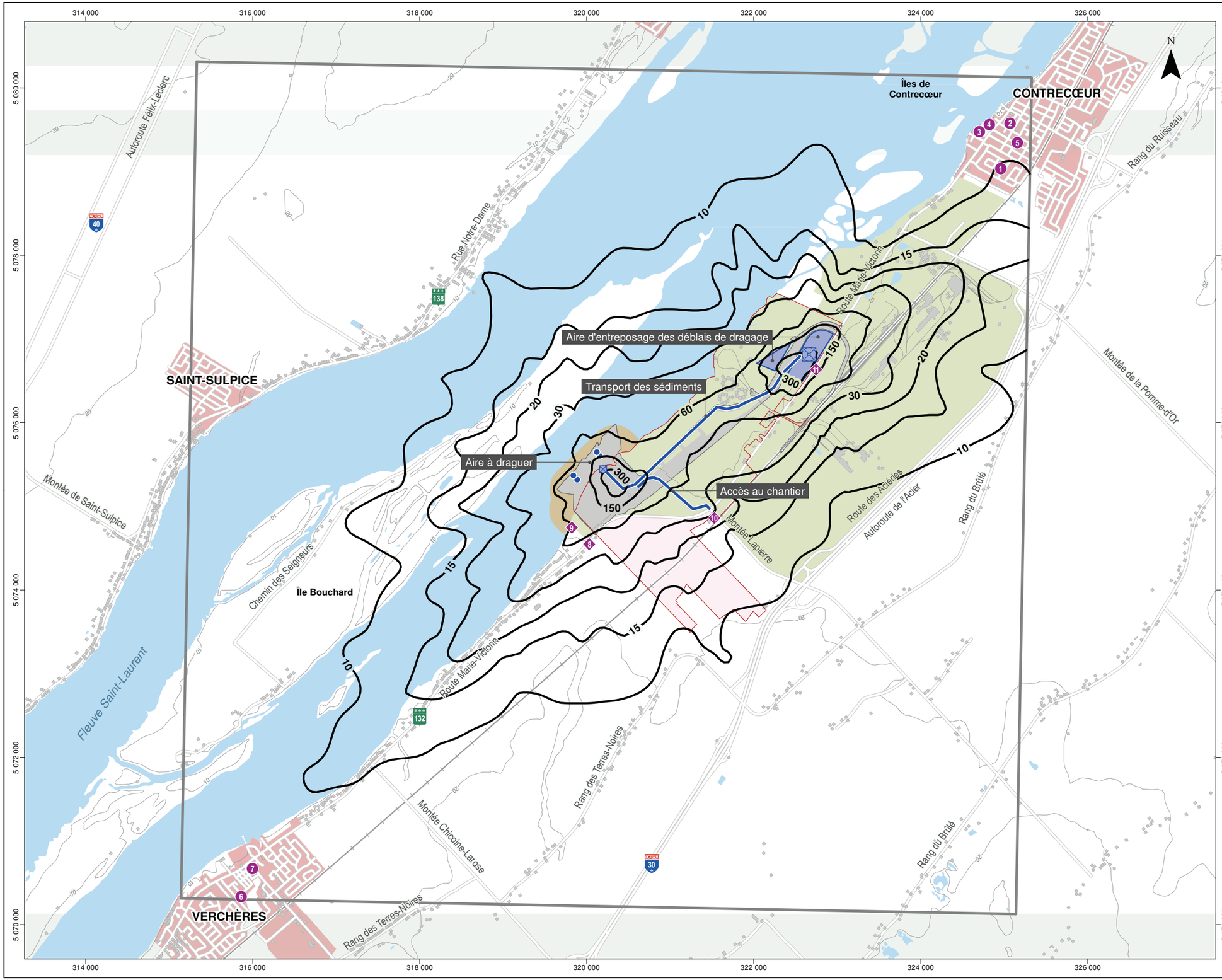
Projet: 643872

0 450 900 m
1/45 000
Projection MTM, fuseau 8, NAD83

Rév.	aaaa/mm/jj	Description	Préparé	Vérifié
01	2017/07/07	Finale	A. Chouinard	É. Delisle
00	2017/05/31	Préliminaire	A. Chouinard	É. Delisle

Format 11x17

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Composantes du projet

- Aire du projet - Variante 2
- Courbe de niveau (équidistance de 10 m)

Modélisation atmosphérique

- Domaine de modélisation

Sources de contaminants atmosphériques

- Source ponctuelle
- Source linéaire volumique
- Source de surface
- Source volumique

Récepteurs

- Récepteur sensible
- Résidence

Territoires exclus de la modélisation

- Territoire de l'APM
- Affectation industrielle
- Zone tampon de 300 m du quai

Concentration de PM_{10}

- Concentration maximale calculée dans l'air ambiant (µg/m³)

Norme canadienne (non entérinée): 60 µg/m³

Notes :
Les concentrations indiquées ne tiennent compte que de la contribution du projet.
Modèle de dispersion : AERMOD version 16216r
Météorologie : Varennes 2008-2012

Numéro	Récepteurs sensibles et résidences
1	C.P.E. Petit à Petit
2	École Mère-Marie-Rose
3	Centre d'hébergement de Contrecœur
4	Résidence L'Autre Jeunesse
5	Maison des Gens Heureux
6	École Ludger-Duvernay
7	Résidence Florentine-Dansereau
8	1220, Rte Marie-Victorin, Verchères
9	1219, Rte Marie-Victorin, Verchères
10	986, Montée Lapierre, Contrecœur
11	2001, Rte Marie-Victorin, Contrecœur

PORT MONTRÉAL — SNC·LAVALIN

ADMINISTRATION PORTUAIRE DE MONTRÉAL
Projet d'agrandissement du terminal de Contrecœur

Figure 3.6
Concentrations maximales journalières (µg/m³) de particules fines (PM_{10}) calculées dans l'air ambiant lors de la construction

Sources :
MRC Marguerite-D'Youville
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
CanVec, 1/50 000, RNCan, 2017
Composantes du projet, APM, février 2017

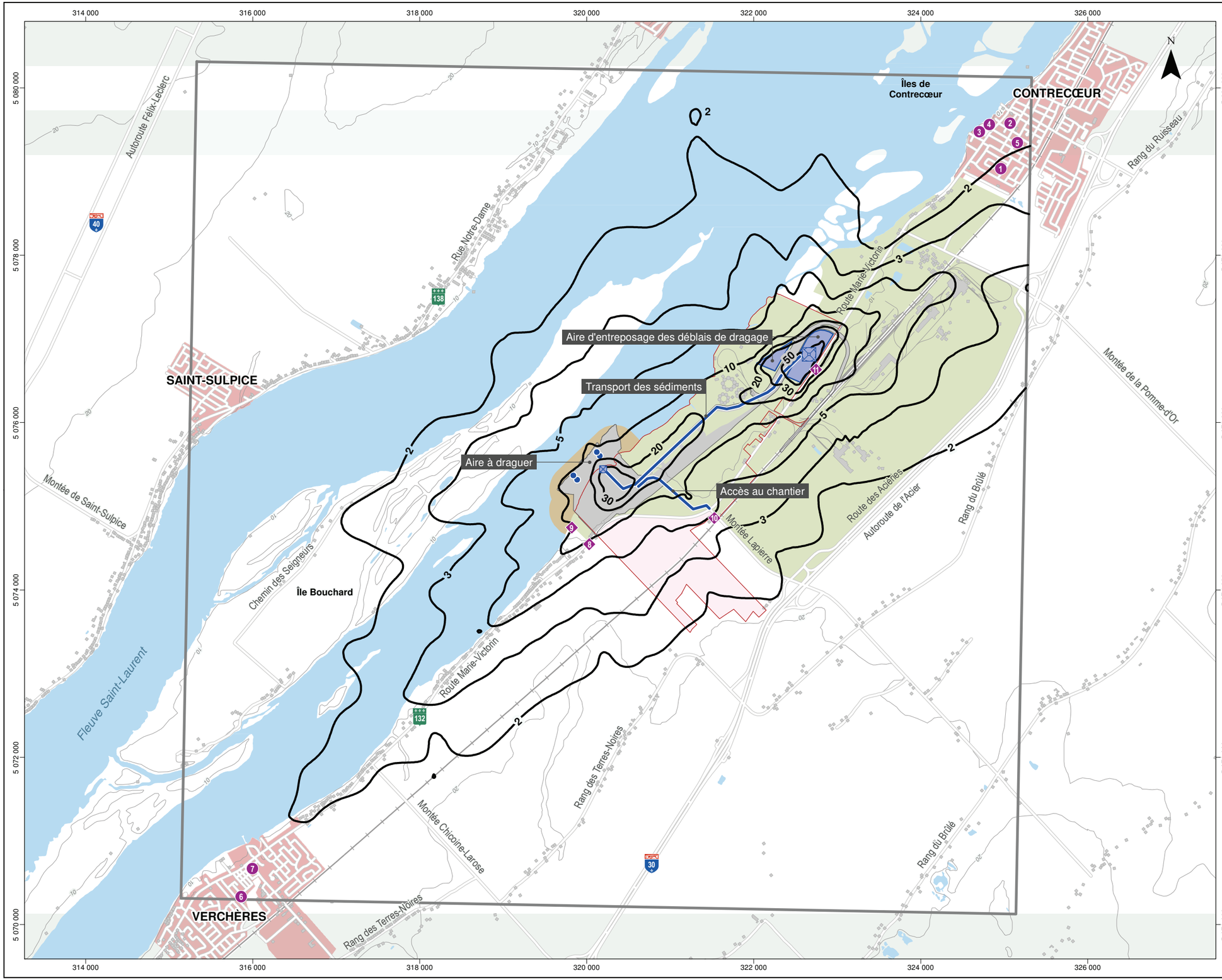
Projet: 643872

0 450 900 m
1/45 000
Projection MTM, fuseau 8, NAD83

Rév.	aaaa/mm/jj	Description	Préparé	Vérifié
01	2017/07/07	Finale	A. Chouinard	É. Delisle
00	2017/05/31	Préliminaire	A. Chouinard	É. Delisle

Format 11x17

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Composantes du projet

- Aire du projet - Variante 2
- Courbe de niveau (équidistance de 10 m)

Modélisation atmosphérique

- Domaine de modélisation

Sources de contaminants atmosphériques

- Source ponctuelle
- Source linéaire volumique
- Source de surface
- Source volumique

Récepteurs

- Récepteur sensible
- Résidence

Territoires exclus de la modélisation

- Territoire de l'APM
- Affectation industrielle
- Zone tampon de 300 m du quai

Concentration de $PM_{2.5}$

- Concentration maximale calculée dans l'air ambiant (µg/m³)

Norme du RAA : 30 µg/m³

Notes :
Les concentrations indiquées ne tiennent compte que de la contribution du projet.

Modèle de dispersion : AERMOD version 16216r
Météorologie : Varennes 2008-2012

Numéro	Récepteurs sensibles et résidences
1	C.P.E. Petit à Petit
2	École Mère-Marie-Rose
3	Centre d'hébergement de Contrecœur
4	Résidence L'Autre Jeunesse
5	Maison des Gens Heureux
6	École Ludger-Duvernay
7	Résidence Florentine-Dansereau
8	1220, Rte Marie-Victorin, Verchères
9	1219, Rte Marie-Victorin, Verchères
10	986, Montée Lapierre, Contrecœur
11	2001, Rte Marie-Victorin, Contrecœur

PORT MONTRÉAL — SNC·LAVALIN

ADMINISTRATION PORTUAIRE DE MONTRÉAL
Projet d'agrandissement du terminal de Contrecœur

Figure 3.7

Concentrations maximales journalières (µg/m³) de particules fines ($PM_{2.5}$) calculées dans l'air ambiant lors de la construction

Sources :
MRC Marguerite-D'Youville
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
CanVec, 1/50 000, RNCan, 2017
Composantes du projet, APM, février 2017

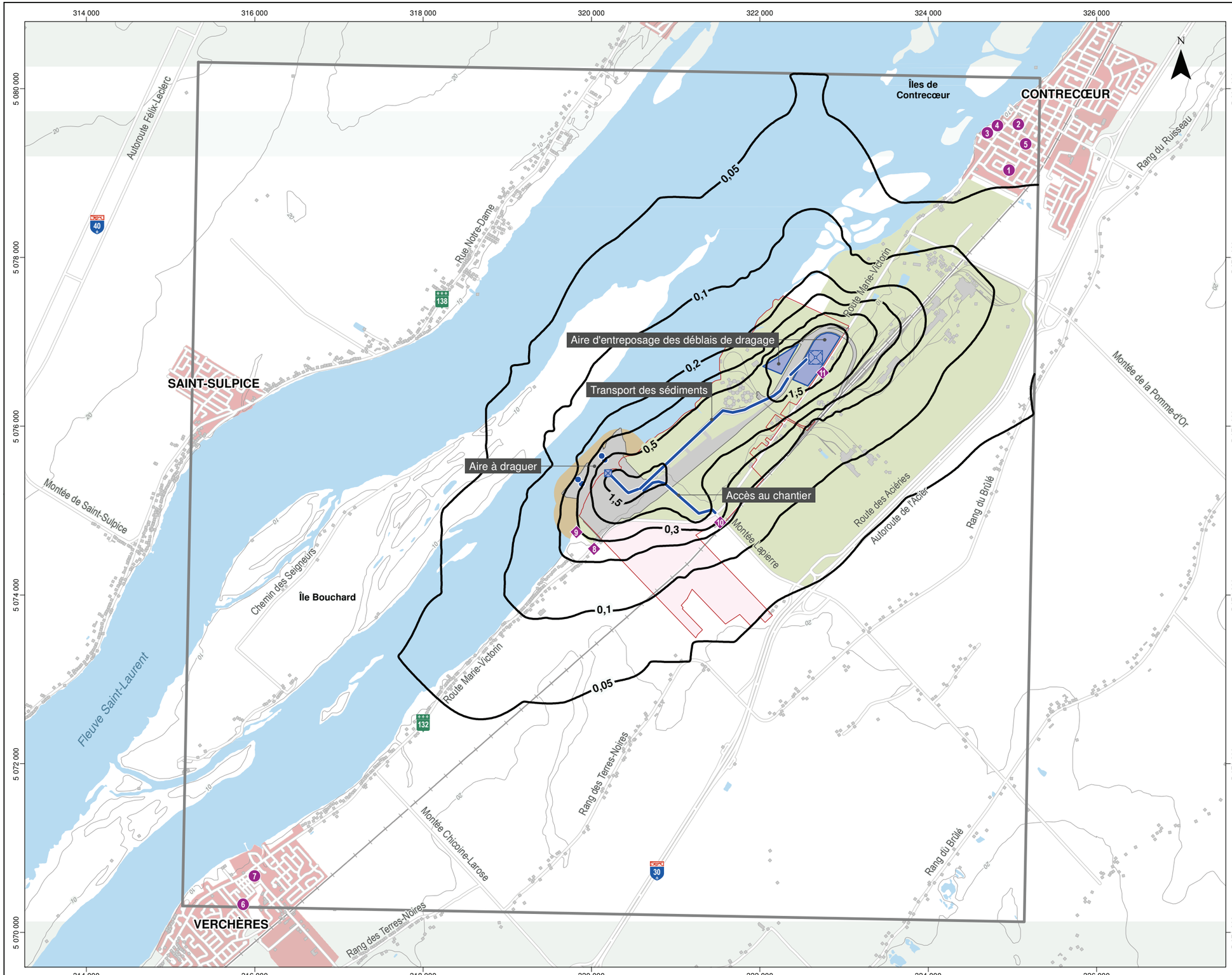
Projet: 643872

0 450 900 m
1/45 000
Projection MTM, fuseau 8, NAD83

Rév.	aaaa/mm/jj	Description	Préparé	Vérifié
01	2017/07/07	Finale	A. Chouinard	É. Delisle
00	2017/05/31	Préliminaire	A. Chouinard	É. Delisle

Format 11x17

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Composantes du projet

- Aire du projet - Variante 2
- Courbe de niveau (équidistance de 10 m)

Modélisation atmosphérique

- Domaine de modélisation

Sources de contaminants atmosphériques

- Source ponctuelle
- Source linéaire volumique
- Source de surface
- Source volumique

Récepteurs

- Récepteur sensible
- Résidence

Territoires exclus de la modélisation

- Territoire de l'APM
- Affectation industrielle
- Zone tampon de 300 m du quai

Concentration de $PM_{2.5}$

- Concentration maximale calculée dans l'air ambiant (µg/m³)

Norme canadienne (2020) : 8,8 µg/m³

Notes :
Les concentrations indiquées ne tiennent compte que de la contribution du projet.

