

TECHNICAL MEMORANDUM

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TO:	Manny Goetz, P.Eng. McCormick Rankin Corporation	DATE:	April 9, 2008
cc:	Michel Vachon, McCormick Rankin Corporation	PROJECT NO:	05-1120-210 Task 2000
RE:	REPORT ADDENDUM GOLDER REPORT NO. 05-1120-2000-6 RETAINING WALLS MAITLAND AVE. TO ISLAND PARK DRIVE 417 QUEENSWAY – GWP 4058-01-00		

This memorandum provides additional geotechnical guidance for the design of the retaining walls along the proposed widening of Highway 417, between Maitland Avenue and Island Park Drive, in Ottawa, Ontario.

The following geotechnical guidance should be read in conjunction with Golder Associates report titled “Foundation Investigation and Design Report, Retaining Walls, Maitland Avenue to Island Park Drive, Highway 417, W.P. 4058-01-00”, report number 05-1120-210-2000-6, dated February 2008. The section numbers noted below reference that report and the guidance provided herein supercedes the guidance provided in the above report.

6.3.1.4 Lateral Earth Pressures for Design

Based on the limited number of boreholes advanced through the existing embankment fill materials along the project alignment it is considered that these materials are not generally frost susceptible.

Considering the composition of the existing embankment fill materials and the proposed construction geometry, which will include 1 horizontal to 1 vertical construction slopes excavated into the existing side slopes, it is considered that Case II referenced in Figure C6.9.1 of the commentary to the Canadian Highway Bridge Design Code (CHBDC) 2001 would be applicable for estimating the lateral earth pressures acting on the retaining walls.

6.3.1.4 & 6.12.4 Lateral Earth Pressures for Design

As noted in Section 6.12.7 of the report, lightweight fill consisting of slag may be used to reduce the loading from the additional fill over the portion of wall 11S from the western end of the wall to about Station 24+250. Ultra lightweight slag has a unit weight of about 11.5 kilonewtons per cubic metre. The friction angle of ultra lightweight slag fill is 35 degrees, similar to OPSS Granular A or Granular B Type II, and the coefficients of lateral earth pressure noted in report sections 6.3.1.4 and 6.12.4 for those materials are equally applicable to lightweight slag fill.

Foamed concrete (i.e., isofill) may also be used to reduce the settlements along the above portion of retaining wall 11S. Foamed concrete typically has a unit weight of about 2 to 3 kilonewtons per cubic metre, depending on the compressive strength. The unit cost for this material is typically about the same, or slightly higher, than for regular concrete. Foamed concrete placed as bulk fill can experience severe degradation from the heat of hydration and must be placed in lifts not exceeding 0.3 metres in thickness and must be allowed to cure for a minimum of 24 hours between lifts.

6.8 Retaining Wall 6S (EBL 23+510 to 23+818)

It is understood that at retaining wall 6S a watermain vault exists immediately north of the hydro tower at about Station 23+575. The vault limits the potential retaining wall options at this location since it would not be possible to install the reinforcing strips for a RSS wall and the limited room would not allow for construction of a gravity wall. Furthermore, a 406 millimetre diameter watermain extends between the hydro tower and vault within the area that would be required for shallow foundations to support a cast-in-place reinforced concrete wall.

It is therefore understood that a soldier pile and lagging wall is under consideration at this location. The overburden thicknesses at this location are limited, less than 4 metres, and are considered insufficient to provide adequate pile (or sheet piling) toe lateral support. It will therefore be necessary to socket the piles into the rock to provide lateral resistance. For piles socketed at least 2 m into bedrock to achieve pile fixity, the ultimate (unfactored) lateral resistance of the limestone may be taken as the lesser of 30 MPa or the compressive strength of the Portland cement grout or concrete placed in the bedrock socket.

The passive resistance of the overburden should be neglected since the pile lengths within the overburden will be relatively short and will likely not displace sufficiently to mobilize the passive resistance available from the overburden materials.

