Technical Memorandum: Review of Potential Alternative Mucking Location for East-West Tunnel

Ottawa Combined Sewer
Storage Tunnel (CSST)

City of Ottawa Contract No.
ISD14-2036

Prepared for:
City of Ottawa

Prepared by:

Stantec Consulting Ltd.

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Sign-off Sheet

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Reviewed by _____
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Adrien Comeau

December 20, 2016

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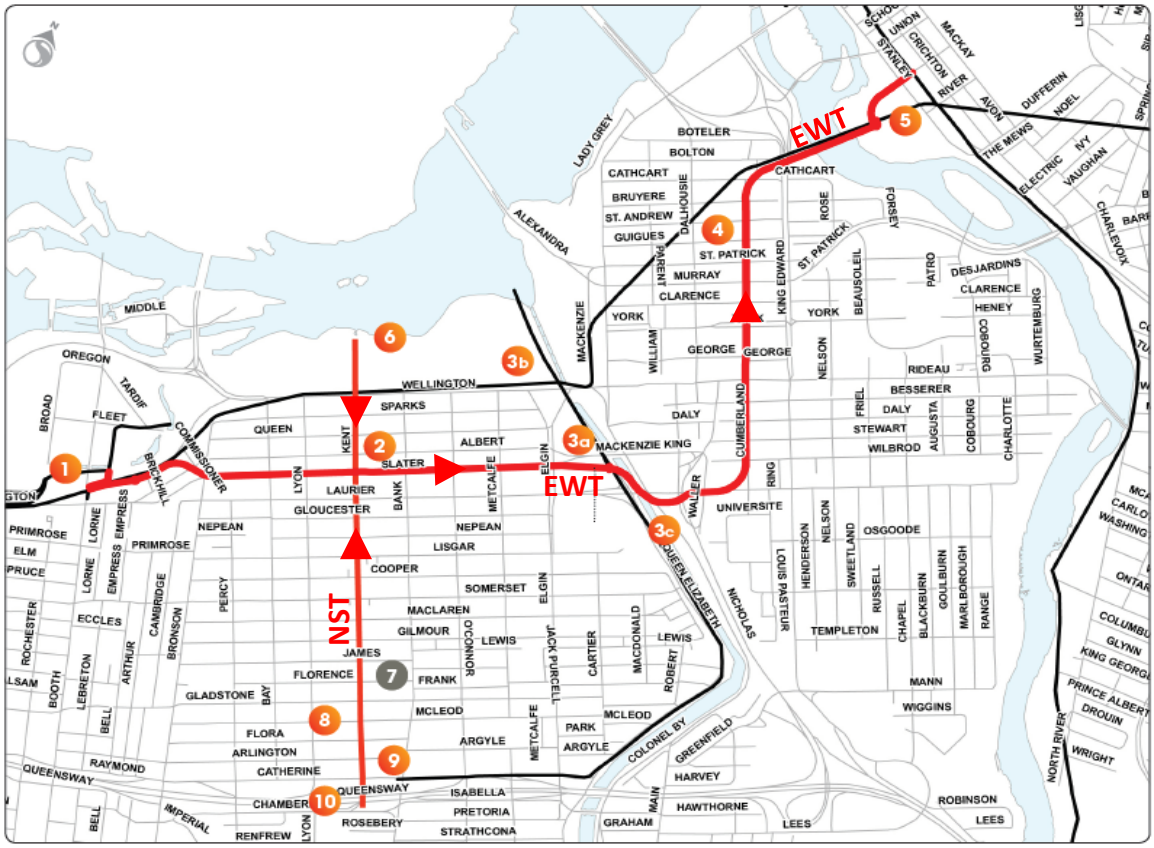
1.0 Introduction

The purpose of this technical memorandum is to review the possibility of relocating the launch and/or mucking operations of the East-West Tunnel (EWT) away from Site 5 of the CSST and to an alternate location. Exhibit 1 provides a high-level outline of the two CSST tunnels (EWT & NST) and the various related construction sites. This technical memorandum will document the high-level review undertaken in assessing the feasibility and implications of relocating these operations to one of the following sites:

- Site 3c – Nicholas/Laurier (the halfway point of the EWT)
- Bordeleau Park (opposing shore of the Rideau River from Site 5)
- Site 1 – Lebreton Flats (the other end of the EWT)

Exhibit 1: CSST Key Plan



2.0 Site 5 Staging Area

In order to meet the City Council's mandated Combined Sewer Overflow (CSO) control objectives, as well as meet Provincial policy objectives, the Combined Sewage Storage Tunnel (CSST) is designed to reduce the volume and frequency of combined sewer overflows at four existing combined sewer outfall locations within the urban core. This includes the control of CSO's from the Rideau River Collector (RRC) to the John Street outfall located on the east side of the Rideau River and within the New Edinburgh community.