Modèle de dispersion : AERMOD version 16216r
Météorologie : Varennes 2008-2012

Numéro	Récepteurs sensibles et résidences
1	C.P.E. Petit à Petit
2	École Mère-Marie-Rose
3	Centre d'hébergement de Contrecœur
4	Résidence L'Autre Jeunesse
5	Maison des Gens Heureux
6	École Ludger-Duvernay
7	Résidence Florentine-Dansereau
8	1220, Rte Marie-Victorin, Verchères
9	1219, Rte Marie-Victorin, Verchères
10	986, Montée Lapierre, Contrecœur
11	2001, Rte Marie-Victorin, Contrecœur

PORT MONTRÉAL — SNC·LAVALIN

ADMINISTRATION PORTUAIRE DE MONTRÉAL
Projet d'agrandissement du terminal de Contrecœur

Figure 3.8

Concentrations maximales annuelles (µg/m³) de particules fines ($PM_{2.5}$) calculées dans l'air ambiant lors de la construction

Sources :
MRC Marguerite-D'Youville
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
CanVec, 1/50 000, RNCan, 2017
Composantes du projet, APM, février 2017

Projet: 643872

0 450 900 m
1/45 000
Projection MTM, fuseau 8, NAD83

Rév.	aaaa/mm/jj	Description	Préparé	Vérifié
01	2017/07/07	Finale	A. Chouinard	É. Delisle
00	2017/05/31	Préliminaire	A. Chouinard	É. Delisle

Format 11x17

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4 Période d'exploitation

4.1 Émissions atmosphériques lors de l'exploitation

Les émissions atmosphériques liées aux activités de l'exploitation du projet de terminal à conteneurs à Contrecœur ont été estimées selon des méthodes reconnues (facteurs d'émission AP-42 de *l'Environmental Protection Agency* des États-Unis (US-EPA), Environnement Canada, MDDELCC) et les caractéristiques du projet.

Les sources d'émissions atmosphériques du terminal sont presque exclusivement liées au transport et à la manutention des conteneurs et sont de deux types :

- la combustion de carburants fossiles par les moteurs des camions et des véhicules de manutention des conteneurs, par les génératrices des locomotives, par les mini-génératrices des conteneurs réfrigérés sur wagon ou camion et par les moteurs, les génératrices et les chaudières des navires;
- les activités de transport sur route générant des émissions fugitives de matières particulaires par mise en suspension de matériel présent sur les surfaces pavées : passages des camions sur la route d'accès et déplacements des véhicules de manutention des conteneurs sur le terminal (entre le quai et la cour et entre la cour et la gare de triage).

4.1.1 Estimation des émissions liées à la combustion

L'estimation des émissions annuelles des PCA et de composés toxiques (certains COV, métaux et HAP spécifiques) liées à la combustion de carburants fossiles pour l'exploitation a été réalisée dans le cadre d'un mandat spécifique (SNC-Lavalin, 2017). Cet inventaire exhaustif comprend l'ensemble des émissions liées à la réception, la manutention et l'expédition par train ou par camion sur le site, de même que les émissions liées aux navires porte-conteneurs et remorqueurs dans la zone de contrôle maritime du terminal. Cet inventaire considère que 50 % des véhicules de manutention des conteneurs sur le site sont électriques, que 25 % des navires à quai sont raccordés électriquement au terminal. De plus, 50 % des navires pourraient éventuellement être de type hybride au gaz naturel liquéfié (GNL) et au carburant diesel. Toutefois, afin d'être plus conservateur, les émissions de ces navires hybrides ont été estimées en considérant l'utilisation de carburant diesel rencontrant les normes d'émission TIER 2 de l'Organisation maritime internationale (OMI) dans l'inventaire. Les grues de manutention des conteneurs sont exclusivement munies de moteurs électriques ne générant pas d'émissions atmosphériques.

4.1.2 Estimation des émissions fugitives de matières particulaires (poussières)

Les émissions des poussières liées au passage des camions sur la route d'accès et aux déplacements de conteneurs entre le quai et la cour et entre la cour et la gare de triage ont été estimées selon les équations de l'AP-42 (section 13.2.1 *Paved Roads*) de l'US-EPA.

Les facteurs d'émission (g/km parcouru) de PM_T, de PM_{10} et de $PM_{2.5}$ tiennent compte de la masse moyenne des véhicules sur chaque segment de route et des teneurs en silt (matériel inférieur à 75 µm de diamètre libre à la surface de roulement) présumées et dérivées des valeurs par défaut suggérées par l'US-EPA. Pour tenir compte de l'utilisation de fondants ou d'abrasifs durant la saison hivernale (décembre à mars), les teneurs en silt considérées sont le double des valeurs estivales.

Les émissions pour chaque type d'activité de transport en surface sont alors obtenues en multipliant les facteurs d'émission par les kilomètres parcourus sur chaque route pour une journée d'exploitation typique. Les calculs détaillés sont présentés à l'annexe B.

4.1.3 Bilan des émissions atmosphériques

Les résultats de l'inventaire des émissions des PCA liées à la combustion sont présentés au tableau 4.1 et le sommaire annuel des émissions fugitives de matières particulaires est présenté au tableau 4.2. Le tableau 4.3 présente le bilan total annuel des émissions des PCA lors de l'exploitation du terminal.

Les navires représentent la plus importante source de contaminants atmosphériques avec 97 % des émissions de SO_2, 80 % des émissions de NOx et plus de la moitié des émissions de CO et de matières particulaires liées à la combustion. Comparativement aux émissions de matières particulaires liées à la combustion, les émissions fugitives représentent environ 80 % des émissions totales de PM_T et 30 % des émissions de $PM_{2.5}$.

4.2 Scénarios de modélisation et paramètres d'émission

Le terminal sera exploité sur une base continuelle (7 jours par semaine, 24 heures par jour), mais le secteur maritime n'est exploité que lorsqu'un navire est présent et le secteur de réception et d'expédition des conteneurs par camions ne sera exploité que du lundi au vendredi durant le jour principalement. La localisation et la représentation des sources considérées dans la modélisation pour l'exploitation sont présentées à la figure 4.1 en fin de chapitre.

Deux scénarios de modélisation, différentiés uniquement par les taux d'émission de contaminants, ont été considérés : un scénario journalier pour estimer les concentrations moyennes à court terme (24 heures et moins) et un scénario annuel. Dans le cas des émissions des navires, pour les deux scénarios, seules les émissions à quai ont été considérées pour trois raisons :

- Les émissions estimées et présentées au tableau 4.3 pour les navires en mouvement surviennent entre le terminal et 14 milles nautiques (26 km) en aval et ne sont pas des sources fixes, ce qui procure une dilution importante de ces émissions pour un récepteur fixe donné. De plus, la majorité de ces émissions surviennent hors de la zone d'étude.
- Les émissions des navires à quai sont fixes et ainsi plus susceptibles d'avoir des impacts importants sur la qualité de l'air de la zone d'étude.
- Les émissions d'un même navire en mouvement et à quai ne surviennent pas simultanément.

Le scénario de modélisation pour estimer les concentrations dans l'air ambiant à court terme (24 heures et moins) est basé sur une journée typique de semaine incluant l'accès des camions de conteneurs hors site (2 430 EVP/j ou 2 430 passages de camions entre 6 :00 et 18 :00[1]), la gare de triage (1 420 EVP/jour en continu[2]), le déchargement et/ou le chargement d'un navire (3 700 EVP/jour en continu[3]) et la présence en continu de deux navires à quai utilisant leurs génératrices et chaudières, tout en supposant que les génératrices des navires sont de type

1 Selon les statistiques aux autres terminaux de l'APM, chaque passage de camion correspond en moyenne à un EVP, i.e. incluant les passages à vide et les conteneurs de 40 pieds (2 EVP/conteneur).
2 Idem. Pour le transport intra-terminal, chaque mouvement de conteneur correspond en moyenne à 1,8 EVP.
3 Idem. Pour le transport intra-terminal, chaque mouvement de conteneur correspond en moyenne à 1,8 EVP.

TIER 2 (selon les normes de l'Organisation maritime internationale (OMI)) alimentées au carburant diesel. Cette journée type de semaine est considérée sur l'ensemble de la période de 5 années de simulation, sans tenir compte de la baisse d'activité durant la fin de semaine.

Le scénario de modélisation pour estimer les concentrations moyennes annuelles dans l'air ambiant est basé sur l'inventaire des émissions annuelles (tableau 4.3), c'est-à-dire en utilisant les taux d'émission moyens annuels de l'ensemble des sources et en considérant le branchement électrique de 25 % des navires.

Tableau 4.1 Bilan annuel des émissions des PCA liées à la combustion lors de l'exploitation du terminal (tonnes/année)

Sources	NOx	SO_2	CO	NH_3	COV	PM_T	PM_{10}	$PM_{2.5}$
Camions sur la route d'accès	7,1	0,078	2,9	0,16	0,77	1,7	1,7	0,38
Véhicules - secteur terrestre	1,3	0,022	0,68	0,046	0,58	0,056	0,056	0,05
Véhicules - secteur maritime	2,1	0,038	0,96	0,066	1,0	0,084	0,084	0,081
Trains (locomotives)	21	0,018	3,1	0,21	1,1	0,62	0,62	0,61
Navires à quai (génératrices et chaudières)	60	4,5	6,8	0,0069	2,6	1,9	1,9	1,8
Navires et remorqueurs en mouvement	77	2,1	9,0	0,12	3,6	1,3	1,3	1,2
Total	**168**	**6,7**	**23**	**0,60**	**9,6**	**5,7**	**5,7**	**4,0**

Dans ce tableau, les émissions des mini-génératrices des conteneurs réfrigérées ont été attribuées aux camions (55 %) et aux trains (45 %).

Tableau 4.2 Bilan annuel des émissions atmosphériques fugitives de matières particulaires liées au transport sur le site lors de l'exploitation du terminal (tonnes/année)

Sources	PM_T	PM_{10}	$PM_{2.5}$
Camions sur la route d'accès	20	3,8	0,93
Véhicules - secteur terrestre	7,1	1,4	0,33
Véhicules - secteur maritime	6,8	1,3	0,32
Total	**34**	**6,5**	**1,6**

Tableau 4.3 Bilan annuel des émissions des PCA lors de l'exploitation du terminal (tonnes/année)

Sources	NOx	SO_2	CO	NH_3	COV	PM_T	PM_{10}	$PM_{2.5}$
Camions sur la route d'accès	7,1	0,078	2,9	0,16	0,77	22	5,6	1,3
Véhicules - secteur terrestre	1,3	0,022	0,7	0,046	0,58	7,1	1,4	0,38
Véhicules - secteur maritime	2,1	0,038	0,96	0,066	1,0	6,9	1,4	0,40
Trains (locomotives)	21	0,018	3,1	0,21	1,1	0,62	0,62	0,61
Navires à quai (génératrices et chaudières)	60	4,5	6,8	0,0069	2,6	1,9	1,9	1,8
Navires et remorqueurs en mouvement	77	2,1	9,0	0,12	3,6	1,3	1,3	1,2
Total	**168**	**6,7**	**23**	**0,60**	**9,6**	**40**	**12,2**	**5,6**

4.2.1 Sources linéaires volumiques représentant le transport terrestre des conteneurs

Les sources d'émissions atmosphériques liées au transport terrestre des conteneurs sur le site sont représentées par des sources linéaires composées de plusieurs sources volumiques carrées dans le modèle de dispersion. Quatre de ces sources ont été définies pour le transport par camion sur le chemin d'accès, par les camions de cours dans la zone terrestre du terminal (entre la cour et la gare de triage), par les charriots dans la zone maritime du terminal (entre le quai et la cour de conteneurs) et finalement pour les émissions des locomotives. Pour ces sources, à l'exception du déplacement des trains, la déposition sèche des émissions fugitives de matières particulaires a été modélisée en utilisant les paramètres présentés au tableau 4.4. Les autres caractéristiques de ces sources sont présentées au tableau 4.5 et leurs localisations à la figure 4.1 en fin de chapitre. La source linéaire représentant les émissions des locomotives des trains entrant et sortant et celles de la gare de triage a été localisée à l'est des aiguillages de la gare de triage. La longueur de cette source correspond approximativement à la longueur des sections de trains sur les voies de réception, d'expédition et de chargement de la gare de triage.

4.2.2 Sources ponctuelles représentant les cheminées des navires à quai

À pleine capacité, le terminal recevrait en moyenne trois navires porte-conteneurs par semaine pour une durée d'escale moyenne de 48 heures. Lors de l'escale, les besoins en électricité des navires peuvent être comblés par un branchement électrique au terminal ou par l'utilisation des génératrices à bord du navire.

Dans une approche de pire cas dans la modélisation sur une base journalière, deux navires autonomes pour la production d'électricité utilisant du carburant diesel pour leurs génératrices (TIER 2 de la norme de l'OMI, 213,4 kg/h) et leurs chaudières (137,4 kg/h) ont été considérés.

Une source ponctuelle a été utilisée pour représenter la cheminée de chaque navire à quai dont les génératrices et la chaudière sont en exploitation durant toute la durée de l'escale. Les paramètres et les taux d'émission de contaminants de la cheminée des navires sont présentés au tableau 4.6. Pour estimer le débit de gaz de combustion, une combustion à 150 % d'air en excès a été considérée pour les génératrices et à 15 % d'air en excès pour les chaudières.

Tableau 4.4 Paramètres pour la déposition sèche des particules pour les sources fugitives (routes pavées)

Classes de particules (µm)	< 2,5	2,5 -10	10-15	15-30
Diamètres moyens (µm)	1,25	6,25	12,5	22,5
Fractions massiques (%)	4,6%	14,6%	4,6%	76,2%
Masse volumique des particules (g/cm^3)	2,0			

Tableau 4.5 Paramètres des sources linéaires volumiques représentant le transport terrestre de conteneurs

Paramètres	Route d'accès	Zone terrestre	Zone maritime	Locomotives
Longueur (m)	3 816	2 300	582	1 400
Nombre de sources alternées	92	56	13	77
Élévation (m)	8 à 10,8	9 à 11	9,5	9 à 10
Largeur des segments (m) (1)	21	21	25	9,0
Hauteur d'émission (m) (1)	3,48	3,48	3,48	3,89
Sigma-Y (1)	19,4	19,21	21,59	8,32
Sigma-Z (1)	3,24	3,24	3,24	3,62
Horaire journalier	6 - 18 h	24 / 24	24 / 24	24 / 24
Facteur de pondération annuel pour le scénario annuel (3)	0,71 (5 jours/semaine)	1,0	0,85 (310 jours/an)	1,0
Scénario journalier Taux d'émission moyens horaires (g/s) - Total sur l'ensemble des sources volumiques				
NO_X	0,632 (4)	0,040	0,079	0,658
SO_2	0,00698	0,000694	0,00140	0,000581
CO	0,259	0,0215	0,0357	0,0992
NH_3	0,0140	0,00146	0,00246	0,00673
PM_T (combustion)	0,153	0,00179	0,00312	0,0198
PM_{10} (combustion)	0,153	0,00179	0,00312	0,0198
$PM_{2.5}$ (combustion)	0,0337	0,00174	0,00303	0,0192
PM_T (fugitives) (2)	1,38	0,174	0,196	Négligeable
PM_{10} (fugitives) (2)	0,257	0,0333	0,0377	Négligeable
$PM_{2.5}$ (fugitives) (2)	0,0621	0,00806	0,0091	Négligeable
COV, métaux, HAP				
Éthylbenzène	1,44E-04	5,59E-05	1,15E-04	1,10E-04
Styrène	1,34E-04	1,07E-05	2,20E-05	2,10E-05
Toluène	2,93E-04	2,72E-04	5,55E-04	5,29E-04
Hexane	3,52E-04	2,87E-05	5,90E-05	5,63E-05
Xylène	3,65E-04	1,91E-04	3,92E-04	3,74E-04
Octane	4,56E-05	1,30E-05	2,67E-05	2,54E-05
Acétaldéhyde	3,61E-03	9,72E-04	1,97E-03	8,55E-04
Acroléine	1,98E-04	5,78E-05	1,12E-04	1,18E-04
Benzène	1,32E-04	4,13E-04	7,54E-04	9,90E-05
Formaldéhyde	4,01E-03	2,45E-03	4,38E-03	2,03E-03
Chrome trivalent	7,44E-07	3,92E-08	8,02E-08	3,33E-08
Chrome hexavalent	1,65E-07	2,02E-08	4,14E-08	1,72E-08
Mercure	1,00E-08	2,45E-08	4,55E-08	1,89E-08
Plomb	3,25E-05	3,19E-07	6,63E-07	4,20E-06
Manganèse	8,65E-07	2,72E-06	5,56E-06	2,31E-06
Nickel	2,26E-06	4,04E-06	8,25E-06	3,43E-06
Arsenic	1,74E-06	5,90E-08	1,21E-07	7,70E-07
Pyrène	7,95E-06	6,28E-09	9,05E-09	3,21E-06
Naphtalène	2,03E-04	7,37E-07	1,44E-06	1,06E-04
Benzo(a)pyrène	1,91E-06	6,47E-10	1,09E-09	1,42E-07
HAP (BaP_{ET})	3,17E-06	2,64E-09	4,87E-09	4,10E-07

(1) Propriétés de chacune des sources du segment
Hauteur véhicule (m) : H_v
Distance centre au centre (m) :D
Hauteur du panache (m) : $H_p=1,7*H_v$
Largeur des segments : largeur de la route + 6 mètres
Hauteur d'émission (m) : $H_p/2$, Sigma-Y (m) : $S_Y=D/2,15$; Sigma-Z (m) : $S_Z=H_p/2,15$

(2) Les taux d'émission sont indiqués sont ceux d'avril à novembre. De décembre à mars, multiplier par 1,88. Les paramètres pour la déposition sèche sont présentés au tableau 4.4.