Additional lateral restraint may be provided by tie-backs, with or without waler beams, installed into the bedrock or attached to a passive soil anchor (deadman) installed within the embankment

fill. Rock anchors may be a practical option since the bedrock is at relatively shallow depths of less than 4 m. An appropriate (rectangular) lateral pressure distribution on the retaining wall should be considered for the design if tie-backs are used.

Rock or soil anchors may be designed in accordance with the guidance provided in the report in Section 6.12.5 Soil and Rock Anchors – RW11S and that guidance is also applicable for rock or soil anchors for retaining wall 5S.

6.8, 6.12 & 6.13 Retaining Walls 6S, 11S and 12S

Piles along retaining walls 6S, 11S and 12S may be driven in close proximity to existing watermains.

It may be necessary to excavate to expose the watermain(s) along these retaining wall alignments to confirm the pipe locations.

Piles bearing on the bedrock surface should not be driven closer than 1 metre to the edge of the pipe. Driven pile locations within 3 metres of the edge of pipe should be preaugered to a depth of 1 metre below the pipe invert prior to driving. Where piles are socketed into the underlying bedrock to provide lateral resistance the piles may be installed no closer than 0.5 metres to the edge of pipe since the full pile depth will be preaugered in order to socket the pile into the rock.

6.8. Retaining Wall and Embankment Stability – RW 6S

It is understood that 2 horizontal to 1 vertical side slopes are under consideration from about Station 23+700 to the eastern end of retaining wall 6S due to right-of-way constraints. A layer of peat is indicated to underlie the existing fill materials along at least part of this alignment.

Additional slope stability analyses have been carried out and indicate that 2 horizontal to 1 vertical side slopes placed on the surface of the existing fill materials, after stripping of the surficial topsoil and with appropriate subgrade preparation and proper placement of granular soils, will have static factors of safety greater than 1.3 against deep-seated global instability.

Pseudo-static seismic slope stability analyses for the above configuration also indicate that the embankment side slopes will have factors of safety of greater than 1.1.

6.14, 6.15 and 6.16 Retaining Walls 1N, 2N and 3N

A 900 to 1,220 mm diameter storm sewer extends along the alignment of these walls and this sewer is about 2 to 3 m inside the toe of the existing side slope.

The retaining walls will be founded immediately adjacent to the sewer pipe alignment and, at some locations, potentially over the pipe. Reinforced concrete walls or soldier pile and lagging walls have been proposed as potential options for these retaining walls, in addition to mechanically stabilized walls or slopes. Reinforced concrete or soldier pile and lagging walls would likely need to be supported on or within the limestone bedrock.


Based on the refusal depths encountered in the boreholes and some limited coring carried out during this investigation the bedrock surface is indicated to be about 1 to 3 metres below the existing ground surface. However, these depths are likely not representative of the bedrock surface levels along the full alignment of these retaining walls. The sewer trench is understood to have been excavated into the bedrock and the width of that excavation is unknown. Additionally, the bedrock excavation may have resulted in considerable disturbance to the bedrock surrounding the sewer excavation reducing the available capacity of the bedrock to support foundation loads from shallow foundations; significant subexcavation and mass concrete placement may be required.


For pile and lagging walls, for which the piles should be socketed a minimum of 1 metre into good quality bedrock at all retaining wall locations, the piles may need to be socketed considerably deeper to penetrate to good quality rock below the disturbed zone. Additionally, the piles may be located within the sewer trench and in that case would need to extend to deeper depths to reach the bedrock surface at or near the base of the trench. The potential pile lengths and socket depths cannot therefore be reliably estimated based on the very limited information available for the storm sewer.


The above concerns represent significant risks for the construction of reinforced concrete or soldier pile and lagging retaining walls along these alignments and it may be impractical, in view of these risks, to construct these wall types in close proximity to this existing sewer in this area.

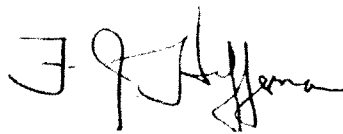
An updated summary comparison of the advantages, disadvantages, relative costs and risks associated with the retaining wall options at each location is presented in the revised Table 1 attached to this memorandum.