The CSST project was tendered and awarded in 2016. Site 5 of the CSST project is the downstream end of the East-West Tunnel (EWT) and the location where combined sewer flows stored in the CSST during a storm event will flow back into the Interceptor Outfall Sewer (IOS), which conveys sewer flows to ROPEC. The IOS Connection Chamber at Site 5 is located within Stanley Park on the northeast shore of the Rideau River. In addition to the IOS Connection Chamber, Site 5 also includes the EWT Outlet Chamber (a surge attenuation tank), and the Rideau River Collector Overflow Diversion Chamber (at Queen Victoria and River Lane) and related diversion sewer (i.e. directing combined sewage from the RRC/John Street overflow pipe to the CSST). **Exhibit 2** presents an illustration of the new infrastructure and construction staging area at Site 5 within Stanley Park.

As tendered, and in accordance with the contractor's preliminary proposed construction sequencing, Site 5 is the launch site for the tunnel boring machine (TBM) that will excavate the EWT. The excavation shaft required to launch the TBM will be repurposed to form the EWT Outlet Chamber (surge attenuation tank) and IOS connection once the tunneling of the EWT is completed. A tunnel launch site is also the location from where the excavated material (spoils) is extracted. The material excavated at the face of the TBM comes out the back of the unit and is conveyed down the excavated tunnel in rail carts to the launch pit.

The CSST construction Contract was awarded in August 2016 and the contractor's schedule indicates a launch shaft construction at Site 5 commencing in March 2017 in preparation for a TBM launch in February 2018. The contractor reports that it will take the better part of a year to prepare the shaft, tail-tunnel, TBM assembly and supporting rail system in preparation for the launch.

After several months of agency consultations and negotiations throughout the design period (2013-2015), and preliminary land-owner approval during the Environmental Assessment (EA - pre-2013), all approvals are in place for the March 2017 commencement of launch shaft construction at Site 5.

Exhibit 2: Site 5 Staging Area

3.0 Infrastructure Required at Site 5

Key Existing Infrastructure

The Rideau River Collector (RRC) is an existing trunk sewer that collects wastewater and some stormwater from local sewers and conveys the combined flows in a northerly direction along the east side of the Rideau River and the Riverside/Vanier corridor. When the RRC was first constructed, it conveyed untreated flows directly to the Ottawa River via an outfall sewer that crosses the New Edinburgh neighborhood along River Lane / John Street. In the mid-1960s, the Interceptor Outfall Sewer (IOS) was constructed in an east-west direction roughly parallel to the Ottawa River. The IOS was designed to intercept all of the wastewater and some of the stormwater from combined outfalls that previously discharged untreated to the river and convey these sewer flows easterly to a new waste water treatment facility – the Robert O. Pickard Environmental Centre (ROPEC) located on Shefford Road, near the Greenbelt. The IOS is a large diameter trunk sewer that intercepts the RRC at the intersection of River Lane / Keefer Street at an underground facility called the Keefer Regulator.

During dry weather flows or modest wet weather flows, the IOS has capacity to intercept all of the flow from the RRC and convey it to the treatment facility at ROPEC. However, during large rain events, the IOS reaches capacity and the Keefer Regulator directs the balance of the flow as a combined sewer overflow (CSO) to the Ottawa River via the old RRC overflow along River Lane / John Street. It acts like a relief valve to mitigate the risk of sewer backups and basement flooding. The overflow is one of the four large CSO outfall locations in the core area of the City where CSOs are to be captured in order to attain the mandated control objectives.

Rationale for CSST Infrastructure Requirement at Site 5

The CSST's primary purpose is to intercept and provide additional storage for combined sewage during wet weather events and thus prevent CSOs from reaching the Ottawa River. It is critical that the four primary CSO locations in the urban core be intercepted by the CSST to achieve the mandate of the project. In addition to three CSO outfall locations west of the Rideau River (i.e. Ottawa River outfalls at LeBreton Flats, Kent St., and Rideau Canal), this includes the RRC/John St. Overflow (i.e. CSO outfall) on River Lane, north of Keefer Street.