(3) Pour le scénario de modélisation annuelle, les taux d'émission du tableau sont multipliés par ce facteur.

(4) Exemple de calcul à partir des émissions annuelles de 7,1 tonnes par année (tableau 4.3) :
Nombre d'heures par année : 5 jours/semaine x 52 semaines /an x 12 h/jour = 3 120 heures /an
7,1 t/an x 10^6 g/t * 1 an / 3 120 heures * 1 h / 3 600 s = 0,632 g/s

Tableau 4.6 Paramètres des sources ponctuelles représentant la cheminée des navires à quai

Paramètres	Valeurs	
Température des gaz à la cheminée (°C)	130	
Vitesse de gaz (m/s)	10	
Diamètre de cheminée (m)	1,3	
Hauteur de la cheminée (m)	32	
Élévation à la base (m)	7	
Coordonnées UTM18, NAD83 (m)	**X**	**Y**
Navire 1	631 768	5 075 280
Navire 2	631 998	5 075 507
Dimensions des navires (m) (bâtiment équivalent : largeur, longueur, hauteur)	32 x 270 x 25	
Horaire journalier	24 / 24	
Taux d'émission horaires (g/s)	24 heures	Annuel
NO_X	2,68	0,950
SO_2	0,190	0,0706
CO	0,321	0,108
NH_3	0,000319	0,000110
PM_T	0,0827	0,0406
PM_{10}	0,0827	0,0304
$PM_{2.5}$	0,0761	0,0279
COV, métaux, HAP		
Éthylbenzène	1,37E-04	5,08E-05
Styrène	1,43E-04	5,32E-05
Toluène	2,19E-04	8,12E-05
Hexane	3,77E-04	1,40E-04
Xylène	3,28E-04	1,22E-04
Octane	2,74E-05	1,02E-05
Acétaldéhyde	4,41E-03	1,64E-03
Acroléine	2,40E-04	8,89E-05
Benzène	1,21E-03	4,48E-04
Formaldéhyde	8,91E-03	3,31E-03
Chrome trivalent	6,36E-06	2,36E-06
Chrome hexavalent	3,27E-06	1,21E-06
Mercure	1,27E-08	4,71E-09
Plomb	6,98E-06	2,59E-06
Manganèse	2,29E-06	8,48E-07
Nickel	1,69E-04	6,28E-05
Arsenic	4,69E-06	1,74E-06
Pyrène	9,83E-07	3,65E-07
Naphthalène	3,53E-05	1,31E-05
Benzo(a)pyrène	2,31E-07	8,59E-08
HAP (BaP_{ET})	5,02E-07	1,86E-07

Taux sur 24 heures : navires avec génératrices diesels TIER2.
Taux annuels : taux moyen sur l'ensemble des types de navires (tableau 4.3).

4.3 Résultats de modélisation pour l'exploitation

Les résultats de modélisation de la dispersion atmosphérique pour l'exploitation sont présentés sous la forme de tableaux pour l'ensemble des contaminants à l'étude et sous la forme de cartes pour les contaminants pour lesquelles la contribution du projet par rapport aux normes de qualité de l'air ambiant serait la plus importante. Ces normes comprennent les normes du RAA, les critères du MDDELCC et les normes canadiennes (pour 2020) de qualité de l'air ambiant.

Dans les tableaux de résultats, les concentrations maximales calculées dans l'air ambiant sur l'ensemble de la période de modélisation (5 années) sont présentées et comparées aux normes et critères québécois et canadiens de qualité de l'air ambiant. Ces tableaux présentent les résultats pour la contribution du terminal seul, et aussi en incluant les concentrations initiales.

Sur toutes les cartes de résultats, ce sont les concentrations maximales calculées pour l'exploitation du terminal sur l'ensemble de la période de modélisation qui sont représentées par des courbes d'iso concentrations sur une carte de la zone d'étude. Ces maximums ne surviendraient donc pas simultanément sur l'ensemble du domaine de modélisation. Sur ces figures, les conditions de dispersion les plus défavorables sont représentées simultanément sur la même carte.

4.3.1 Principaux contaminants atmosphériques

Les concentrations maximales de PCA calculées dans l'air ambiant pour l'exploitation du terminal sont présentées au tableau 4.7. Seuls les résultats maximums sur le domaine d'applicabilité des normes de qualité de l'air ambiant sont présentés. Les normes de qualité de l'air ambiant sont applicables à l'extérieur de la propriété de l'APM et à l'extérieur de la zone industrielle. Elles sont aussi applicables à la résidence située au centre de la zone industrielle, soit au 2001, route Marie-Victorin (art. 202 du RAA).

Pour tous les contaminants, les concentrations maximales calculées dans l'air ambiant pour la contribution du terminal sont nettement inférieures aux normes, avec une contribution maximale de 145 µg/m³ pour le NO_2 horaire (35 % de la norme). Les contributions maximales pour le CO et le SO_2 sont marginales par apport aux normes du RAA et du même ordre ou inférieures aux concentrations initiales.

Pour les matières particulaires sur une base journalière, la contribution du terminal atteindrait 25 µg/m³ (21 % de la norme) pour les PM_T et 3,9 µg/m³ pour les particules fines ($PM_{2.5}$, 13 % de la norme). Cependant, et principalement à cause des concentrations initiales qui sont relativement élevées par rapport aux normes, les concentrations totales calculées atteignent 81 µg/m³ (68% de la norme de 120 µg/m³) pour les PM_T, 53 µg/m³ (88 %) de l'ancienne norme proposée pour les PM_{10} et 24 µg/m³ (80 % de la norme de 30 µg/m³) pour les $PM_{2.5}$. Comparativement aux normes canadiennes de 2020 pour les $PM_{2.5}$, les concentrations totales maximales calculées atteignent 89 % de la norme journalière et 102 % de la norme annuelle. Par contre, ces résultats ne tiennent pas compte du fait que la norme journalière canadienne est applicable pour le 98^e centile des moyennes journalières et non à la concentration maximale. Pour la moyenne annuelle, c'est la concentration initiale qui atteint actuellement 99% de la norme prévue pour 2020. D'ici l'exploitation du terminal vers 2023, le niveau ambiant moyen de $PM_{2.5}$ dans l'air ambiant sera probablement plus faible en raison des divers programmes gouvernementaux pour réduire les concentrations de $PM_{2.5}$ dans l'air ambiant.

Les résultats présentés au tableau 4.7 ne sont toutefois pas représentatifs de l'ensemble de la zone d'étude, mais plutôt du point d'impact maximum, ce dernier pouvant être différent selon les

contaminants et les périodes horaire, journalière ou annuelle. Pour le NO_2 et les matières particulaires, le tableau 4.8 présente les résultats à quatre résidences à proximité du site du terminal. La résidence située au centre de la zone industrielle (2001, route Marie-Victorin, récepteur n°11) correspond généralement au point d'impact maximum pour le NO_2.

Afin de présenter les résultats de modélisation sur l'ensemble de la zone d'étude, des cartes illustrant les concentrations maximales calculées sur le domaine sont présentées aux figures 4.2 à 4.4 pour les maximums de NO_2 horaires, journaliers et annuels, aux figures 4.5 à 4.7 pour les maximums journaliers de PM_T, de PM_{10} et de $PM_{2.5}$ et à la figure 4.8 pour les maximums annuels de $PM_{2.5.}$ Les courbes d'iso concentrations pour le CO et le SO_2 ne sont pas présentées parce que les concentrations totales maximales calculées sont inférieures à 5 % des normes de qualité de l'air ambiant du RAA. Ces figures ont été produites pour les périodes et contaminants pour lesquels le projet de terminal aurait les effets les plus importants par rapport aux normes parmi les contaminants à l'étude et aussi pour lesquels les concentrations totales sont importantes par rapport aux normes. Notez que ces figures ne présentent que la contribution du terminal, c'est-à-dire que les concentrations initiales n'y sont pas représentées.

L'ensemble de ces figures montrent que les concentrations maximales suivent l'axe du projet et diminuent rapidement avec la distance du terminal. Ainsi, les concentrations maximales calculées dans les zones urbaines de Contrecœur et de Verchères ou sur la rive nord du fleuve Saint-Laurent pour la contribution du terminal sont significativement plus faibles (plus de 10 fois inférieures) que celles présentées aux tableaux 4.7 et 4.8.

4.3.2 Composés toxiques

Les concentrations maximales de composés toxiques calculées dans l'air ambiant pour l'exploitation du terminal sont présentées au tableau 4.9. Seuls les résultats maximums sur le domaine d'applicabilité des normes de qualité de l'air ambiant sont présentés. Pour la plupart des contaminants toxiques, les résultats de modélisation sont non significatifs (<1 %) par rapport aux normes ou aux concentrations initiales. C'est le cas des HAP, des métaux à l'exception du nickel (19 % de la norme pour la contribution du terminal) et de la plupart des COV, à l'exception de l'acétaldéhyde (22 % du critère provisoire sur 4 minutes (99^e centile)), de l'acroléine (5,7 % du critère provisoire annuel) et du formaldéhyde (7,8 % de la norme sur 15 minutes). Pour l'acétaldéhyde, la figure 4.9 présente les 99^e centiles des concentrations sur 4 minutes calculées dans l'air ambiant.

Tableau 4.7 Sommaire des concentrations maximales des PCA calculées dans l'air ambiant lors de l'exploitation du terminal

Contaminants	Périodes	Contributions maximales du terminal (1)		Concentrations initiales (2)		Concentrations totales (3)		Normes du RAA
		µg/m³	% norme	µg/m³	% norme	µg/m³	% norme	µg/m³
SO_2	4 minutes	25	1,9 %	21	1,6 %	46	3,5 %	1 310 (4)
	1 heure	13	7,8 %	11	6,5 %	24	14 %	170 (5)
	24 heures	2,7	0,9 %	5,2	1,8 %	7,9	2,7 %	288
	Annuelle	0,19	0,37 %	1,7	3,3 %	1,9	3,6 %	52
	Annuelle	0,19	1,7 %	1,7	15 %	1,9	17 %	11 (6)
NO_2 (7)	1 heure	145	35 %	40	10 %	185	45 %	414
	24 heures	48	23 %	24	12 %	72	35 %	207
	Annuelle	5,0	4,9 %	9,4	9,1 %	14	14 %	103
CO	1 heure	64	0,19 %	441	1,3 %	505	1,5 %	34 000
	8 heures	20	0,16 %	430	3,4 %	450	3,5 %	12 700
NH_3	4 minutes	7,1	2,0%	100	29%	107	31%	350
PM_T	24 heures	25	21 %	56	47 %	81	68 %	120
PM_{10}	24 heures	14	24 %	39	65 %	53	89 %	60 (8)
$PM_{2.5}$	24 heures	3,9	13 %	20	67 %	24	80 %	30
	24 heures	3,9	15 %	20	74 %	24	89 %	27 (9)
	Annuelle	0,28	3,2 %	8,7	99 %	9,0	102 %	8,8 (10)

(1) Concentrations maximales calculées à l'extérieur de la zone industrielle, de la propriété de l'APM et de la zone tampon de 300 m au-delà du terminal maritime, mais incluant les récepteurs résidentiels à l'intérieur de la zone industrielle.
(2) Concentrations initiales dérivées des mesures de suivi de la qualité de l'air ambiant (voir section 2.5), sauf pour les $PM_{2.5}$ pour lesquelles la valeur par défaut du RAA est considérée, comme spécifié à l'article 202 du RAA.
(3) Concentrations totales : sommation des concentrations maximales pour le terminal et des concentrations initiales.
(4) Avec 99,5^e centile inférieur ou égal à 1 050µg/m³.
(5) Norme canadienne de qualité de l'air ambiant (NCQAA) pour 2025, moyenne triennale du 99^e centile annuel des maximums quotidiens des concentrations moyennes sur une heure.
(6) Norme canadienne de qualité de l'air ambiant (NCQAA) pour 2025.
(7) Résultats pour le NO_2 en supposant une conversion totale du NO en NO2 pour les périodes annuelle et sur 24 heures et une conversion partielle sur une base horaire (méthode OLM).
(8) Ancien standard pancanadien proposé, mais non entériné, moyenne triennale du 98^e centile annuel des concentrations quotidiennes moyennes sur 24 heures.
(9) Norme canadienne de qualité de l'air ambiant (NCQAA) pour 2020, moyenne triennale du 98^e centile annuel des concentrations quotidiennes moyennes sur 24 heures.
(10) Norme canadienne de qualité de l'air ambiant (NCQAA) pour 2020, moyenne triennale des moyennes annuelles.

Tableau 4.8 Sommaire des concentrations maximales de NO_2 et de particules calculées dans l'air ambiant à certains récepteurs sensibles lors de l'exploitation du terminal

Récepteurs (Numéro sur les figures 4.2 à 4.9)	Contaminants	Périodes	Contributions maximales du terminal (1)		Concentrations initiales (2)		Concentrations totales (3)		Normes
			µg/m³	% norme	µg/m³	% norme	µg/m³	% norme	µg/m³
1220, Rte Marie-Victorin, Verchères (8)	NO_2 (4)	1 heure	136	33 %	40	10 %	176	43 %	414
		24 heures	23	11 %	24	12 %	47	23 %	207
		Annuelle	1,9	1,8 %	9,4	9,1 %	11	11 %	103
	PM_T	24 heures	18	15 %	56	47 %	74	62 %	120
	PM_{10}	24 heures	11	19 %	38,7	65 %	50	83 %	60 (5)
	$PM_{2.5}$	24 heures	3,1	10 %	20	67 %	23	77 %	30
		Annuelle	0,21	2 %	8,7	99 %	8,9	101 %	8,8 (6)
1219, Rte Marie-Victorin, Verchères (9)	NO_2 (4)	1 heure	143	35 %	40	10 %	183	44 %	414
		24 heures	35	17 %	24	12 %	59	28 %	207
		Annuelle	2,4	2,3 %	9,4	9,1 %	12	11 %	103
	PM_T	24 heures	16	13 %	56	47 %	72	60 %	120
	PM_{10}	24 heures	9,9	17 %	38,7	65 %	49	81 %	60 (5)
	$PM_{2.5}$	24 heures	3,1	10 %	20	67 %	23	77 %	30
		Annuelle	0,25	2,8 %	8,7	99 %	9,0	102 %	8,8 (6)
986, Montée La pierre, Contrecœur (10)	NO_2 (4)	1 heure	93	22 %	40	10 %	133	32 %	414
		24 heures	15	7,2 %	24	12 %	39	19 %	207
		Annuelle	1,4	1,3 %	9,4	9,1 %	11	10 %	103
	PM_T	24 heures	5,6	4,7 %	56	47 %	62	51 %	120
	PM_{10}	24 heures	4,5	7,5 %	38,7	65 %	43	72 %	60 (5)
	$PM_{2.5}$	24 heures	1,5	5,0 %	20	67 %	22	72 %	30
		Annuelle	0,09	1,0 %	8,7	99 %	8,8	100 %	8,8 (6)
2001, Rte Marie-Victorin, Contrecœur (11)	NO_2 (4)	1 heure	145	35 %	40	10 %	185	45 %	414
		24 heures	48	23 %	24	12 %	72	35 %	207
		Annuelle	5,0	4,9 %	9,4	9,1 %	14,4	14 %	103
	PM_T	24 heures	12	10 %	56	47 %	68	57 %	120
	PM_{10}	24 heures	9,2	15 %	38,7	65 %	48	80 %	60 (5)
	$PM_{2.5}$	24 heures	3,3	11 %	20	67 %	23	78 %	30
		Annuelle	0,24	2,7 %	8,7	99 %	8,9	102 %	8,8 (6)

(1) Concentrations maximales calculées aux récepteurs sur la période de modélisation (2008-2012).
(2) Concentrations initiales dérivées des mesures de suivi de la qualité de l'air ambiant (voir section 2.5), sauf pour les $PM_{2.5}$ pour lesquelles la valeur par défaut du RAA est considérée, comme spécifié à l'article 202 du RAA.
(3) Concentrations totales : sommation des concentrations maximales pour le terminal et des concentrations initiales.
(4) NO_2 en supposant une conversion totale du NO en NO_2 pour les périodes annuelles et sur 24 heures et une conversion partielle sur une base horaire (méthode OLM).
(5) Ancien standard pancanadien proposé, mais non entériné, moyenne triennale du 98e centile annuel des concentrations quotidiennes moyennes sur 24 heures.
(6) Norme canadienne de qualité de l'air ambiant (NCQAA) pour 2020, moyenne triennale des moyennes annuelles.