We trust that this memo provides sufficient information for your present requirements. If you have any questions concerning this memo, please don't hesitate to contact us.


William Cavers, P.Eng.




Michael S. Snow, P.Eng.
Principal


Fintan J. Heffernan, P.Eng.
Designated MTO Foundations Contact



WC:MSS:FJH:ch

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TABLE 1 (REVISED)
COMPARISON OF RETAINING WALL / EMBANKMENT ALTERNATIVES
MAITLAND AVENUE TO ISLAND PARK DRIVE
HIGHWAY 417
W.P. 4058-01-00

Retaining Wall	Retaining Wall Option	Feasibility	Advantages	Disadvantages	Relative Costs	Risks/Consequences
1S (EBL 22+150 to 22+475)	Toe wall as per OPSD 3120.100	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Simple to construct 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> Least expensive option 	<ul style="list-style-type: none"> N/A
2S & 3S (EBL 22+600 to 22+715)	2H:1V slope with toe wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Landscaping can be more easily carried out and maintained. Widely used construction (Atypical methods or materials are not required) 	<ul style="list-style-type: none"> More property required 	<ul style="list-style-type: none"> Less expensive than RSS wall 	<ul style="list-style-type: none"> N/A
	1H:1V MSE slope	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Simple to construct 	<ul style="list-style-type: none"> Can be difficult to carry out and maintain landscaping (particularly with southern exposure as at this location) 	<ul style="list-style-type: none"> Less expensive than RSS wall 	<ul style="list-style-type: none"> May be difficult to achieve and maintain vegetation
	RSS wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Appearance may be considered preferable to MSE slopes or toe walls 	<ul style="list-style-type: none"> Excavation of existing embankment may be required for installation of reinforcing strips 	<ul style="list-style-type: none"> More expensive than MSE slope or toe walls 	<ul style="list-style-type: none"> Most costly
	'Perched' RSS wall	<ul style="list-style-type: none"> Not feasible due to low strength soils underlying existing fill materials 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A
4S (EBL 22+745 to 23+020)	1H:1V MSE slope	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Simple to construct 	<ul style="list-style-type: none"> Can be difficult to carry out and maintain landscaping (particularly with southern exposure as at this location) 	<ul style="list-style-type: none"> Less expensive than RSS wall 	<ul style="list-style-type: none"> May be difficult to achieve and maintain vegetation
	RSS wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Appearance may be considered preferable to MSE slope 	<ul style="list-style-type: none"> Excavation of existing embankment may be required for installation of reinforcing strips 	<ul style="list-style-type: none"> More expensive than MSE slope 	<ul style="list-style-type: none"> Most costly

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HIGHWAY 417
W.P. 4058-01-00

Retaining Wall	Retaining Wall Option	Feasibility	Advantages	Disadvantages	Relative Costs	Risks/Consequences
	'Perched' RSS wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Reduced excavation required compared to full height walls. 	<ul style="list-style-type: none"> Settlement of existing fill materials difficult to estimate. 	<ul style="list-style-type: none"> Less costly than full height RSS wall 	<ul style="list-style-type: none"> Magnitude of post-construction settlement may be higher than anticipated
5S (EBL 23+140 to 23+330)	RSS wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Appearance may be considered preferable to concrete wall 	<ul style="list-style-type: none"> Excavation of existing embankment may be required for installation of reinforcing strips Full closure of ramp may be required to excavate for installation of reinforcing strips 	<ul style="list-style-type: none"> Less expensive than concrete wall 	<ul style="list-style-type: none"> N/A
	Soldier pile and lagging wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Simple to construct 	<ul style="list-style-type: none"> Increased maintenance 	<ul style="list-style-type: none"> Less expensive to construct than reinforced concrete wall Increased maintenance costs 	<ul style="list-style-type: none"> N/A
	Reinforced concrete wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> More involved construction 	<ul style="list-style-type: none"> More expensive than RSS wall 	<ul style="list-style-type: none"> Most costly
6S (EBL 23+510 to 23+818)	2H:1V or flatter slopes with local walls around hydro towers	<ul style="list-style-type: none"> 2H:1V or flatter slopes feasible from Station 23+700 to eastern end of wall 2.5H:1V or flatter slopes feasible from western end of wall to Station 23+700 	<ul style="list-style-type: none"> Landscaping can be readily carried out and maintained. Widely used construction (Unusual methods or materials are not required) Subexcavation of buried peat may not be required 	<ul style="list-style-type: none"> Subexcavation of buried peat would be required from western end of wall to Station 23+700 if slopes steeper than 2.5H:1V Subexcavation of buried peat not required from Station 23+700 to eastern end of wall if slopes no steeper than 2H:1V 		<ul style="list-style-type: none"> N/A