The East-West Tunnel (EWT) of the CSST also roughly parallels the IOS and connects to the IOS at the upper and lower ends of the EWT. The CSST will provide an opportunity for the City to occasionally divert flows from the IOS to the CSST in order to do inspections, repair and maintenance along the IOS – something that has not been possible since the IOS was constructed in the mid-1960s due to the amount of flow in the IOS. Part of the mandate of the CSST project is to provide redundancy to the IOS in the most critical areas, which especially include the watercourse crossings (Rideau Canal and Rideau River). A failure of the IOS under the Rideau River with no contingency plan could be catastrophic. Consequently, the City has deemed that providing redundancy to the Rideau River crossing (i.e. extending the CSST across the Rideau River) is a priority to mitigate this risk.

In addition to providing this system reliability, the CSST infrastructure is primarily required in the New Edinburgh area because that is where the existing critical infrastructure is located. This is where the IOS intercepts the RRC and where the RRC/John St. Overflow needs to be intercepted by the CSST. The closest area that has sufficient open space to allow the staging area requirements is Stanley Park.

Infrastructure Required at Site 5

Site 5 is the location where the CSST reconnects to the IOS and also the location where the RRC Overflow needs to be intercepted. Infrastructure required at Site 5 as part of the CSST project include:

- CSST/IOS Connection Chamber in Stanley Park
- CSST Outlet Chamber (surge attenuation tank) in Stanley Park. The purpose of this tank is to attenuate and dissipate the energy from the forward and backward waves of water that can materialize as the tunnel fills and water at this downstream location meets with a closed outlet to the IOS.
- RRC Overflow Chamber (on the RRC/John St. Overflow Sewer north of Keefer along River Lane).
- New activated-carbon Odour Control Facility (OCF) to replace the existing biofilter, which is experiencing performance shortcomings. This new OCF will continue to draw air from the Keefer Regulator (RRC, IOS and local sewers) in order to provide the same functionality as the existing biofilter. This new system is not required for the CSST at Site 5. As the CSST fills with the gate closed at the bottom end, the air will be pushed upstream within the CSST. Air from the CSST will then be treated by other OCFs at other upstream locations.

It is important to note that, regardless of the location of the TBM launch and tunnel mucking operations, the infrastructure described above needs to be located in the New Edinburgh / Stanley Park area. This implies that, even if the TBM launch and tunnel mucking were relocated elsewhere, it would still be necessary to have construction activities in Stanley Park and at the intersection of River / Queen Victoria. In addition, it is noted that the outlet chamber that was anticipated to be the launching shaft was sized based on hydraulic requirements and not for the TBM.

The current construction contract allows the contractor in Stanley Park for 30 months. The contractor's preliminary schedule indicates an occupation of the Stanley Park staging area for a period of approximately 30 months (in accordance with the contract permission). This 30-month duration is comprised of 11 months of pre-tunneling activities, 10 months of tunneling, and 9 months of post-tunneling activities. If the tunnel launch and mucking was relocated, it is estimated that the Stanley Park staging area would still be occupied for a minimum of 20 months (exact duration would need to be confirmed).

4.0 Consideration of Site 3C (Nicholas/Laurier)

Site 3c within the CSST Contract package is a heavily sloped and treed parcel of land located south of Laurier Avenue between Nicholas Street and the Colonel By Parkway. Site 3c is approximately the halfway point of the 4.0 km long EWT (halfway between Sites 1 and 5). In the tender document, the option to use a large staging area at this location was provided to the bidders in the event that they would deem it desirable to muck half the EWT from a mid-point location instead of carting the excavated rock to the launch shaft. The bidders could also consider Site 3c as an alternative launch site if they wished.

The tendering period included a process by which bidders were invited to submit and present value added ideas (i.e. White Paper Proposals) that could also reduce risk on the project. Through this process, all of

the participating bidders indicated that they did not intend to use this site for launching or mucking for reasons explained below.

Site 3c is located immediately adjacent to one of the largest rock faults in the City's core. The fault is roughly parallel to the Rideau Canal, close to Nicholas / Site 3c. A buried valley is located along this same fault alignment, resulting in the top of rock being at or about the top of the tunnel. This same fault extends northerly and crosses Rideau Street approximately where the recent sinkhole occurred (summer 2016).

A tunnel launch or mucking shaft at this location would be approximately 12m in diameter and 20m deep. A TBM launch also requires the excavation of hand-mined starter tunnels (drill & blast) forward and backwards to align the TBM and rail carts. **As a result, locating the tail tunnel and starter tunnels in this location represented a much higher risk (and cost) to the contractor. Through the white paper process, Site 3c was eliminated as a shaft and site and the function of access shaft was relocated elsewhere on a City street, and the tunnel alignment was modified to mitigate this construction risk.** This modification also reduced the amount of time for the overall duration of tunneling and thus the amount of time required for mucking out of Site 5.