Tableau 4.9 Sommaire des concentrations maximales de contaminants toxiques calculées dans l'air ambiant lors de l'exploitation du terminal

Contaminants	CAS	Périodes	Contributions maximales du terminal (1)		Concentrations initiales (2)		Concentrations totales (3)		Normes ou critères	
			µg/m³	% norme	µg/m³	% norme	µg/m³	% norme	µg/m³	
Composés organiques volatils (COV)										
Acétaldéhyde	75-07-0	4 minutes	2,0	NA	NA	NA	2,0	NA	NA	
		99e centile 4 minutes	0,65	22 %	NA	NA	0,65	22 %	3	C (4)
		Annuelle	0,019	3,8 %	NA	NA	0,019	3,8 %	0,5	
Acroléine	107-02-8	4 minutes	0,13	1,5 %	NA	NA	0,13	1,5 %	8,3	C (4)
		Annuelle	0,0011	5,7 %	NA	NA	0,0011	5,7 %	0,02	
Benzène	71-43-2	24 heures	0,075	0,75 %	3	30 %	3,1	31 %	10	N
		Annuelle	0,0066							
Éthylbenzène	100-41-4	4 minutes	0,11	0,014 %	140	19 %	140	19 %	740	N
		Annuelle	0,0011	0,00053 %	3	1,5 %	3,0	1,5 %	200	
Formaldéhyde	50-00-0	15 minutes	2,9	7,8 %	3	8,1 %	5,9	16 %	37	N
Hexane	110-54-3	4 minutes	0,15	0,0028 %	140	2,6 %	140	2,6 %	5 300	N
		Annuelle	0,00084	0,00060 %	3	2,1 %	3,0	2,1 %	140	
Octane	540-84-1	1 heure	0,015	0,00043 %	0	0,0 %	0,015	0,00043 %	3 500	C
		Annuelle	0,00025	0,000071 %	0	0,0 %	0,00025	0,000071 %	350	
Styrène	100-42-5	1 heure	0,029	0,019 %	0	0,0 %	0,029	0,019 %	150	N
Toluène	108-88-3	4 minutes	0,49	0,082 %	260	43 %	260	43 %	600	N
Xylènes	1330-20-7	4 minutes	0,35	0,10 %	150	43 %	150	43 %	350	N
		1 heure	0,18	0,91 %	8	40 %	8,2	41 %	20	
Métaux										
Arsenic	7440-38-2	Annuelle	0,0000067	0,22 %	0,002	67 %	0,0020	67 %	0,003	N
Chrome trivalent	16065-83-1	Annuelle	0,0000066	0,0066 %	0,01	10 %	0,010	10 %	0,1	N
Chrome hexavalent	18540-29-9	Annuelle	0,0000033	0,083 %	0,002	50 %	0,0020	50 %	0,004	N
Manganèse (PM_{10})	7439-96-5	Annuelle	0,000045	0,18 %	0,02	80 %	0,020	80 %	0,025	C
Mercure	7439-97-6	Annuelle	0,00000038	0,0075 %	0,002	40 %	0,0020	40 %	0,005	N
Nickel (PM_{10})	7440-02-0	24 heures	0,0026	19 %	0,002	14 %	0,0046	33 %	0,014	N
Plomb	7439-92-1	Annuelle	0,000050	0,050 %	0,025	25 %	0,025	25 %	0,1	N
Hydrocarbures aromatiques polycycliques (HAP)										
Benzo(a)pyrène	50-32-8	Annuelle	0,0000022	0,25 %	0,0003	33 %	0,00030	34 %	0,0009	N
HAP totaux (BaP_{ET})		Annuelle	0,0000043	0,47 %	0,0003	33 %	0,00030	34 %	0,0009	C
Naphthalène	91-20-3	4 minutes	0,093	0,047 %	5	2,5 %	5,1	2,5 %	200	N
		Annuelle	0,00083	0,028 %	0	0,0 %	0,00083	0,028 %	3	
Pyrène	129-00-0	Annuelle	0,000026	0,00020 %	0	0,0 %	0,000026	0,00020 %	13	C

(1) Concentrations maximales calculées aux récepteurs sur la période de modélisation (2008-2012).
(2) Concentrations initiales par défaut du RAA.
(3) Concentrations totales : sommation des concentrations maximales pour le terminal et des concentrations initiales.
(4) Critères provisoires du MDDELCC. Pour ces substances, il n'y a pas de concentration initiale à prendre en compte, les critères correspondent à l'ajout permis pour le projet. Les concentrations sur 4 minutes sont applicables au 99e centile sur une base annuelle.

631 000 632 000 633 000 634 000 635 000 636 000

5 077 000
5 076 000
5 075 000
5 074 000

N

Île Bouchard

Fleuve Saint-Laurent

Route Marie-Victorin

Route d'accès

Installations actuelles

Accès ferroviaire

Locomotives

Accès routier

Zone maritime

Navire 2

Navire 1

Cour intermodale

Quai et cour des conteneurs

Zone terrestre

Route des Aciéries

Autoroute de l'Acier

Montée Lapierre

Route Marie-Victorin

132 30

Composantes du projet

Empreinte du projet - Variante 2

Modélisation atmosphérique

Source de contaminants atmosphériques

Territoires exclus de la modélisation

Territoire de l'APM

Affectation industrielle

Zone tampon de 300 m du quai

Récepteurs

Résidence

Infrastructures existantes

Chemin de fer du CN

Autre chemin de fer

Réseau routier

Courbe de niveau (équidistance de 10 m)

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ADMINISTRATION PORTUAIRE DE MONTRÉAL
Projet d'agrandissement du terminal de Contrecoeur

Figure 4.1
Configuration des sources de contaminants atmosphériques modélisées lors de l'exploitation

Sources :
MRC Marguerite-D'Youville
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
CanVec, 1/50 000, RNCan, 2017
Composantes du projet, APM, février 2017

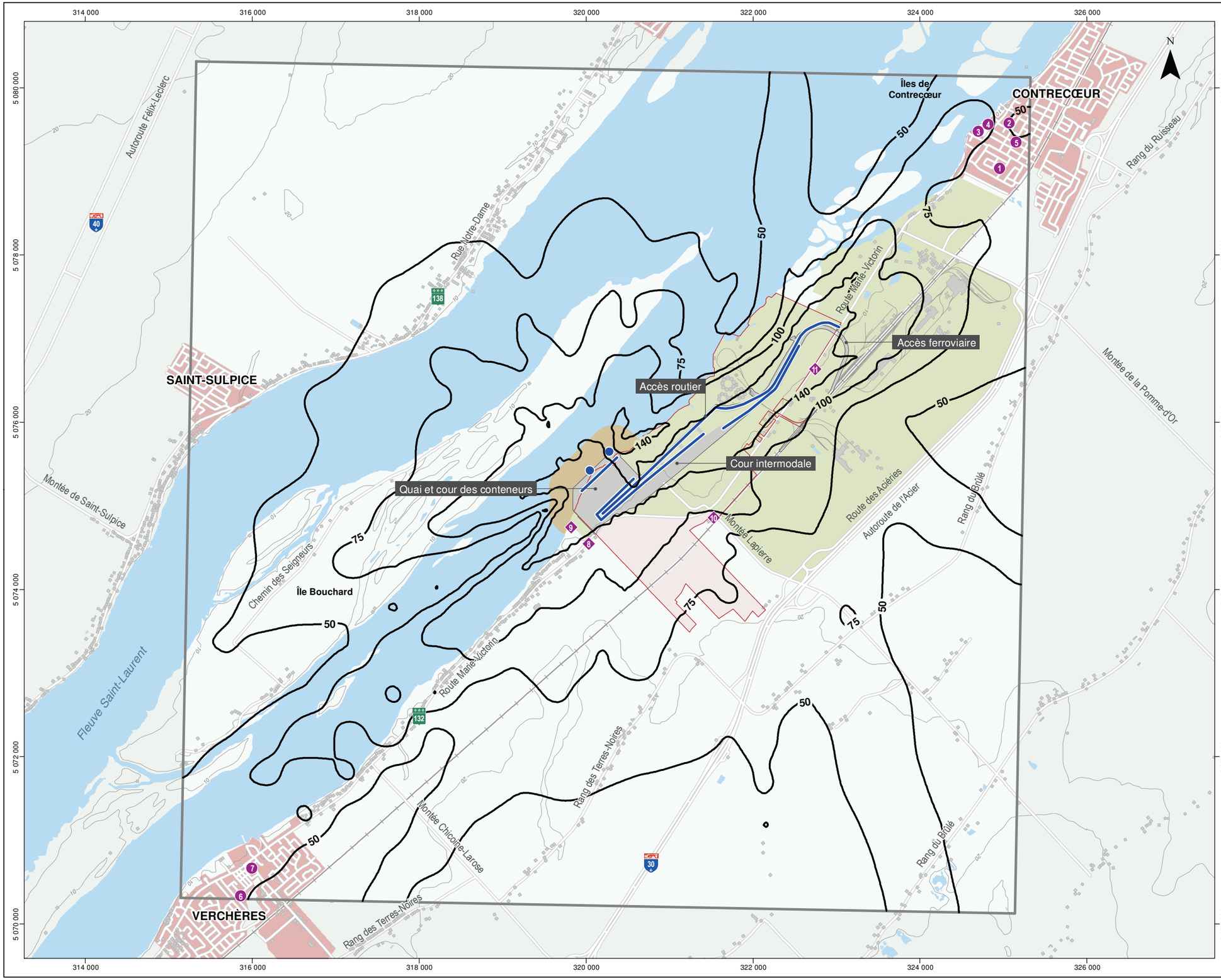
Projet: 643872

0 180 360 m
1/18 458
Projection MTM, fuseau 8, NAD83

Rév.	aaaa/mm/jj	Description	Préparé	Vérifié
01	2017/07/07	Finale	A. Chouinard	É. Delisle
00	2017/05/25	Préliminaire	A. Chouinard	É. Delisle

Format 11x17

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Composantes du projet

- Aire du projet - Variante 2
- Courbe de niveau (équidistance de 10 m)

Modélisation atmosphérique

- Domaine de modélisation
- Source de contaminants atmosphériques
- Récepteur sensible
- Résidence

Territoires exclus de la modélisation

- Territoire de l'APM
- Affectation industrielle
- Zone tampon de 300 m du quai

Concentration de NO_2

- Concentration maximale calculée dans l'air ambiant (µg/m³)

Norme du RAA : 414 µg/m³

Notes :
Les concentrations indiquées ne tiennent compte que de la contribution du projet.

Modèle de dispersion : AERMOD version 16216r
Météorologie : Varennes 2008-2012
Conversion du NO en NO_2 avec la méthode OLM.

Numéro	Récepteurs sensibles et résidences
1	C.P.E. Petit à Petit
2	École Mère-Marie-Rose
3	Centre d'hébergement de Contrecœur
4	Résidence L'Autre Jeunesse
5	Maison des Gens Heureux
6	École Ludger-Duvernay
7	Résidence Florentine-Dansereau
8	1220, Rte Marie-Victorin, Verchères
9	1219, Rte Marie-Victorin, Verchères
10	986, Montée Lapierre, Contrecœur
11	2001, Rte Marie-Victorin, Contrecœur

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Projet d'agrandissement du terminal de Contrecœur

Figure 4.2

Concentrations maximales horaires (µg/m³) de NO_2 calculées dans l'air ambiant lors de l'exploitation

Sources :
MRC Marguerite-D'Youville
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
CanVec, 1/50 000, RNCan, 2017
Composantes du projet, APM, février 2017

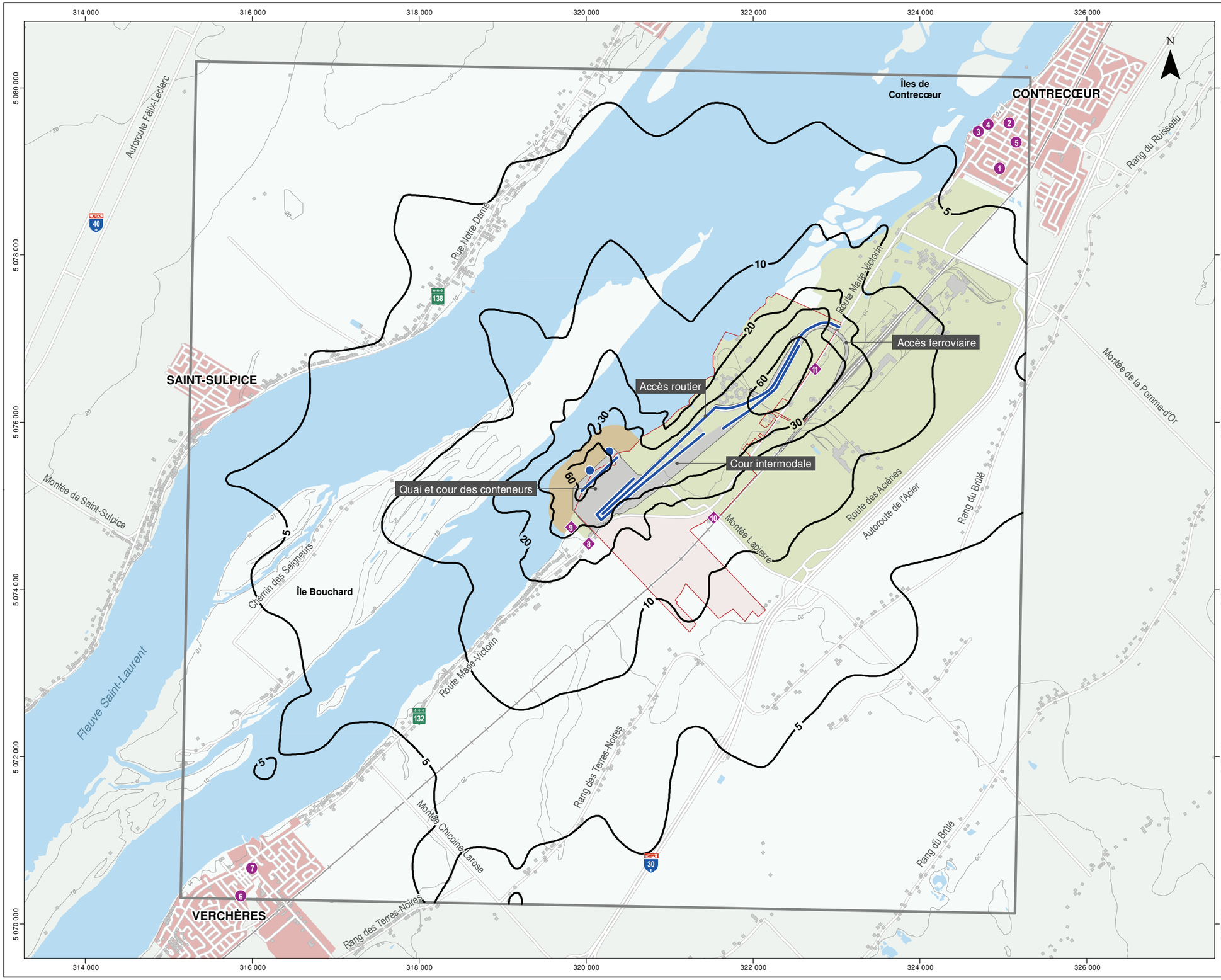
Projet: 643872

0 450 900 m
1/45 000
Projection MTM, fuseau 8, NAD83

Rév.	aaaa/mm/jj	Description	Préparé	Vérifié
01	2017/07/07	Finale	A. Chouinard	É. Delisle
00	2017/05/25	Préliminaire	A. Chouinard	É. Delisle

Format 11x17

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Composantes du projet

- Aire du projet - Variante 2
- Courbe de niveau (équidistance de 10 m)

Modélisation atmosphérique

- Domaine de modélisation
- Source de contaminants atmosphériques
- Récepteur sensible
- Résidence

Territoires exclus de la modélisation

- Territoire de l'APM
- Affectation industrielle
- Zone tampon de 300 m du quai

Concentration de NO_2

- Concentration maximale calculée dans l'air ambiant (µg/m³)

Norme du RAA : 207 µg/m³

Notes :
Les concentrations indiquées ne tiennent compte que de la contribution du projet.

Modèle de dispersion : AERMOD version 16216r
Météorologie : Varennes 2008-2012
Conversion totale du NO en NO_2.