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Retaining Wall	Retaining Wall Option	Feasibility	Advantages	Disadvantages	Relative Costs	Risks/Consequences
	Soldier pile and lagging wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Reasonably simple to construct Widely used construction (Unusual methods or materials are not required) 	<ul style="list-style-type: none"> Insufficient thickness of overburden to provide toe fixity; socketing piles into bedrock will be required Increased maintenance 	<ul style="list-style-type: none"> Less expensive to construct than other wall options Increased maintenance costs 	<ul style="list-style-type: none"> N/A
	RSS Wall	<ul style="list-style-type: none"> Not feasible due to insufficient room for reinforcing strips 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A
7S EBL (23+842 to 23+862)	2H:1V slopes	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Landscaping can be readily carried out and maintained. Widely used construction (Unusual methods or materials are not required) 	<ul style="list-style-type: none"> Property requirements 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A
	OPSD toe wall at hydro tower	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Simple to construct 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A
8S (EBL 23+958 to 23+975)	Toe wall as per OPSD 3120.100	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Simple to construct 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> Least expensive option 	<ul style="list-style-type: none"> N/A
9S (EBL 23+975 to 24+050)	RSS wall	<ul style="list-style-type: none"> Not feasible due to settlement 	<ul style="list-style-type: none"> Simple to construct 	<ul style="list-style-type: none"> Excavation of existing embankment may be required for installation of reinforcing strips 	<ul style="list-style-type: none"> Less expensive than concrete wall 	<ul style="list-style-type: none"> N/A

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Retaining Wall	Retaining Wall Option	Feasibility	Advantages	Disadvantages	Relative Costs	Risks/Consequences
	Reinforced concrete wall	<ul style="list-style-type: none"> Not feasible due to depth of existing fills 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A
	Reinforced concrete wall supported on piles	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> May have a more acceptable appearance Relatively less maintenance required than for pile and lagging wall Reduced embankment settlement 	<ul style="list-style-type: none"> More involved construction 	<ul style="list-style-type: none"> More expensive than pile and lagging wall 	<ul style="list-style-type: none"> N/A
	Soldier pile and lagging wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Simple to construct 	<ul style="list-style-type: none"> Increased maintenance 	<ul style="list-style-type: none"> Less expensive than reinforced concrete wall 	<ul style="list-style-type: none"> Increased maintenance costs
11S (EBL 24+160 to 24+515)	Soldier pile and concrete lagging wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Simple to construct 	<ul style="list-style-type: none"> Increased maintenance 	<ul style="list-style-type: none"> More expensive than reinforced concrete wall (due to EPS fill required with this option) 	<ul style="list-style-type: none"> Increased maintenance costs
	Reinforced concrete wall supported on deep foundations	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> May have a more acceptable appearance Relatively less maintenance required than for pile and lagging wall Reduced embankment settlement 	<ul style="list-style-type: none"> More involved construction 	<ul style="list-style-type: none"> Less expensive than pile and lagging wall 	<ul style="list-style-type: none"> N/A