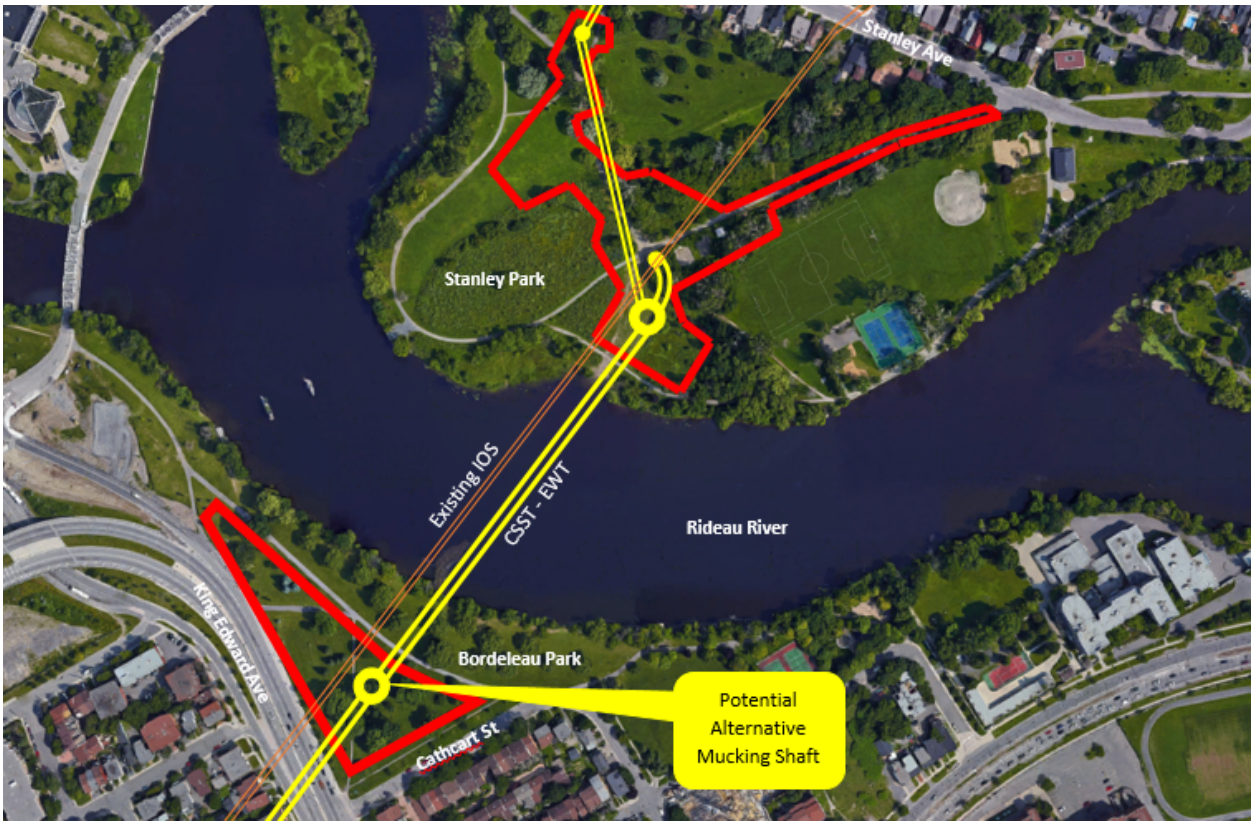
The contractor has also informed the project team that if this site was to be used for launch and mucking, that additional off-site staging would be required due to the size constraints of the site. Using the site for launching in two directions would also result in a longer time requirement for the site than is currently negotiated with the NCC, and thus would result in additional time and costs, and protracted negotiations.

5.0 Consideration of Bordeleau Park as a Mucking Shaft

The design team has been requested to comment on the implications of a scenario that would see the TBM being launched from Bordeleau Park instead of being launched from Stanley Park. The design team has also considered the possibility of launching the TBM from Stanley Park and at least mucking the EWT from Bordeleau Park in the event that launching from this alternate location is deemed impractical.

Bordeleau Park is a shoreline park along the southwest shore of the Rideau River in Lowertown immediately adjacent to King Edward Avenue. The site is under the jurisdiction of the NCC and adjacent to a City of Ottawa park. A TBM launch shaft in Bordeleau Park would be located approximately 300 m southwest of the one proposed in Stanley Park. **Exhibit 3** presents an illustration of the potential staging area at Bordeleau Park.