Numéro	Récepteurs sensibles et résidences
1	C.P.E. Petit à Petit
2	École Mère-Marie-Rose
3	Centre d'hébergement de Contrecœur
4	Résidence L'Autre Jeunesse
5	Maison des Gens Heureux
6	École Ludger-Duvernay
7	Résidence Florentine-Dansereau
8	1220, Rte Marie-Victorin, Verchères
9	1219, Rte Marie-Victorin, Verchères
10	986, Montée Lapierre, Contrecœur
11	2001, Rte Marie-Victorin, Contrecœur

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ADMINISTRATION PORTUAIRE DE MONTRÉAL
Projet d'agrandissement du terminal de Contrecœur

Figure 4.3

Concentrations maximales journalières (µg/m³) de NO_2 calculées dans l'air ambiant lors de l'exploitation

Sources :
MRC Marguerite-D'Youville
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
CanVec, 1/50 000, RNCan, 2017
Composantes du projet, APM, février 2017

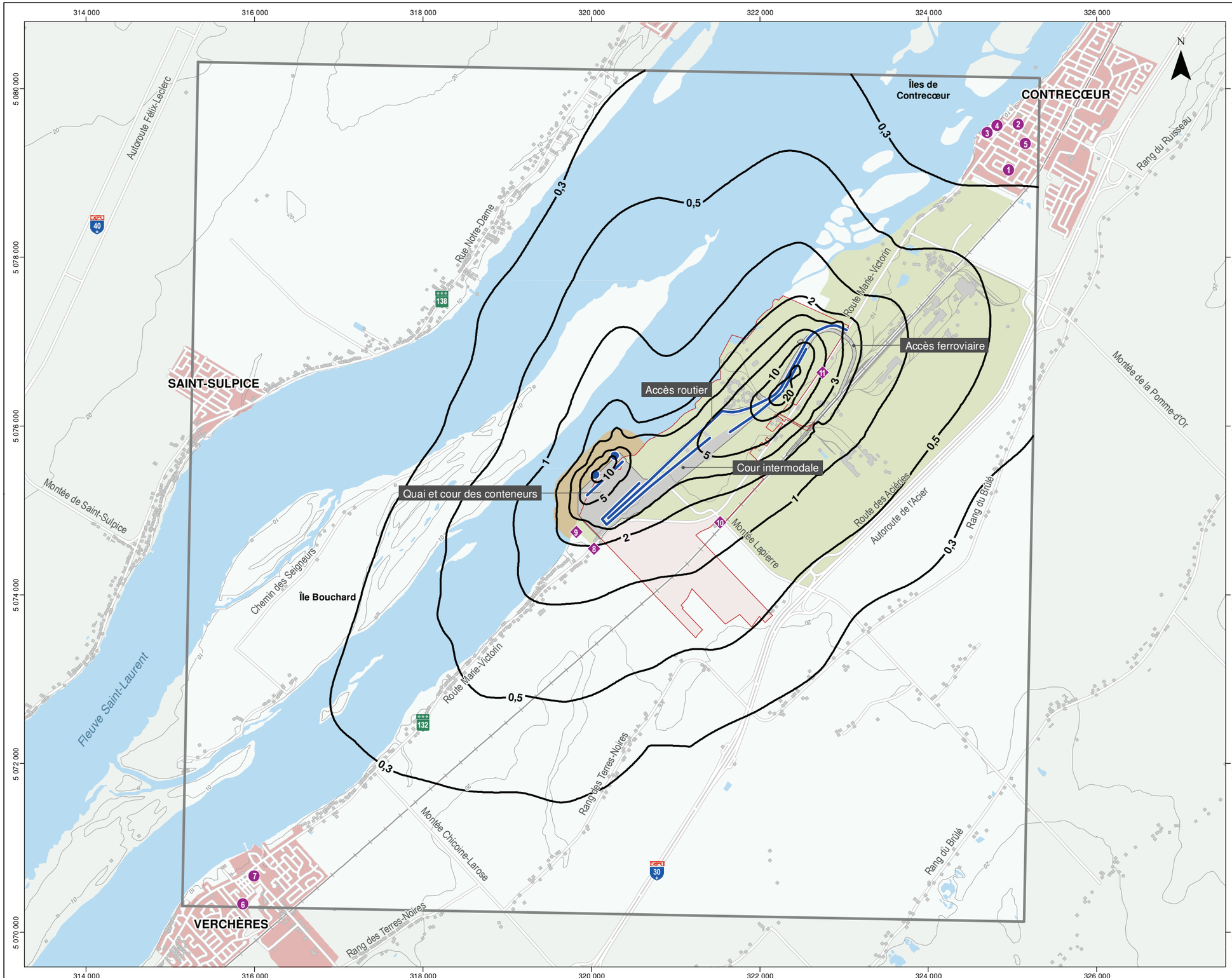
Projet: 643872

0 450 900 m
1/45 000
Projection MTM, fuseau 8, NAD83

Rév.	aaaa/mm/jj	Description	Préparé	Vérifié
01	2017/07/07	Finale	A. Chouinard	É. Delisle
00	2017/05/25	Préliminaire	A. Chouinard	É. Delisle

Format 11x17

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Composantes du projet

- Aire du projet - Variante 2
- Courbe de niveau (équidistance de 10 m)

Modélisation atmosphérique

- Domaine de modélisation
- Source de contaminants atmosphériques
- Récepteur sensible
- Résidence

Territoires exclus de la modélisation

- Territoire de l'APM
- Affectation industrielle
- Zone tampon de 300 m du quai

Concentration de NO_2

- Concentration maximale calculée dans l'air ambiant (µg/m³)

Norme du RAA : 103 µg/m³

Notes :
Les concentrations indiquées ne tiennent compte que de la contribution du projet.

Modèle de dispersion : AERMOD version 16216r
Météorologie : Varennes 2008-2012
Conversion totale du NO en NO_2.

Numéro	Récepteurs sensibles et résidences
1	C.P.E. Petit à Petit
2	École Mère-Marie-Rose
3	Centre d'hébergement de Contrecœur
4	Résidence L'Autre Jeunesse
5	Maison des Gens Heureux
6	École Ludger-Duvernay
7	Résidence Florentine-Dansereau
8	1220, Rte Marie-Victorin, Verchères
9	1219, Rte Marie-Victorin, Verchères
10	986, Montée Lapierre, Contrecœur
11	2001, Rte Marie-Victorin, Contrecœur

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ADMINISTRATION PORTUAIRE DE MONTRÉAL
Projet d'agrandissement du terminal de Contrecœur

Figure 4.4

Concentrations maximales annuelles (µg/m³) de NO_2 calculées dans l'air ambiant lors de l'exploitation

Sources :
MRC Marguerite-D'Youville
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
CanVec, 1/50 000, RNCan, 2017
Composantes du projet, APM, février 2017

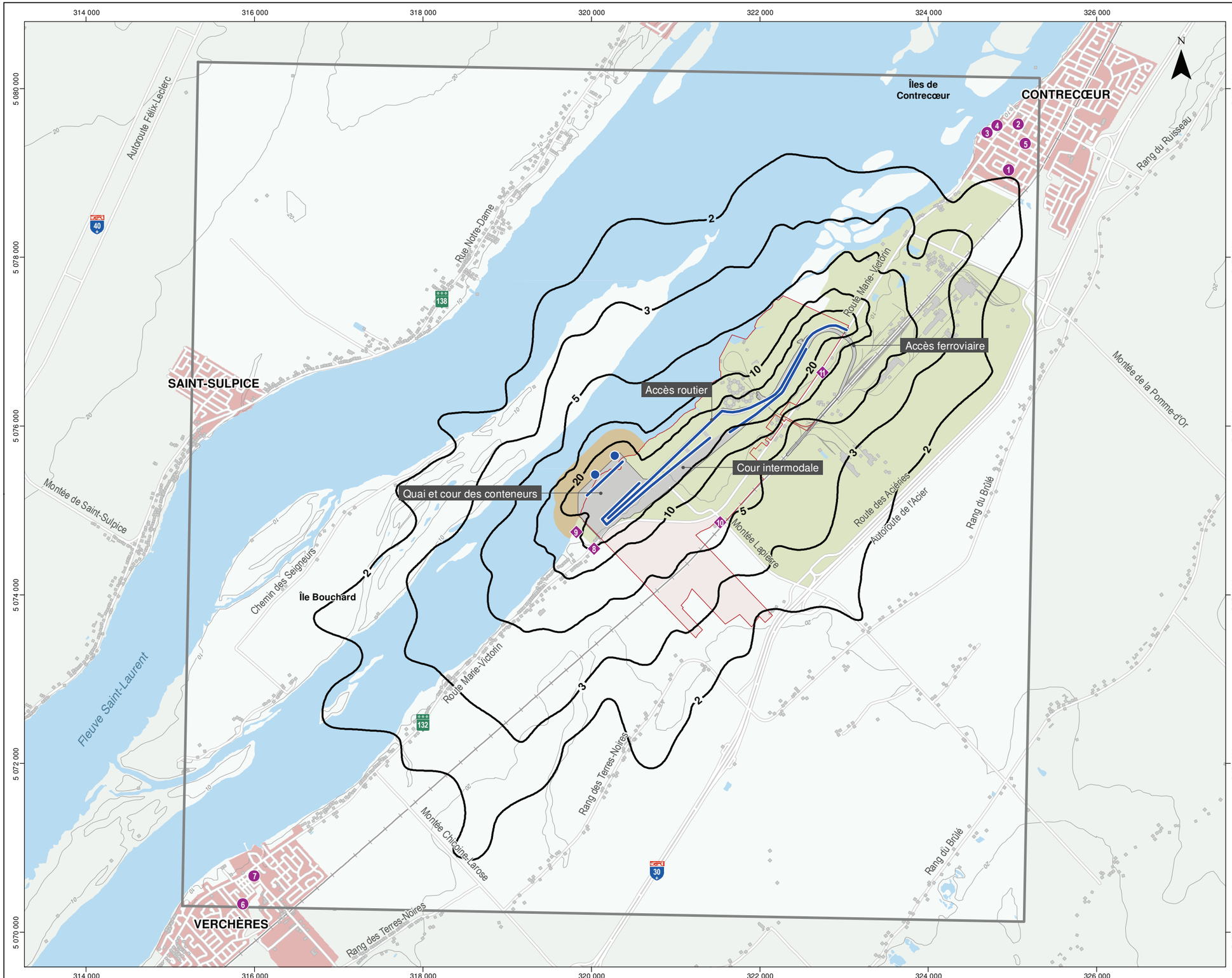
Projet: 643872

0 450 900 m
1/45 000
Projection MTM, fuseau 8, NAD83

Rév.	aaaa/mm/jj	Description	Préparé	Vérifié
01	2017/07/07	Finale	A. Chouinard	É. Delisle
00	2017/05/25	Préliminaire	A. Chouinard	É. Delisle

Format 11x17

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Composantes du projet

- Aire du projet - Variante 2
- Courbe de niveau (équidistance de 10 m)

Modélisation atmosphérique

- Domaine de modélisation
- Source de contaminants atmosphériques
- Récepteur sensible
- Résidence

Territoires exclus de la modélisation

- Territoire de l'APM
- Affectation industrielle
- Zone tampon de 300 m du quai

Concentration de PM_T

- Concentration maximale calculée dans l'air ambiant (µg/m³)

Norme du RAA : 120 µg/m³

Notes :
Les concentrations indiquées ne tiennent compte que de la contribution du projet.

Modèle de dispersion : AERMOD version 16216r
Météorologie : Varennes 2008-2012

Numéro	Récepteurs sensibles et résidences
1	C.P.E. Petit à Petit
2	École Mère-Marie-Rose
3	Centre d'hébergement de Contrecœur
4	Résidence L'Autre Jeunesse
5	Maison des Gens Heureux
6	École Ludger-Duvernay
7	Résidence Florentine-Dansereau
8	1220, Rte Marie-Victorin, Verchères
9	1219, Rte Marie-Victorin, Verchères
10	986, Montée Lapierre, Contrecœur
11	2001, Rte Marie-Victorin, Contrecœur

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ADMINISTRATION PORTUAIRE DE MONTRÉAL
Projet d'agrandissement du terminal de Contrecœur

Figure 4.5
Concentrations maximales journalières (µg/m³) de particules totales (PM_T) calculées dans l'air ambiant lors de l'exploitation

Sources :
MRC Marguerite-D'Youville
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
CanVec, 1/50 000, RNCan, 2017
Composantes du projet, APM, février 2017

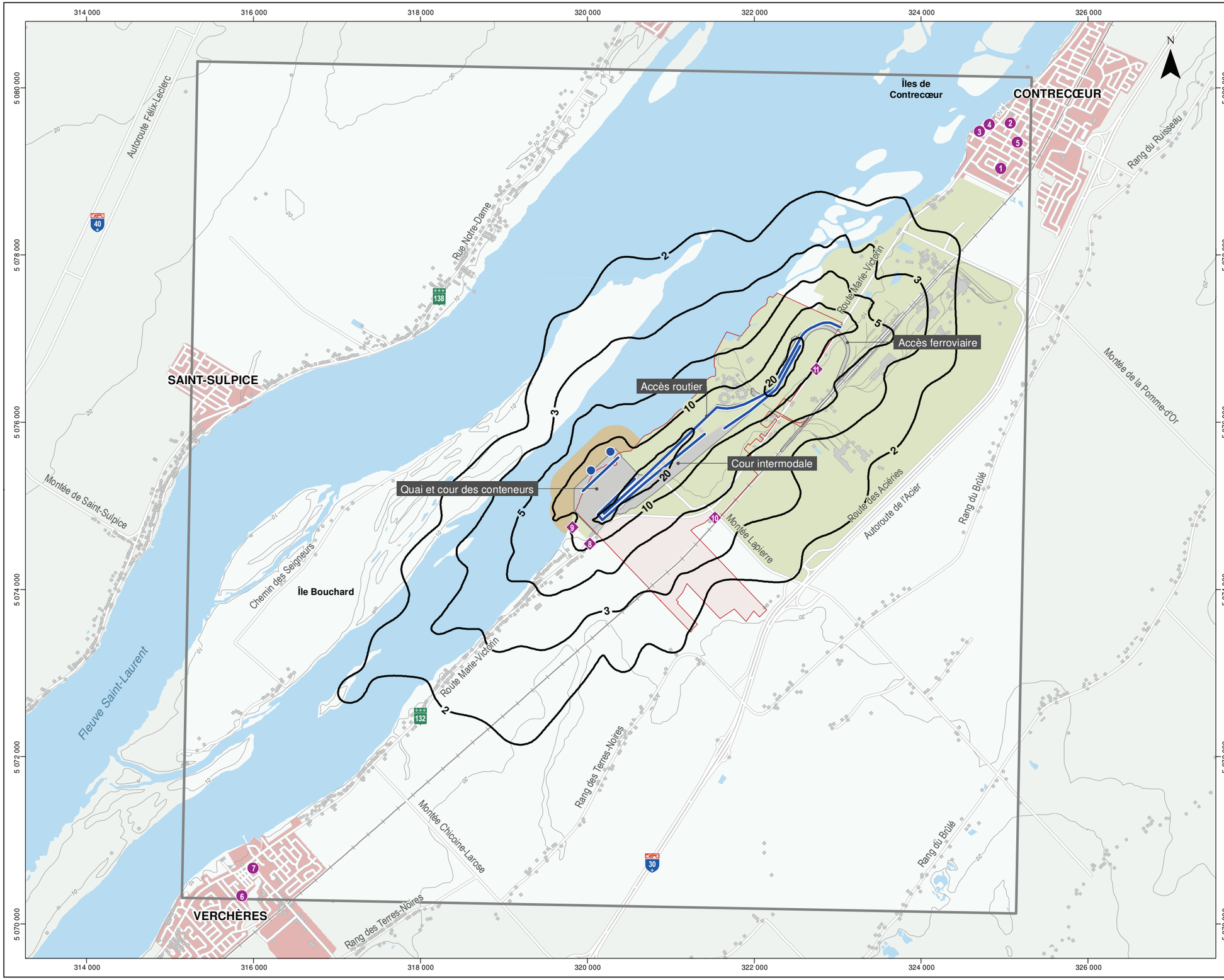
Projet: 643872

0 450 900 m
1/45 000
Projection MTM, fuseau 8, NAD83

Rév.	aaaa/mm/jj	Description	Préparé	Vérifié
01	2017/07/07	Finale	A. Chouinard	É. Delisle
00	2017/05/25	Préliminaire	A. Chouinard	É. Delisle

Format 11x17

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Composantes du projet

- Aire du projet - Variante 2
- Courbe de niveau (équidistance de 10 m)

Modélisation atmosphérique

- Domaine de modélisation
- Source de contaminants atmosphériques
- Récepteur sensible
- Résidence

Territoires exclus de la modélisation

- Territoire de l'APM
- Affectation industrielle
- Zone tampon de 300 m du quai

Concentration de PM_{10}

- Concentration maximale calculée dans l'air ambiant (µg/m³)

Norme canadienne (non entérinée): 60 µg/m³

Notes :
Les concentrations indiquées ne tiennent compte que de la contribution du projet.