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	RSS wall	<ul style="list-style-type: none"> Not feasible due to settlement 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A
	MSE slope with local walls (RSS or soldier pile and lagging) at hydro towers	<ul style="list-style-type: none"> Not feasible due to settlement 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A
12S (EBL 24+540 to 24+595)	Reinforced concrete wall supported on deep foundations	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> May have a more acceptable appearance Relatively less maintenance required than for pile and lagging wall Reduced embankment settlement 	<ul style="list-style-type: none"> More involved construction 	<ul style="list-style-type: none"> Less expensive than pile and lagging wall (due to EPS fill required with pile and lagging wall) 	<ul style="list-style-type: none"> N/A
	1H:1V MSE slope	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Simple to construct 	<ul style="list-style-type: none"> Differential settlement with respect to existing roadway Can be difficult to carry out and maintain landscaping (particularly with southern exposure as at this location) 	<ul style="list-style-type: none"> Less expensive than RSS wall 	<ul style="list-style-type: none"> Increased roadway maintenance due to differential settlement
	RSS wall	<ul style="list-style-type: none"> Not feasible due to settlement 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A

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Retaining Wall	Retaining Wall Option	Feasibility	Advantages	Disadvantages	Relative Costs	Risks/Consequences
1N (WBL 22+610 to 22+747)	Soldier pile and lagging wall with tie-backs to bedrock	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Simple to construct 	<ul style="list-style-type: none"> Increased maintenance 	<ul style="list-style-type: none"> Less expensive than reinforced concrete wall 	<ul style="list-style-type: none"> Relatively high risk due to uncertain rock elevations and condition along existing storm sewer trench Increased maintenance costs
	Reinforced concrete wall supported on shallow foundations	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> May have a more acceptable appearance Relatively less maintenance required than for pile and lagging wall 	<ul style="list-style-type: none"> Rock anchors may be required to limit excavation width 	<ul style="list-style-type: none"> More expensive than pile and lagging wall 	<ul style="list-style-type: none"> Relatively high risk due to uncertain rock elevations and condition along existing storm sewer trench
	RSS wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Appearance may be considered preferable to MSE slope 	<ul style="list-style-type: none"> Will restrict access to storm sewer Excavation of existing embankment may be required for installation of reinforcing strips 	<ul style="list-style-type: none"> More expensive than MSE slope 	<ul style="list-style-type: none"> Restricted access to storm sewer
	'Perched' RSS wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Reduced excavation required compared to full height walls. 	<ul style="list-style-type: none"> Settlement of existing fill materials difficult to estimate. 	<ul style="list-style-type: none"> Less costly than full height RSS wall but more expensive than MSE slope 	<ul style="list-style-type: none"> Magnitude of post-construction settlement may be higher than anticipated
	1H:1V MSE slope	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Simple to construct 	<ul style="list-style-type: none"> Will restrict access to storm sewer Can be difficult to carry out and maintain landscaping 	<ul style="list-style-type: none"> Less expensive than RSS wall 	<ul style="list-style-type: none"> Restricted access to storm sewer

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Retaining Wall	Retaining Wall Option	Feasibility	Advantages	Disadvantages	Relative Costs	Risks/Consequences
2N (WBL 22+770 to 22+975)	Soldier pile and lagging wall with tie-backs to bedrock	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Simple to construct 	<ul style="list-style-type: none"> Increased maintenance 	<ul style="list-style-type: none"> Less expensive than reinforced concrete wall 	<ul style="list-style-type: none"> Relatively high risk due to uncertain rock elevations and condition along existing storm sewer trench Increased maintenance costs
	Reinforced concrete wall supported on shallow foundations	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> May have a more acceptable appearance Relatively less maintenance required than for pile and lagging wall 	<ul style="list-style-type: none"> Rock anchors may be required to limit excavation width 	<ul style="list-style-type: none"> More expensive than pile and lagging wall 	<ul style="list-style-type: none"> Relatively high risk due to uncertain rock elevations and condition along existing storm sewer trench
	RSS wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Appearance may be considered preferable to MSE slope 	<ul style="list-style-type: none"> Will restrict access to storm sewer Excavation of existing embankment may be required for installation of reinforcing strips 	<ul style="list-style-type: none"> More expensive than MSE slope 	<ul style="list-style-type: none"> Restricted access to storm sewer
	'Perched' RSS wall	<ul style="list-style-type: none"> Not feasible due to low strength soil underlying existing fill materials 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A
	1H:1V MSE slope	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Simple to construct 	<ul style="list-style-type: none"> Will restrict access to storm sewer Can be difficult to carry out and maintain landscaping 	<ul style="list-style-type: none"> Less expensive than RSS wall 	<ul style="list-style-type: none"> Restricted access to storm sewer