Exhibit 3: Potential Staging Area at Bordeleau Park



Bordeleau Park as a Potential TBM Launch Site

The timing associated with the commencement of construction in preparation for the TBM launch is described in Section 2.

Bordeleau Park, like Stanley Park, is under the jurisdiction of the National Capital Commission (NCC). Land (easement) acquisition and approval to commence construction of a launch shaft at Bordeleau Park would not be feasible by the spring of 2017. The exact length of time required to secure these approvals and agreements cannot be known at this time, but it is estimated that it could be in the 9-10 month range, including significant design revisions and negotiations with the contractor for this considerable contract change. This would imply that the contractor would commence work at the launch shaft in late 2017 instead of the spring of 2017. This would delay the contractor's start of tunneling by several months. It is estimated, based on the contractor's projected production, that delays in tunneling could amount to costs in the range of $3M per month. This delay cost is in addition to the capital costs associated with constructing an additional large diameter shaft as well as all related works associated with an additional site. These additional costs would also be in the millions, as described further below.

For the reasons described above, Bordeleau Park is not carried forward as an alternative TBM launch location.

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Bordeleau Park as a Potential Mucking Site

This subsection documents consideration of the viability of retaining Stanley Park as a TBM launch site and using Bordeleau Park as a mucking location for part of the EWT.

If approval can be secured to add a mucking shaft at this location, it is expected that by the time the work is approved, land is transferred, and the shaft is designed and constructed, the TBM would have already been launched from Site 5 (Stanley Park) and have progressed past Bordeleau Park. Therefore, this option considers the possibility of relocating the mucking operation from Site 5 to Bordeleau Park at some point in 2018 – partway into the EWT tunneling operation. It would imply that only part of the tunnel would be mucked from Site 5 before the mucking operation would be relocated across the Rideau River.

This option would be more viable than the launch option as it would not result in the delay in the range of half a year or more for the contractor to commence the tunneling works. However, this option would still result in delays to the tunneling operation, albeit of a shorter duration. The shaft at Bordeleau Park would be excavated while the TBM is tunneling from Site 5 and past this site. The excavation of the shaft can only proceed to a certain depth before the tunneling operation will have to cease (i.e. as the shaft excavation is approaching the elevation of the tunnel). While the tunneling and operation of the mucking trains is paused, the chamber would be excavated the remainder of the depth, a section of the tunnel would be removed, and a *California Switch* station (location where the cart trains can pass each other) would be configured. This switch station is required at the mucking shaft for execution of the contractor's work plan. Meanwhile, during this pause in operation, the mucking equipment and installation would be relocated from Site 5 to Bordeleau Park, and so would the segmental tunnel liner setup area. It is expected that this pause in tunneling would be at least 2 months. In accordance with the productivity parameters described above, this 2-month delay would result in loss of cash flow of at least $6M that would be in addition to the capital cost associated with the works described further below.

Other Considerations

Other considerations include:

- No significant reduction in the required staging area within Stanley Park and still a minimum of 20 months of construction in Stanley Park. The change in duration from 30 to 20 months would need to be negotiated with the contractor; the impact to cost is unknown at this time.
- TBM would still be launched from Stanley Park and some mucking activities would still take place at Stanley Park for an undetermined length of time (until the new Bordeleau shaft is ready and the mucking operation is relocated).
- Would achieve a significant reduction in trucking volumes from Stanley Park. Could be as much as a 40-60% reduction, depending on the timing of the relocation. Also implies that trucking operation would be relocated to King Edward Avenue, thus representing an equivalent increase in construction and truck traffic to that community.
- Contractor is mobilizing to Stanley Park by March 2017 to commence work on the TBM launch facility.

- Bordeleau Park would be another impacted NCC property. Significant negotiations and approvals would be required with agencies, especially the NCC – could take 9-10 months. It took years of planning for the agreement at Stanley Park. Thus the contractor will continue to muck from Site 5 until the shaft is ready for tunnel mucking operations at Bordeleau Park. The tunnel will most likely already be constructed under and beyond Bordeleau Park before this approval is secured. The impact on this is that during the final construction of the shaft in Bordeleau Park, the tunneling operation (due to safety requirements) will need to be stopped. This will result in a cost impact to the project of at least $3 million a month for this delay.
- Much of Bordeleau Park is under the floodplain elevation, which will pose significant risks since shaft and tunnel construction will likely be continuing through the spring melt period. The area available at Bordeleau Park is limited and the staging would result in impacting a large number of mature trees along the Rideau River (in addition to those in Stanley Park).
- Relocating mucking activities to Bordeleau Park impacts two parks and two communities instead of one.