Modèle de dispersion : AERMOD version 16216r
Météorologie : Varennes 2008-2012

Numéro	Récepteurs sensibles et résidences
1	C.P.E. Petit à Petit
2	École Mère-Marie-Rose
3	Centre d'hébergement de Contrecœur
4	Résidence L'Autre Jeunesse
5	Maison des Gens Heureux
6	École Ludger-Duvernay
7	Résidence Florentine-Dansereau
8	1220, Rte Marie-Victorin, Verchères
9	1219, Rte Marie-Victorin, Verchères
10	986, Montée Lapierre, Contrecœur
11	2001, Rte Marie-Victorin, Contrecœur

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Figure 4.6

Concentrations maximales journalières (µg/m³) de particules fines (PM_{10}) calculées dans l'air ambiant lors de l'exploitation

Sources :
MRC Marguerite-D'Youville
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
CanVec, 1/50 000, RNCan, 2017
Composantes du projet, APM, février 2017

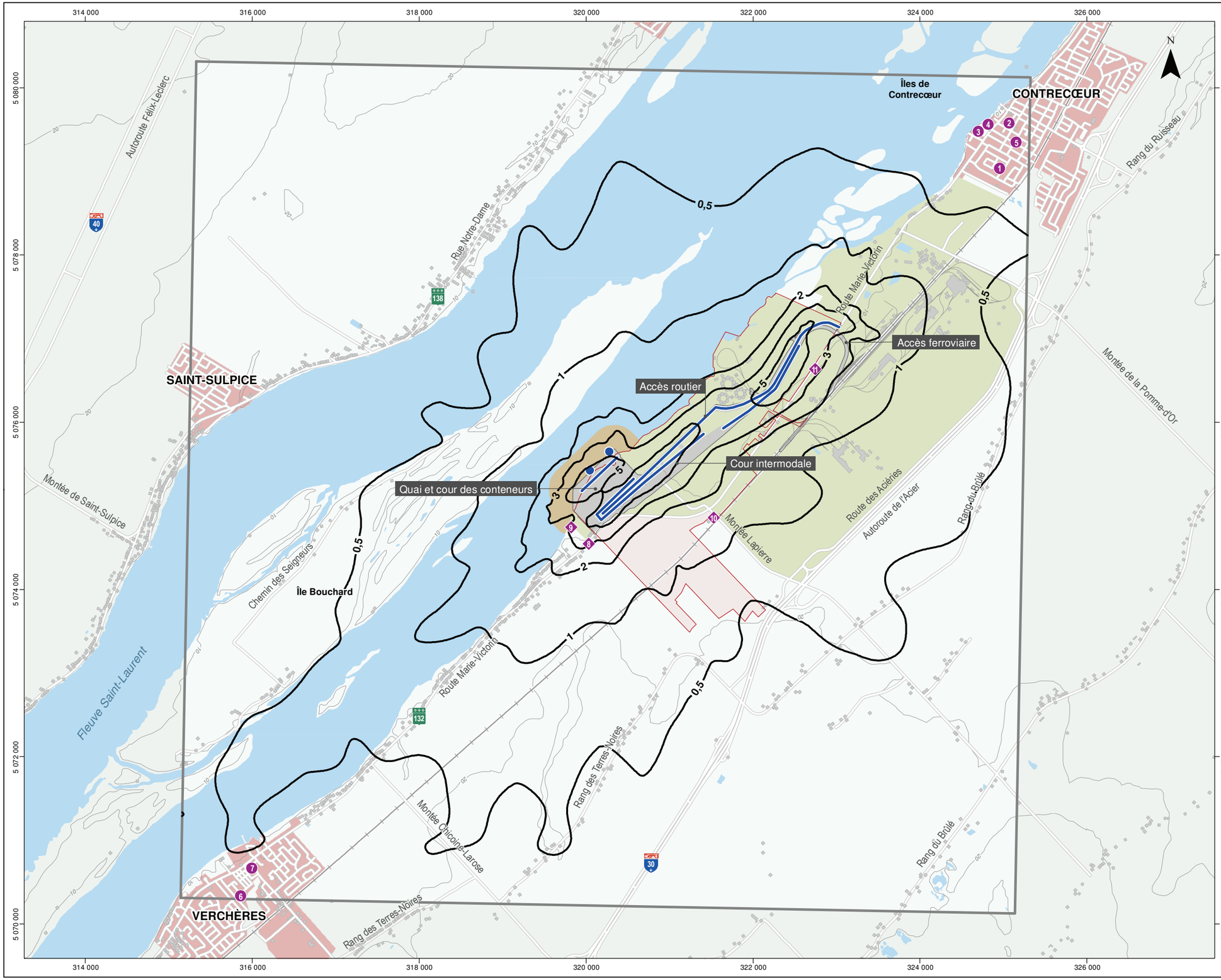
Projet: 643872

0 450 900 m
1/45 000
Projection MTM, fuseau 8, NAD83

Rév.	aaaa/mm/jj	Description	Préparé	Vérifié
01	2017/07/07	Finale	A. Chouinard	É. Delisle
00	2017/05/25	Préliminaire	A. Chouinard	É. Delisle

Format 11x17

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Composantes du projet

- Aire du projet - Variante 2
- Courbe de niveau (équidistance de 10 m)

Modélisation atmosphérique

- Domaine de modélisation
- Source de contaminants atmosphériques
- Récepteur sensible
- Résidence

Territoires exclus de la modélisation

- Territoire de l'APM
- Affectation industrielle
- Zone tampon de 300 m du quai

Concentration de $PM_{2.5}$

- Concentration maximale calculée dans l'air ambiant (µg/m³)

Norme du RAA : 30 µg/m³

Notes :
Les concentrations indiquées ne tiennent compte que de la contribution du projet.

Modèle de dispersion : AERMOD version 16216r
Météorologie : Varennes 2008-2012

Numéro	Récepteurs sensibles et résidences
1	C.P.E. Petit à Petit
2	École Mère-Marie-Rose
3	Centre d'hébergement de Contrecœur
4	Résidence L'Autre Jeunesse
5	Maison des Gens Heureux
6	École Ludger-Duvernay
7	Résidence Florentine-Dansereau
8	1220, Rte Marie-Victorin, Verchères
9	1219, Rte Marie-Victorin, Verchères
10	986, Montée Lapierre, Contrecœur
11	2001, Rte Marie-Victorin, Contrecœur

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Projet d'agrandissement du terminal de Contrecœur

Figure 4.7
Concentrations maximales journalières (µg/m³) de particules fines ($PM_{2.5}$) calculées dans l'air ambiant lors de l'exploitation

Sources :
MRC Marguerite-D'Youville
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
CanVec, 1/50 000, RNCan, 2017
Composantes du projet, APM, février 2017

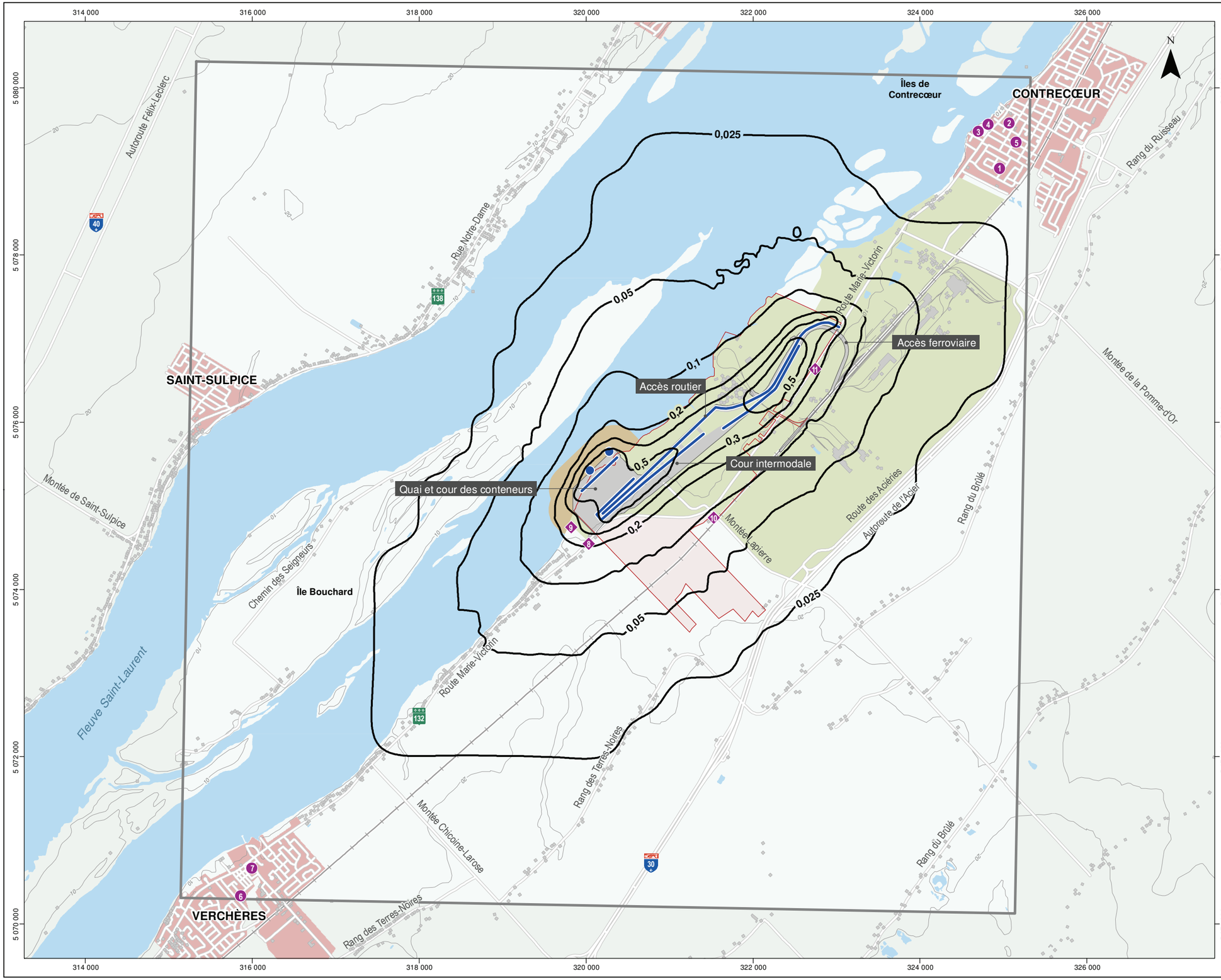
Projet: 643872

0 450 900 m
1/45 000
Projection MTM, fuseau 8, NAD83

Rév.	aaaa/mm/jj	Description	Préparé	Vérifié
01	2017/07/07	Finale	A. Chouinard	É. Delisle
00	2017/05/25	Préliminaire	A. Chouinard	É. Delisle

Format 11x17

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Composantes du projet

- Aire du projet - Variante 2
- Courbe de niveau (équidistance de 10 m)

Modélisation atmosphérique

- Domaine de modélisation
- Source de contaminants atmosphériques
- Récepteur sensible
- Résidence

Territoires exclus de la modélisation

- Territoire de l'APM
- Affectation industrielle
- Zone tampon de 300 m du quai

Concentration de $PM_{2.5}$

- Concentration maximale calculée dans l'air ambiant (µg/m³)

Norme canadienne (2020) : 8,8 µg/m³

Notes :
Les concentrations indiquées ne tiennent compte que de la contribution du projet.

Modèle de dispersion : AERMOD version 16216r
Météorologie : Varennes 2008-2012

Numéro	Récepteurs sensibles et résidences
1	C.P.E. Petit à Petit
2	École Mère-Marie-Rose
3	Centre d'hébergement de Contrecœur
4	Résidence L'Autre Jeunesse
5	Maison des Gens Heureux
6	École Ludger-Duvernay
7	Résidence Florentine-Dansereau
8	1220, Rte Marie-Victorin, Verchères
9	1219, Rte Marie-Victorin, Verchères
10	986, Montée Lapierre, Contrecœur
11	2001, Rte Marie-Victorin, Contrecœur

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Figure 4.8
Concentrations maximales annuelles (µg/m³) de particules fines ($PM_{2.5}$) calculées dans l'air ambiant lors de l'exploitation

Sources :
MRC Marguerite-D'Youville
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
CanVec, 1/50 000, RNCan, 2017
Composantes du projet, APM, février 2017

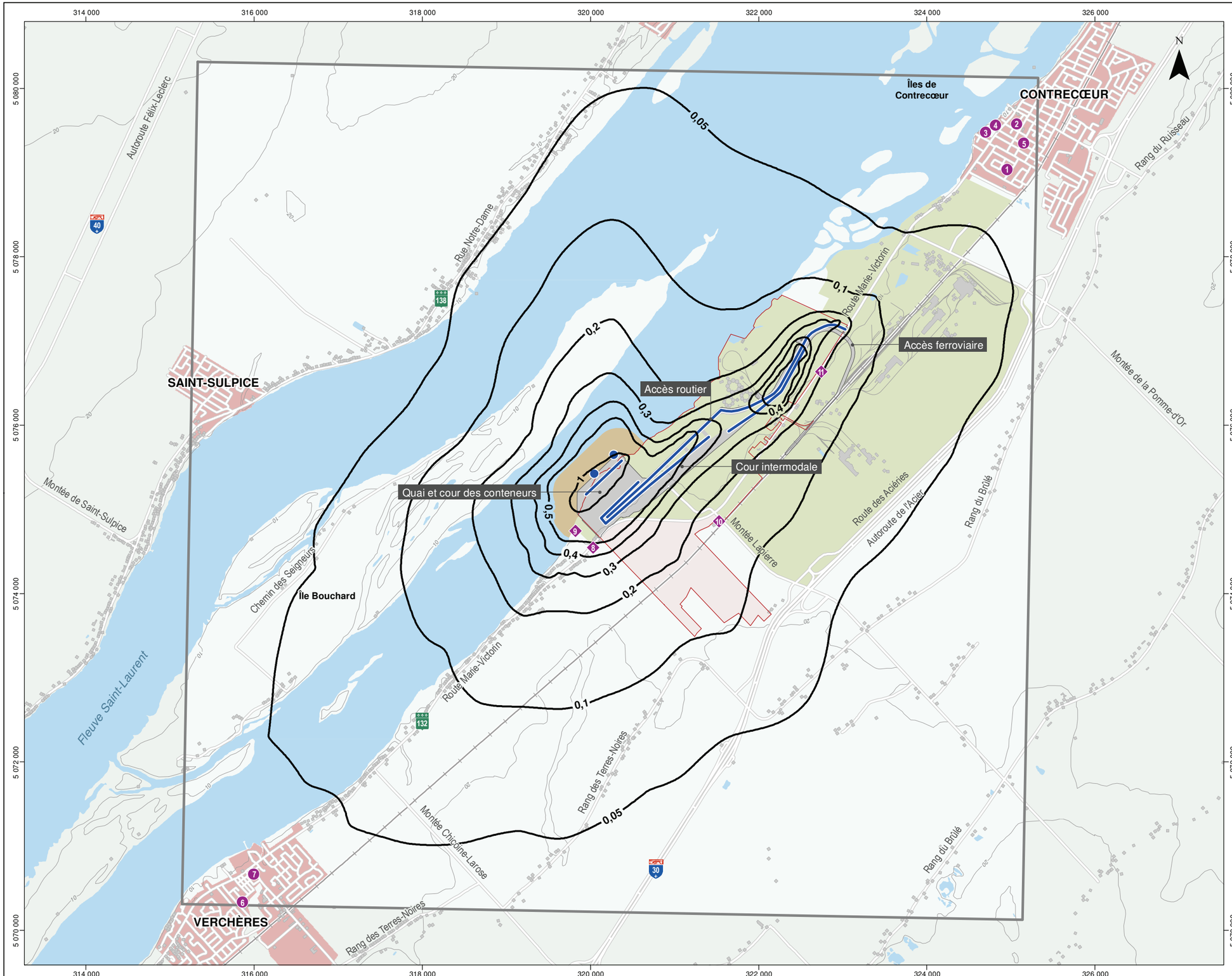
Projet: 643872

0 450 900 m
1/45 000
Projection MTM, fuseau 8, NAD83

Rév.	aaaa/mm/jj	Description	Préparé	Vérifié
01	2017/07/07	Finale	A. Chouinard	É. Delisle
00	2017/05/25	Préliminaire	A. Chouinard	É. Delisle

Format 11x17

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Composantes du projet

- Aire du projet - Variante 2
- Courbe de niveau (équidistance de 10 m)

Modélisation atmosphérique

- Domaine de modélisation
- Source de contaminants atmosphériques
- Récepteur sensible
- Résidence

Territoires exclus de la modélisation

- Territoire de l'APM
- Affectation industrielle
- Zone tampon de 300 m du quai

Concentration d'acétaldéhyde

- 99^{e} centiles des concentrations calculées dans l'air ambiant (µg/m^{3})

Critère provisoire du MDDELCC : 3 µg/m^{3}

Notes :
Les concentrations indiquées ne tiennent compte que de la contribution du projet.