Opinion of Probable Costs

Anticipated cost impacts to the CSST project have been estimated based on a high-level assessment of design changes and construction requirements. They are presented in the summary below. It needs to be noted that there could be numerous unknown costs at this time as this estimate of probable costs is prepared at a conceptual level with limited review of details. It must be considered to represent a minimum cost impact to the project. There are many factors related to the contractor's planned construction methods that the design team and the City are not yet party to and/or aware of at this time to allow for a more accurate assessment of the cost impacts. **There is a considerable risk that cost escalation beyond this high-level opinion of probable costs may occur.**

Item	Estimated Cost
Bordeleau Shaft Construction	$4.2M
California Switch, Granular Working Platform, New Electrical Supply for Crane, Ventilation, Relocation of Crane and Stockpiling Compound, Cost of Land	$2.2M
Site Restoration to Park Condition and Tree Plantings	$0.2M
Efficiency Impacts due to constrained space resulting in estimated 15% loss of efficiency during mucking and due to lack of tail tunnel resulting in inefficient California Switch setup – estimated loss of two months.	$6.0M
Increase in insurance cost due to most of site being within floodplain	$0.2M
Contractor Overhead and Markup	$3.2M
Subtotal (Including Overhead and Profit and Excluding Project Allowances)	**$16.0M**
Project Allowances (Engineering (15%), Utilities (5%), City Internal Costs (3%)) – calculated based on the City of Ottawa Cost Estimate Classification System	$3.7M
Work Stoppage in tunneling operation (i.e. to finish constructing shaft near tunnel elevation and relocate mucking operation). Estimated 2 months**	$6.0M
Class C OPC Contingency [25% of Subtotal (Capital Cost + Project Allowances + Contract Delay)]	$6.4M
TOTAL Opinion of Probable Cost (OPC)* ** Class 'C' OPC considered to have an accuracy of +25% to -25%.*	**$32M**

***The duration of the delay is subject to change, refer to discussion throughout Section 5.0.*

6.0 Consideration of Launching from Site 1 (Lebreton Flats)

The design team was also mandated to assess the possibility of tunneling the EWT in the reverse direction, which would imply launching the tunnel boring machine (TBM) from Site 1 at Lebreton Flats. In this scenario, all the mucking associated with the EWT would be extracted from the launch shaft at Site 1, while the TBM would be extracted from the shaft at Site 5 – Stanley Park.

Lebreton Flats currently consists of vacant development land north of Albert Street, west of Bronson Avenue. The property is owned by the City, but is currently occupied by the RTG (design-build consortium) for the construction of the Ottawa Light Rail Transit (OLRT) system. It is the site of the west portal for the underground portion of the OLRT and one of their key staging areas.

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Timing of Availability of Lebreton Flats to the CSST Project

The OLRT project currently occupies the potential launching site at Lebreton Flats. During the design and tendering phase of the CSST project, the parameters were that this site would only become available in mid-2018. This time constraint played a big part in the planning of the project sequencing and the overall project construction timelines. In accordance with the current construction sequencing, the site would become available just in time for the arrival of the TBM at the end of the EWT tunneling (late-2018).

Additional discussions have recently been held between the City and RTG in an attempt to determine whether the availability date for the site could be advanced sufficiently to render the site as a possible option for TBM launch. For the purpose of this review and tech memo, and based on the ongoing negotiations with RTG, the design team was instructed to assume that the site could become available a year earlier than anticipated – by July 2017. The CSST contractor has indicated that in order to have no impact to the schedule, they would need access at Site 1 no later than March 1, 2017. Based on ongoing preliminary discussions with RTG, it is possible that the site could become available even earlier than July (maybe May), although this is yet to be finalized or agreed upon by RTG or the City's Rail Implementation Office (RIO). Despite access potentially being granted within this period, the time required to make the necessary contractual modifications to both the CSST and RTG contracts, as well as the time for the additional site investigations and design modifications that are required, may result in further delays beyond this aforementioned period. Any delays pushing the start of shaft construction any later than the contractor intends to commence work at Stanley Park will result in an overall impact on the project schedule and have a cost impact of at least $3 million per month.