Modèle de dispersion : AERMOD version 16216r
Météorologie : Varennes 2008-2012

Numéro	Récepteurs sensibles et résidences
1	C.P.E. Petit à Petit
2	École Mère-Marie-Rose
3	Centre d'hébergement de Contrecœur
4	Résidence L'Autre Jeunesse
5	Maison des Gens Heureux
6	École Ludger-Duvernay
7	Résidence Florentine-Dansereau
8	1220, Rte Marie-Victorin, Verchères
9	1219, Rte Marie-Victorin, Verchères
10	986, Montée Lapierre, Contrecœur
11	2001, Rte Marie-Victorin, Contrecœur

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Projet d'agrandissement du terminal de Contrecœur

Figure 4.9
99^{e} centiles des concentrations sur 4 minutes (µg/m^{3}) d'acétaldéhyde calculées dans l'air ambiant lors de l'exploitation

Sources :
MRC Marguerite-D'Youville
Adresses Québec, MERN, mars 2015
Carte écoforestière, 1/20 000, MRN, 2010
CanVec, 1/50 000, RNCan, 2017
Composantes du projet, APM, février 2017

Projet: 643872

0 450 900 m
1/45 000
Projection MTM, fuseau 8, NAD83

Rév.	aaaa/mm/jj	Description	Préparé	Vérifié
01	2017/07/07	Finale	A. Chouinard	É. Delisle
00	2017/05/25	Préliminaire	A. Chouinard	É. Delisle

Format 11x17

\\sli1877\SLEI\PROJ\639223_APM_EIE_Contrecoeur\4.7_CadDaoSig\GEOMATIQUE\interne\diffusion\produits\643872-01-Dispersion\snc643872_air_f4-9_ACD_4min_tab_170707_pre01.mxd

5 Incertitudes et conclusions

5.1 Incertitudes liées aux résultats modélisation

Un modèle de dispersion atmosphérique comme le modèle AERMOD considère les principaux phénomènes physiques du transport et de la dispersion des contaminants atmosphériques dans l'atmosphère. Tous les modèles peuvent sous-estimer ou surestimer les phénomènes qu'ils tentent de reproduire. Un bon modèle sera « en moyenne » très près de la réalité. Le modèle AERMOD a cependant été développé dans un contexte règlementaire pour démontrer le respect des normes de qualité de l'air ambiant des émissions de projets industriels. Dans son développement et dans ses recommandations d'utilisation, l'US-EPA préfère donc un modèle qui ne sous-estime pas les concentrations ambiantes à un modèle plus précis, mais qui parfois à tendance à la sous-estimation. De par sa formulation même, AERMOD est donc conservateur et a donc tendance à une légère surestimation des concentrations ambiantes. La fiabilité d'AERMOD est aussi supérieure pour estimer les concentrations moyennes à long terme que les concentrations moyennes à court terme.

Mais dans l'incertitude d'une étude de dispersion, la performance d'AERMOD ou son exactitude est habituellement moins importante que l'incertitude liée aux conditions d'utilisation et de la fiabilité des intrants (données météorologiques, phénomènes modélisés, informations sur les sources et les taux d'émission de contaminants, etc.). Dans le cadre de l'application du *Règlement sur l'assainissement de l'atmosphère*, l'objectif ultime est de démontrer que les normes de qualité de l'air ambiant seront respectées en tout temps. Pour ce faire, plusieurs hypothèses conservatrices ont été considérées en plus de l'aspect conservateur d'AERMOD :

- L'effet des précipitations sur l'atténuation des émissions fugitives de PM sur les routes ou sur l'érosion éolienne sur l'aire de disposition des sédiments est négligé, de même que le phénomène de déposition humide. Cette hypothèse engendre principalement une surestimation des concentrations moyennes annuelles ou des fréquences de concentrations journalières ou horaires élevées.
- L'ajout de concentrations initiales élevées et peu fréquentes aux concentrations maximales simulées, sans savoir si elles surviennent simultanément.
- Considération d'une conversion totale du NO en NO_2 pour estimer les concentrations maximales annuelles et sur 24 heures. Bien que la méthode OLM ait été utilisée pour estimer les concentrations maximales horaires de NO_2, des concentrations élevées d'ozone et de NO_2 comme concentrations initiales ont été considérées dans l'analyse. Or, dans la réalité, les concentrations élevées d'ozone sont associées à de faibles concentrations ambiantes de NO_2 et vice-versa. Les impacts du projet concernant le NO_2 sont donc conservateurs (surestimation) pour toutes les périodes.

Du point de vue météorologique, la base de données météorologique est considérée de grande qualité. En effet, la station de Varennes est située à seulement 14 km du projet, dans un environnement similaire et dans la même zone climatique. Bien que la station de Maniwaki, d'où proviennent les sondages aérologiques utilisés pour estimer les hauteurs de mélange convectives durant le jour, soit relativement éloignée du site (220 km), et donc pas toujours sous l'action du même système météorologique que la station de Varennes, il n'existe pas d'autres données disponibles. Cette situation est commune à presque toutes les études de dispersion réalisées au Québec. D'ailleurs, étant donné que les sources à l'étude sont presque toutes au niveau ou à quelques mètres du sol, l'influence de la hauteur de mélange convective durant le jour sera négligeable (par exemple, que la hauteur de mélange ait 200 ou 1000 m

n'influencera pas les résultats pour des sources d'émissions près de la surface sans élévation de panache).

Dans la définition des scénarios de construction et d'exploitation, quelques hypothèses de pire cas ont été considérées :

- Sélection du pire cas d'émissions atmosphériques lors de la construction avec le scénario de dragage avec disposition des sédiments.
- Considération de la présence de deux navires à quai avec génératrices diesels (au lieu d'un branchement électrique avec le terminal) lors de l'exploitation.
- Exploitation typique d'un jour de semaine sur toute la période de modélisation pour l'estimation des concentrations maximales à court terme lors de l'exploitation.

La variabilité horaire ou journalière des diverses activités lors de la construction ou de l'exploitation du terminal en exploitation est évidemment bien trop complexe pour pouvoir être intégrée dans le modèle de dispersion. C'est pourquoi une journée typique moyenne de semaine (pas d'accès de camions les fins de semaine) avec deux navires diesels à quai a été considérée dans le scénario de modélisation pour l'exploitation. Pour la construction, le scénario de pire cas d'émissions atmosphériques a été considéré.

Du point de vue des facteurs d'émission atmosphérique pour la combustion dans les moteurs, ces derniers sont représentatifs de l'ensemble d'une population de moteurs diesels, pas nécessairement des émissions d'un moteur spécifique. Par contre, étant donné le nombre élevé d'engins diesels utilisés durant la construction ou l'exploitation, les facteurs d'émission sont donc jugés représentatifs des engins utilisés par le projet. Aussi, les facteurs d'émission considérés sont ceux pour 2017 ou avant. Lors de l'exploitation vers 2023 et après, les émissions des moteurs diesels seront vraisemblablement plus faibles en raison des développements technologiques.

Finalement, l'aspect de l'étude de dispersion qui comporte le plus haut degré d'incertitude est certainement l'estimation des émissions fugitives de poussières, que ce soit lors de la construction ou de l'exploitation. Les émissions fugitives de matières particulaires ont été estimées en fonction des caractéristiques du projet et des facteurs d'émission de l'AP-42 pour les routes et les activités de construction et de la méthode suggérée par le MDDELCC (2017) pour l'érosion éolienne. Ces méthodes approximatives sont basées sur des relations empiriques établissant une corrélation moyenne entre les facteurs d'émission et les propriétés des matériaux ou de la surface de la route (teneurs en silt, humidité). En l'absence de données propres au site d'application, tel que les teneurs en silt libre sur les surfaces des routes ou des zones sujettes à l'érosion éolienne pour lesquelles des valeurs ont été assumées dans cette étude, ces méthodes peuvent être qualifiées d'approximatives et représentent ainsi l'ordre de grandeur des émissions, plutôt qu'une estimation précise.

5.2 Conclusions de l'étude de dispersion

Le modèle de dispersion atmosphérique AERMOD a été utilisé conjointement avec cinq années de données météorologiques (2008-2012) de Varennes pour estimer les concentrations maximales d'une multitude de contaminants atmosphériques dans l'air résultant de la construction et de l'exploitation du projet d'un nouveau terminal de conteneurs à Contrecœur par l'APM.

Selon les résultats de modélisation de la dispersion atmosphérique, il appert que les effets sur la qualité de l'air pour le monoxyde de carbone, le dioxyde de soufre et les contaminants toxiques sont marginaux. En effet, les concentrations maximales calculées dans l'air ambiant sont très inférieures aux normes et critères québécois et aux normes canadiennes de qualité de l'air et aux concentrations qui seraient déjà présentes dans le milieu ambiant. Pour le NO_2, tous les résultats demeurent nettement inférieurs aux normes de qualité de l'air ambiant que ce soit pour la phase de construction ou celle de l'exploitation. Pour les contaminants gazeux et les composés toxiques, les impacts seraient plus importants durant l'exploitation que durant la construction, principalement à cause des émissions des moteurs diesels et des taux d'activité plus intenses.

Les impacts appréhendés sont plus importants au niveau des concentrations de matières particulaires dans l'air ambiant, principalement lors de la construction. En effet, pour la phase de construction, des dépassements des normes journalières de PM_T et de $PM_{2.5}$ ont été calculés pour la résidence située à l'est de la zone n°4 pour la disposition des sédiments dans la zone industrielle. Des dépassements potentiels pour ces paramètres ont aussi été calculés en phase de construction à l'extérieur de la zone industrielle de 0,3 à 1 km au sud-ouest du terminal. Tel que discuté dans la section précédente sur les incertitudes liées à l'estimation des émissions de PM lors de la construction, les résultats de l'étude de dispersion sont directement tributaires des teneurs présumées en silt libre à la surface des aires de disposition des sédiments et à la surface des routes ou à l'étendue de la surface sèche de l'aire de disposition des sédiments (100% de pleine surface sèche et en tout temps dans la modélisation). Ces teneurs de silt pourraient être supérieures ou inférieures par un facteur important aux teneurs considérées pour l'étude de dispersion. Ainsi, pour la construction, à cause des incertitudes dans l'estimation des émissions atmosphériques, l'étude de dispersion ne permet pas de conclure sur le dépassement ou non des normes de matières particulaires dans l'air ambiant à la résidence dans la zone industrielle et à l'extérieur de la zone industrielle au sud-ouest du terminal.

Pour la phase de construction, des dépassements des normes journalières de PM_T et de $PM_{2.5}$ du RAA ont été calculés par modélisation pour la résidence à l'intérieur de la zone industrielle (pour l'option de disposition des sédiments à la zone 4) et au sud-ouest de la zone industrielle. Puisque les résultats de modélisation pour les concentrations maximales et les fréquences calculées de dépassements des normes à cette résidence sont plus élevés qu'au sud-ouest de la zone industrielle, le risque de dépassement des normes y est plus élevé. Il appert que seules des mesures des teneurs en silt ou encore mieux de la qualité de l'air ambiant durant la construction permettraient de vraiment conclure sur ce problème. Pour les autres contaminants et partout dans les zones urbaines de Contrecœur et de Verchères, il appert que la construction du projet respecte les normes du *Règlement sur l'assainissement de l'atmosphère* (RAA) et que les normes canadiennes de qualité de l'air ambiant ne seraient pas dépassées.

Pour la phase d'exploitation, les incertitudes sur les résultats de PM sont moins importantes que pour la phase de construction et les résultats pour la contribution du projet sont beaucoup plus faibles. Tous les résultats sont inférieurs aux normes de qualité de l'air ambiant du RAA et la contribution du projet est inférieure aux concentrations initiales. Il appert donc que le projet en phase d'exploitation respecte les normes du RAA et que sa réalisation n'entrainerait pas de dépassements des normes québécoises et canadiennes de qualité de l'air ambiant pour tous les contaminants.

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Annexe A

Estimation des émissions atmosphériques durant la construction

A. Estimation des émissions atmosphériques durant la construction

Tableau A.1 Taux d'émission des moteurs diesels

Équipements (puissance moteur)	NOx	SO_2	CO	NH_3	PM_T	PM_{10}	$PM_{2.5}$
Excavatrice (268 hp)	0,0123	0,000222	0,00513	0,000381	0,000483	0,000483	0,000469
Compacteur (100 hp)	0,00460	0,0000919	0,00627	0,000158	0,000180	0,000180	0,000175
Bouteur (138 hp)	0,00635	0,000114	0,00310	0,000196	0,000243	0,000243	0,000236
Camion hors-route (500 hp)	0,0230	0,000414	0,0113	0,000710	0,000902	0,000902	0,000875
Drague (208 hp)	0,00957	0,000172	0,00467	0,000295	0,000366	0,000366	0,000355
Camions routiers (lourd)	0,0113	0,000150	0,00339	0,000225	0,00256	0,00256	0,000562
Remorqueur (1500 hp)	0,957	0,000916	0,255	0,00351	0,0191	0,0191	0,0176

Ces taux sont tirés de l'inventaire des émissions atmosphériques (SNC-Lavalin, 2017).

Tableau A.2 Propriétés des matériaux et des surfaces des routes

Matériaux	% silt	% humidité	t/m³	t/m³ (grain)	Notes
Sédiments humides	7,4	30	1,7	2,7	AP-42 - Argile, caractérisations
Sédiments asséchés (digues)	7,4	6	1,7	2,7	AP-42 - Argile
Routes					
Routes pavées (g/m²)	3,9				AP42 - Carrières, sites d'enfouissement - Moyenne de 7,8, réduction 50% pour gestion des poussières
Routes non-pavées	8,5				AP42 - Construction sites

Tableau A.3 Taux d'activité durant le dragage

Durée journalière	12	h/jour
Taux journalier	4800	m³/jour
Taux horaire	400	m³/h
Masse volumique des sédiments	1,7	t/m³
Taux horaire	680	t/h

Tableau A.4 Facteurs d'émission pour les transferts de matériaux

Transferts (pelle mécanique, chargement/déchargement)
Référence:AP42, section 13.2.4, Aggregate Handling and Storage Piles

$$FE = k \times 0{,}0016 \frac{(U/2{,}2)^{1{,}3}}{(M/2)^{1{,}4}}$$

FE: facteur d'émission (kg/t)
U: Vitesse moyenne du vent (m/s)
M: % humidité du matériel

	PM_T	PM_{15}	PM_{10}	PM_5	$PM_{2.5}$
Constante k	0,74	0,48	0,35	0,2	0,053

Vitesse moyenne du vent (m/s) 3,79 Varennes (2008-2012)

Facteurs d'émission (kg/t)

Matériaux	% humidité	PM_T	PM_{15}	PM_{10}	PM_5	$PM_{2.5}$
Sédiments humides	30	5,42E-05	3,52E-05	2,56E-05	1,47E-05	3,88E-06
Sédiments asséchés	6	5,16E-04	3,35E-04	2,44E-04	1,39E-04	3,70E-05
Matériaux granulaire	2,1	2,24E-03	1,46E-03	1,06E-03	6,06E-04	1,61E-04
Terre	3,4	1,14E-03	7,41E-04	5,41E-04	3,09E-04	8,19E-05

Tableau A.5 Taux d'émission liés au boutage et compactage

Boutage/Compactage (fugitives)
Réf.: AP-42, section 11.9 Western Surface Coal Mining
Tableau 11.9-2: Équations pour les taux d'émission de poussières

$$PM_T = \frac{2{,}6\ s^{1{,}2}}{M^{1{,}3}}$$

$$PM_{15} = \frac{0{,}45\ s^{1{,}5}}{M^{1{,}4}}$$

PM_{10} = 0,75 x PM_{15}
$PM_{2,5}$ = 0,105 x PM_T
M: Humidité (%)
s: Teneur en silt (%)

Facteur d'utilisation 50%
Le facteur d'utilisation permet de tenir compte que les bouteurs travaillent effectivement environ 50% du temps.

Taux d'émission (kg/h) = équations ci-haut x facteur d'utilisation

Matériaux	% silt	% humidité	PM_T	PM_{15}	PM_{10}	$PM_{2.5}$
Sédiments humides	7,4	30	0,172	0,0387	0,0290	0,0181
Sédiments asséchés	7,4	6,0	1,40	0,369	0,276	0,147

Tableau A.6 Taux d'émission liés à l'érosion éolienne sur les zones de disposition des sédiments

Taux d'émission surfacique (g/m²/s) =	**1,52 x 10^{-5} x J x s, si la vitesse du vent est >= à 19,3 km/h**		
	0, si la vitesse du vent est inférieure à 19,3 km/h		
	Modèle du Guide du MDDELCC		
où:	s: teneur moyenne en silt du matériau		
	J (facteur de classe de particules)		
	PM_T	**PM_{10}**	**$PM_{2.5}$**
Facteurs J	1	0,5	0,075
% silt du matériel	7,4	AP42, Argile	
	PM_T	**PM_{10}**	**$PM_{2.5}$**
Taux d'émission surfacique (g/s/m²)	**1,12E-04**	**5,62E-05**	**8,44E-06**
Surfaces (m²), zone 4A	48070		
Surfaces (m²), zone 4B	149232		
% de pile active	100%	Émission d'avril à novembre	
Taux d'émission (g/s) - Surface sèche, lorsque vent >= 19.3 km/h			
	PM_T	**PM_{10}**	**$PM_{2.5}$**
Zone 4A	5,4	2,7	0,4
Zone 4B	16,8	8,4	1,3
Fréquence d'émission	21,1%	Vent >= 19.3 km/h, Varennes	

Tableau A.7 Taux d'émission de matières particulaires fugitives sur les routes pavées

Poussières de routes pavées
Réf.: AP42, section 13.2.1, Routes pavées

$$FE = k(sL)^{0,91}\, W^{1,02}$$

FE=Facteur d'émission de particules (g/VKT)
k = multiplicateur selon la classe de particule
sL =teneur en silt à la surface de la route (g/m^2)
silt: matière libre dont le diamètre est inférieur ou égal à 75 µm de diamètre.
W = masse moyenne (en tonne) des véhicules circulant sur la route

Facteurs K (g/VKT)	3,23	0,77	0,62	0,15

g/VKT: gramme par kilomètre parcouru

Accès au site (route 1): 150 camions de 30 tons (masse moyenne) par jour
Route de transport des sédiments du quai aux zones 4A et 4B (Route 2): 220 voyages par jour

Volume par jour (m³)	4800
Volume par chargement (m³)	22
Masse volumique des sédiments (t/m³)	1,7
Masse par chargement (t)	37,4
Masse camion vide (t), type CAT740	36
Masse camion chargé (t)	73,4
Masse moyenne des camions (t)	54,7
Masse moyenne des camions (tons)	**60,3**

Masses et distances parcourues par jour (VKT/j)

Route	Masse moyenne des véhicules (W, tons)	Longueur des trajets (km)	Trajets par jour	VKT/jour
Route 1	30	2,05	150	308
Route 2B	60,3	4,55	220	1002

aller-retour

Teneur en silt des routes (sL, g/m²) 3,9

Facteurs d'émission (g/km)

Route	PM_T	PM_{15}	PM_{10}	$PM_{2.5}$
Route 1	358	85	69	17
Route 2B	729	174	140	34

Émissions par jour (kg/j)

Route	PM_T	PM_{15}	PM_{10}	$PM_{2.5}$
Route 1	110	26	21	5,1
Route 2B	731	174	140	34

Taux d'émission (g/s)

Route	PM_T	PM_{15}	PM_{10}	$PM_{2.5}$	Heures/jour
Route 1 (7 à 17 h)	3,06	0,729	0,587	0,142	10
Route 2B (7 à 19 h)	16,9	4,03	3,25	0,786	12

Tableau A.8 Taux d'émission de matières particulaires fugitives sur les routes non pavées

Poussières de routes non-pavées
Réf.: AP42, section 13.2.1, Routes non-pavées
Facteur d'émission des surfaces non-pavées des sites industriels:

$$FE = 281,9\ k\ (s/12)^a (W/3)^b\ (1 - \%EC)$$

FE	Facteur d'émission (g/VKT)
281,9	Facteur de conversion de lb/VMT à g/VKT
s	Teneur en silt de la surface de la route (%)
W	Masse moyenne (en tons) des véhicules
k, a et b	Constants empiriques
%EC	Efficacité de contrôle des émissions
VMT	Véhicules-miles parcourus
VKT	Véhicules-kilomètres parcourus

Constantes	PM_T	PM_{10}	$PM_{2.5}$
k (lb/miles)	4,9	1,5	0,15
a	0,7	0,9	0,9
b	0,45	0,45	0,45

Teneur en silt de la surface des routes (%):	8,5	
Facteur d'efficacité de contrôle des émissions (%EC):	90%	arrosage régulier
Masse moyenne des véhicules (tons)	60,3	Voir routes pavées, tableau A.7
Nombre de voyages par jour	220	Voir routes pavées, tableau A.7

Masses et distances parcourues par jour (VKT/j)

Routes	Masse moyenne des véhicules (W, tons)	Longueur des trajets (km)	Trajets par jour	VKT/jour
Route 2A	60,3	0,9	220	194
Route 2C	60,3	0,6	220	128

Aller-retour

Facteurs d'émission (g/km)

Routes	PM_T	PM_{10}	$PM_{2.5}$
Route 2A	1650	698	69,8
Route 2C	1650	698	69,8

Émissions par jour (kg/j)

Routes	PM_T	PM_{10}	$PM_{2.5}$
Route 2A	320	135	13,5
Route 2C	211	89	8,9

Taux d'émission (g/s)

Routes	PM_T	PM_{10}	$PM_{2.5}$	Heures/jour
Route 2A (7 à 19 h)	7,4	3,13	0,313	12
Route 2C (7 à 19 h)	4,9	2,07	0,207	12

Tableau A.9 Taux d'émission de PCA liés aux gaz d'échappement sur les routes

Routes pavées

Émissions par engin (g/s)*	NOx	SO_2	CO	NH_3	PM_T	PM_{10}	$PM_{2.5}$
Camions routiers	0,0113	0,000150	0,00339	0,000225	0,00256	0,00256	0,000562
Camions hors-route	0,0230	0,000414	0,0113	0,000710	0,000902	0,000902	0,000875

* voir tableau A.1

Route	VKT/jour	Vitesse (km/h)	Heure-engin (h/j)	
Route 1	308	25	12,3	VKT : voir tableau A.7
Route 2B	1002	25	40,1	VKT : voir tableau A.7

Émissions par jour (kg/j)

Route	NOx	SO_2	CO	NH_3	PM_T	PM_{10}	$PM_{2.5}$
Route 1	0,50	0,007	0,15	0,010	0,11	0,11	0,025
Route 2B	3,3	0,060	1,6	0,10	0,13	0,13	0,13

Taux d'émission (g/s)

Route	NOx	SO_2	CO	NH_3	PM_T	PM_{10}	$PM_{2.5}$	Heures par jour
Route 1 (7 à 17 h)	0,0139	0,000184	0,00417	0,000276	0,00315	0,00315	0,000691	10
Route 2B (7 à 19 h)	0,0769	0,00138	0,0378	0,00237	0,00301	0,00301	0,00292	12

Routes non pavées

Émissions par engin (g/s)*	NOx	SO_2	CO	NH_3	PM_T	PM_{10}	$PM_{2.5}$
Camions hors routes	0,0230	0,000414	0,0113	0,000710	0,000902	0,000902	0,000875

* voir tableau A.1

Routes	VKT/jour	Vitesse (km/h)	Heure-engin (h/j)	
Route 2A	194	25	44,4	VKT : voir tableau A.8
Route 2C	128	25	23,5	VKT : voir tableau A.8

Durée: temps de parcours + 10 minutes par voyage pour chargement (2A) ou 5 minutes pour déchargement (2B).

Émissions par jour (kg/j)

Routes	NOx	SO_2	CO	NH_3	PM_T	PM_{10}	$PM_{2.5}$
Route 2A	3,68	0,066	1,81	0,11	0,14	0,14	0,14
Route 2C	1,94	0,035	0,96	0,060	0,076	0,076	0,074

Taux d'émission (g/s)

Routes	NOx	SO_2	CO	NH_3	PM_T	PM_{10}	$PM_{2.5}$	Heures par jour
Route 2A (7 à 19 h)	0,0852	0,00153	0,0419	0,00263	0,00334	0,00334	0,00324	12
Route 2C (7 à 19 h)	0,0450	0,000809	0,0221	0,00139	0,00176	0,00176	0,00171	12

Tableau A.10 Taux d'émission de PCA et de matières particulaires fugitives au quai et à la zone de disposition des sédiments

Quai (12 heures/jour) - Source volumique

Équipement/activité	**Nombre**	**NOx**	**SO_2**	**CO**	**NH_3**	**PM_T**	**PM_{15}**	**PM_{10}**	**$PM_{2.5}$**
Combustion (g/s) par unite (tableau A.1)									
Excavatrice (268 hp)	3	0,0123	0,000222	0,00513	0,000381	0,000483		0,000483	0,000469
Total - Combustion (g/s)		**0,0370**	**0,000665**	**0,0154**	**0,00114**	**0,00145**		**0,00145**	**0,00141**
Fugitives									
Transfert de sédiments	680	t/h	Voir tableau A.2						
FE (kg/t) – (tableau A.4)						5,42E-05	3,52E-05	2,56E-05	1,47E-05
Total - Fugitives (g/s)		**0,000**	**0,000**	**0,000**	**0,000**	**0,0102**		**0,00484**	**0,00277**

Aire de disposition des sédiments (12 heures/jour) - Source volumique

Équipement/activité	**Nombre**	**NOx**	**SO_2**	**CO**	**NH_3**	**PM_T**	**PM_{15}**	**PM_{10}**	**$PM_{2.5}$**
Combustion (g/s), par unité (tableau A.1)									
Excavatrice (268 hp)	4	0,0123	0,000222	0,00513	0,000381	0,000483		0,000483	0,000469
Compacteur (100 hp)	1	0,00460	0,0000919	0,00627	0,000158	0,000180		0,000180	0,000175
Bouteur (138 hp)	4	0,00635	0,000114	0,00310	0,000196	0,000243		0,000243	0,000236
Total - Combustion (g/s)		**0,0794**	**0,00144**	**0,0392**	**0,00246**	**0,00309**		**0,00309**	**0,00299**
Fugitives									
Transfert de sédiments humides	408	t/h	(60% des sédiments totaux: 1 transfert: déchargement)						
Transfert de sédiments asséchés	544	t/h	(40% des sédiments totaux, 2 transferts: déchargement et pelle mécanique)						
FE - humides (kg/t) – tableau A.2						5,42E-05	3,52E-05	2,56E-05	3,88E-06
FE - asséchés (kg/t) – tableau A.2						**5,16E-04**	3,35E-04	2,44E-04	3,70E-05
Total - Transferts (g/s)						**0,0841**	**0,0546**	**0,0398**	**0,00602**
Boutage/compactage humide (g/s) (par unité, tableau A.5)	2					0,0479	0,0108	0,00807	0,00503
Boutage/compactage asséché (g/s) (par unité, tableau A.5)	3					0,388	0,102	0,0768	0,0408
Total - Boutage/compactage (g/s)						**1,26**	**0,329**	**0,247**	**0,132**
Total - Fugitives (g/s)		**0,000**	**0,000**	**0,000**	**0,000**	**1,34**	**0,383**	**0,286**	**0,138**

Annexe B

Estimation des émissions fugitives de matières particulaires durant l'exploitation

B. Estimation des émissions fugitives de matières particulaires durant l'exploitation

Tableau B.1 Estimation des déplacements des véhicules de transport/manutention de conteneurs

Terminal		
Capacité (EVP/an)	1 150 000	
Aire maritime		
Horaire d'exploitation (lorsqu'un navire est présent)	365 jours/an, 24/24	
Cargaison typique d'un navire (EVP)	3 700	
A chaque escale (déchargement, chargement) (EVP)	7 400	
Nombre de navires par an	155	
Nombre de navires par semaine	3	
Durée par escale (heures)	48	
Taux de transfert moyen (EVP/h)	154	
EVP/jour	**3 700**	
EVP/mouvement	1.8	
Aller-retour de véhicule par jour	**2 056**	
Aire terrestre	**Route**	**Triage**
Horaire d'exploitation	5 jrs/sem	365/365
Jours d'exploitation par année	260	365
Heures d'exploitation	6-18 h	24/24
% EVP	55%	45%
EVP/an	632 500	517 500
EVP/jour	**2 433**	**1 418**
EVP/mouvement de conteneur	1.0	1.8
Aller-retour de véhicule par jour	**1 216**	**788**

Notes:
- route d'accès: camions chargés (1 EVP) à l'aller et au retour.
- aire maritime et triage: véhicules chargés (1,8 EVP) à l'aller et vides au retour.

Masse moyenne d'un conteneur (t/EVP) 12

Tableau B.2 Génération de poussières sur le chemin d'accès et les surfaces pavées

Réf.: AP42, section 13.2.1, Routes pavées

Facteur d'émission des routes pavées :

$$E = k(sL)^{0.91}W^{1.02}$$

E=Facteur d'émission de matières particulaires (g/km parcouru)
k = multiplicateur selon la classe de particules.
sL =teneur en silt à la surface de la route (g/m^2).
silt: matière libre dont le diamètre est inférieur ou égal à 75 µm de diamètre.
W = masse moyenne (en tonne américaine) des véhicules circulant sur la route.

Type de particules	k (g/VKT)
$PM_{2.5}$	0.15
PM_{10}	0.62
PM_{15}	0.77
PM_{30} (PM_T)	3.23

g/VKT: gramme par kilomètre parcouru

Masse des types de véhicules

	Véhicules				
Type de véhicule	Camion routier	Camions de cours	Chariot cavalier	Chariot élévateur	Chariot gerbeur
Zone de circulation	Route d'accès	Terrestre	Maritime	Terrestre Maritime	Terrestre Maritime
EVP par mouvement	1.0	1.8	1.8	1.8	1.8
Nombre de véhicules		30	24	3	2
Masse à vide (t)	11.5	9.6	57.0	68.0	68.5
Charge utile (t/voyage)	12	21.6	21.6	21.6	21.6
Masse chargée (t)	23.5	31.2	78.6	89.6	90.1
Masse moyenne (t)	23.5	20.4	67.8	78.8	79.3

% des déplacements intra-terminal selon le type de véhicule et masse moyenne pondérée

	Zone terrestre	Zone maritime	Masse moyenne (t)
Nombre d'EVP par jour	1 418	3 700	
Camion de cours	92.3%	0.0%	20.4
Chariot cavalier	0.0%	90.6%	67.8
Chariot élévateur	4.6%	5.7%	79
Chariot gerbeur	3.1%	3.8%	79.3
Masse moyenne pondérée (t)	**24.9**	**68.9**	

Distances parcourues par type de route

Sources	Longueur des trajets (km)	Trajets par jour	VKT/jour
Camions sur la route d'accès	7.1	1 216	8 636
Véhicules - secteur terrestre	2.60	788	2 048
Véhicules - secteur maritime	0.75	2 056	1 542

aller-retour

Teneur en silt par type de route (g/m²)

Sources	Été	Hiver
Camions sur la route d'accès	0.06	0.12
Véhicules - secteur terrestre	0.06	0.12
Véhicules - secteur maritime	0.03	0.06

Les valeurs suggérées par EPA pour une route normale avec 500-5 000 véhicules par jour dont le trafic est dominé par des véhicules légers (W:2,5-3 tons) sont de 0,2 et 0,6 g/m². Avec des masses de plus de 22 tons à 76 tons, chaque passage de véhicule au terminal correspond aux émissions à 7 à 25 passages de véhicules sur une route normale. Des teneurs en silt à l'équilibre correspondant à 5 000-10 000 véhicules par jour (0,06 g/m²) ou plus de 10 000 véhicules par jour (0,03 g/m²) sont donc sélectionnées. En hiver, ces teneurs sont multipliées par deux pour tenir compte de l'utilisation de fondants et d'abrasifs sur les chaussées.

Facteurs d'émission (g/km)

Sources	Masse moyenne pondérée (t)	Masse moyenne pondérée (tons)	Été (g/km)			Hiver (g/km)		
			PM_T	PM_{10}	$PM_{2.5}$	PM_T	PM_{10}	$PM_{2.5}$
Camions sur la route d'accès	23.5	25.9	6.90	1.32	0.32	12.97	2.49	0.60
Véhicules - secteur terrestre	24.9	27.5	7.32	1.41	0.34	13.76	2.64	0.64
Véhicules - secteur maritime	68.9	75.9	11.00	2.11	0.51	20.66	3.97	0.96

Émissions par jour (kg/j) – Facteurs d'émission (g/km) X VKT (km/jour, page précédente)

Sources	Été			Hiver		
	PM_T	PM_{10}	$PM_{2.5}$	PM_T	PM_{10}	$PM_{2.5}$
Camions sur la route d'accès	60	11	2.8	112	21	5.2
Véhicules - secteur terrestre	15	2.9	0.70	28	5.4	1.3
Véhicules - secteur maritime	17	3.3	0.8	32	6.1	1.5

Taux d'émission (g/s)

Sources	Été			Hiver			Heures/jour	
	PM_T	PM_{10}	$PM_{2.5}$	PM_T	PM_{10}	$PM_{2.5}$		
Camions sur la route d'accès	1.38	0.265	0.0641	2.59	0.498	0.120	12	6 - 18 h
Véhicules - secteur terrestre	0.174	0.0333	0.00806	0.33	0.0626	0.0151	24	24/24
Véhicules - secteur maritime	0.196	0.0377	0.0091	0.369	0.0708	0.0171	24	24/24

Émissions annuelles (t/an)

Sources	PM_T	PM_{10}	$PM_{2.5}$
Camions sur la route d'accès	20	3.8	0.93
Véhicules - secteur terrestre	7.1	1.4	0.33
Véhicules - secteur maritime	6.8	1.3	0.32
Total	34	6.5	1.6

EVP/jour	EVP/an	Jours
2433	632500	260
1418	517500	365
3700	1150000	311

Été	66.7%	du temps (avril à novembre)
Hiver	33.3%	du temps (décembre à mars)



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