Lebreton Flats (Site 1) as a Potential TBM Launch Site

As indicated in Section 2, the contractor plans to mobilize to Stanley Park by March 2017 for site preparations and construction of the launch shaft, starter tunnels and related appurtenances for commencement of tunneling by February 2018. The contractor anticipates needing approximately 11 months for these pre-tunneling activities. The timing of the site preparations are governed by the timing of the North-South Tunnel (NST) tunneling and the expectation that the TBM would be extracted from the NST and delivered to Stanley Park sometime in December 2017. It takes approximately two months to install and reassemble the TBM after a move.

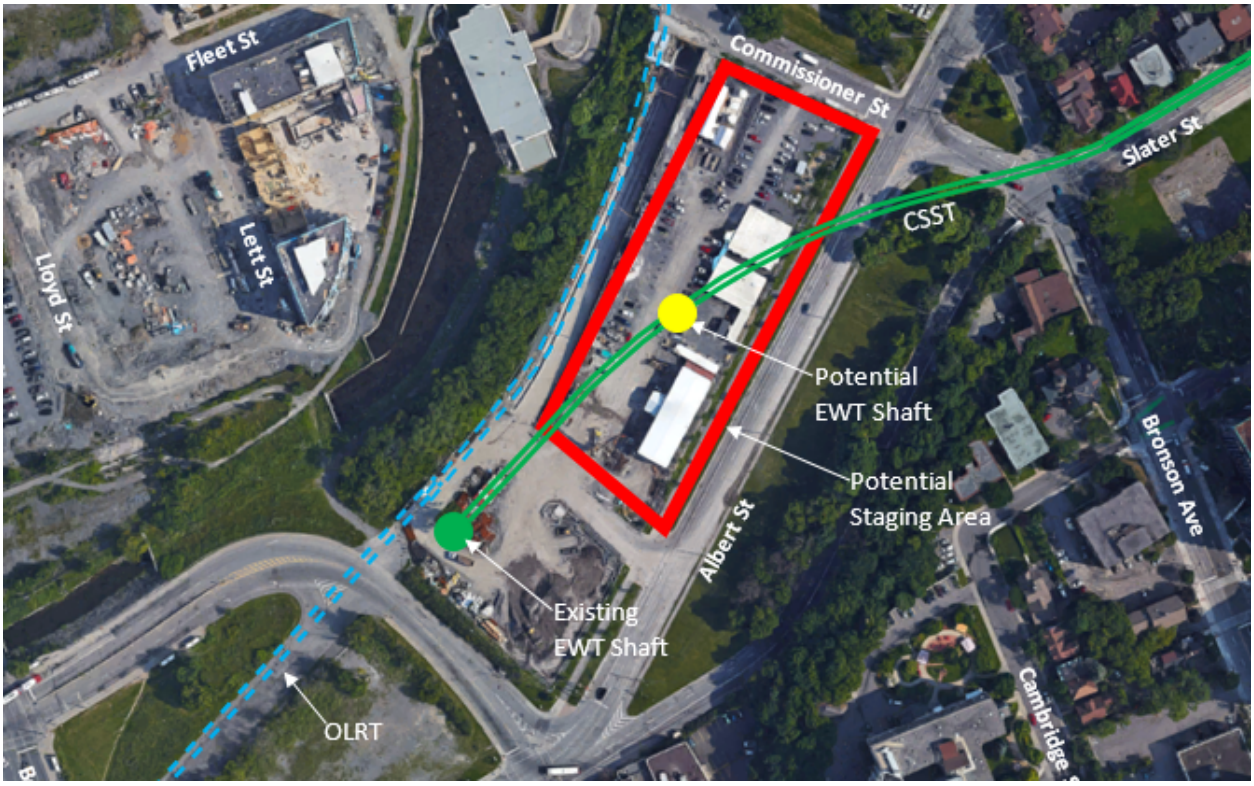
If Lebreton Flats becomes available later than the contractor intends to commence work at Stanley Park, this would result in a delay in the EWT tunneling. As indicated in the Bordeleau Park section, a tunneling delay results in significant loss of cash flow in the range of $3M per month. These delay costs would be in addition to the capital costs for the additional work that would be required as described further below.

An exit shaft for the CSST TBM was designed for Site 1 and it was constructed in 2015/2016 under the jurisdiction of RTG (OLRT design build consortium) as a separate tender in advance of the main CSST tender. The reason this was done is because the Site 1 shaft and related works needed to be constructed at the same time as the OLRT portal retaining walls as they are immediately adjacent to each other. The possibility of repurposing this exit shaft as a TBM launch shaft was evaluated with respect to feasibility as

well as potential cost and time savings. Unfortunately, it is not apparent how it would be feasible to mount the gantry crane over the shaft with the constraint of the shaft being immediately adjacent to the OLRT retaining wall. The shaft was simply not designed as a launch shaft. In addition, the shaft size and the area available for the tail tunnel and *California Switch* setup (location where the cart trains can pass each other) are also too restrained to accommodate the contractor's tunnel launch setup (tunnel boring machine and mucking carts already purchased and being prepared for delivery will not fit).

These constraints imply that a new and larger shaft would need to be constructed, approximately 80-100 m away from the existing one and with a tail tunnel constructed along the alignment of the CSST. It is expected that this new shaft would be temporary only and would be removed once the CSST is completed, as it would be located in the middle of prime development land. Tail tunnels are configured wider than the tunnel required for the CSST and with a flat roof. It is approximately 5m wide instead of the circular tunnel excavated by the TBM. Since the rock cover within Site 1 is very modest, special shoring systems would be required during construction of the tail tunnel by hand-tunneling (drill & blast), which would result is significantly more costs. **Exhibit 4** presents an illustration of the potential staging area for a new shaft at Site 1 (Lebreton Flats).

Exhibit 4: Potential Staging Area for New Shaft at Site 1 (Lebreton Flats)



Other Considerations

Other considerations include:

- No significant reduction in staging area in Stanley Park and unlikely to achieve much of a reduction in occupation time at Stanley Park since the permanent chambers cannot be finalized until the TBM has been removed from the tunnel (same tunneling duration but in reverse direction). It is still estimated that the occupation at Stanley Park would be at least 20 month, and possibly more if there are delays in the tunnel launch.
- Would achieve the greatest reduction in trucking volumes from Stanley Park. Could be as much as a 75% reduction.
- Lebreton Flats is in close proximity to trucking routes but still means trucking through either the Preston or Bronson communities.
- Available staging is more modest than what is available at Site 5 to support tunnel launch operations.
- OLRT related work will still be required beyond March 2017 to complete the OLRT's West Portal facilities. This work will need to be separated from the CSST project either by time or space due to the Construction Lien Act - so that the City does not become the constructor. Some OLRT related work may need to be transferred from the OLRT to the CSST project to avoid this issue. The cost and schedule impacts along with liability issues to both the OLRT and CSST projects for this aspect are unknown at this time but would need to be considered.

Opinion of Probable Costs

Anticipated cost impacts to the CSST project have been estimated based on a high-level assessment of design changes and construction requirements. They are presented in the summary below. It needs to be noted that there could be numerous unknown costs at this time as this estimate of probable costs is prepared at a conceptual level with limited review of details. It must be considered to represent a minimum cost impact to the project. There are many factors related to the contractor's planned construction methods that the design team and the City are not yet party to and/or aware of at this time in order to allow for a more accurate assessment of cost impacts to the CSST project. **There is a considerable risk that cost escalation beyond this high-level opinion of probable costs may occur. In addition, the table below does not consider any schedule and cost impacts that this change would have on the OLRT contract. This would presumably result in added costs that would also be borne by the City**.

Item	Cost
Shaft Construction	$4.2M
New tail tunnel and *California Switch* setup (hand-mining)	$1.0M
Miscellaneous Site Works (Gantry Crane Foundation and Piles, Site Grading/Modifications)	$0.9M
Tunneling Premium with Downhill Construction (Process Water and TBM Groundwater Control, Additional Power Requirements, TBM mining production reduction)	$1.5M
Restoration of Staging Area to Match OLRT Design and prepare site for potential future development	$0.1M
Contractor Overhead and Markup	$1.9M
Subtotal (Including Overhead and Profit and Excluding Project Allowances)	**$9.7M**
Project Allowances (Engineering (15%), Utilities (5%), Property (5%), City Internal Costs (3%), Miscellaneous (0%), etc) – calculated based on the City of Ottawa Cost Estimate Classification System	$2.7M
Contract Delay with getting access sometime between May-July when needed by March – translates to 2 to 4 month delay*	$6.0 to 12.0M range
Class C OPC Contingency [25% of Subtotal (Capital Cost + Project Allowances + Contract Delay)]	$4.6 to 6.1M
TOTAL Opinion of Probable Cost (OPC)** *** Class 'C' OPC considered to have an accuracy of +25% to -25%.*	**$23.0 to 30.5M range**

**The duration of the delay is subject to access to the site being permitted, contractual negotiations completed with RTG and DTJV, and field investigations and designs being completed.*