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Retaining Wall	Retaining Wall Option	Feasibility	Advantages	Disadvantages	Relative Costs	Risks/Consequences
3N (WBL 23+215 to 23+460)	Soldier pile and concrete lagging wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Simple to construct 	<ul style="list-style-type: none"> Increased maintenance 	<ul style="list-style-type: none"> Less expensive than reinforced concrete wall 	<ul style="list-style-type: none"> Relatively high risk due to uncertain rock elevations and condition along existing storm sewer trench Increased maintenance costs
	Reinforced concrete wall supported on shallow foundations	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> May have a more acceptable appearance Relatively less maintenance required than for pile and lagging wall 	<ul style="list-style-type: none"> Rock anchors may be required to limit excavation width 	<ul style="list-style-type: none"> More expensive than pile and lagging wall 	<ul style="list-style-type: none"> Relatively high risk due to uncertain rock elevations and condition along existing storm sewer trench
	RSS wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Appearance may be considered preferable to MSE slope 	<ul style="list-style-type: none"> Will restrict access to storm sewer Excavation of existing embankment may be required for installation of reinforcing strips 	<ul style="list-style-type: none"> More expensive than MSE slope 	<ul style="list-style-type: none"> Restricted access to storm sewer
	'Perched' RSS wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Reduced excavation required compared to full height walls. 	<ul style="list-style-type: none"> Settlement of existing fill materials difficult to estimate. 	<ul style="list-style-type: none"> Less costly than full height RSS wall but more expensive than MSE slope 	<ul style="list-style-type: none"> Magnitude of post-construction settlement may be higher than anticipated
	1H:1V MSE slope	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Simple to construct 	<ul style="list-style-type: none"> Will restrict access to storm sewer Can be difficult to carry out and maintain landscaping 	<ul style="list-style-type: none"> Less expensive than RSS wall 	<ul style="list-style-type: none"> Restricted access to storm sewer
4N (WBL 23+480 to	RSS wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Appearance may be considered preferable to MSE slopes or toe walls 	<ul style="list-style-type: none"> Excavation of existing embankment may be required for installation of reinforcing strips 	<ul style="list-style-type: none"> More expensive than MSE slope or toe walls 	<ul style="list-style-type: none"> Most costly

TABLE 1 (REVISED)
COMPARISON OF RETAINING WALL / EMBANKMENT ALTERNATIVES
MAITLAND AVENUE TO ISLAND PARK DRIVE
HIGHWAY 417
W.P. 4058-01-00

Retaining Wall	Retaining Wall Option	Feasibility	Advantages	Disadvantages	Relative Costs	Risks/Consequences
23+565)	'Perched' RSS wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Reduced excavation required compared to full height walls. 	<ul style="list-style-type: none"> Settlement of existing fill materials difficult to estimate. 	<ul style="list-style-type: none"> Less costly than full height RSS wall but more expensive than MSE slope 	<ul style="list-style-type: none"> Magnitude of post-construction settlement may be higher than anticipated
	1H:1V MSE slope	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Simple to construct 	<ul style="list-style-type: none"> Can be difficult to carry out and maintain landscaping 	<ul style="list-style-type: none"> Less expensive than RSS wall 	<ul style="list-style-type: none"> May be difficult to achieve and maintain vegetation
	2H:1V slope with toe wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Landscaping can be more easily carried out and maintained. Widely used construction (Unusual methods or materials are not required) 	<ul style="list-style-type: none"> More property required 	<ul style="list-style-type: none"> Less expensive than RSS wall 	<ul style="list-style-type: none"> N/A
5N (WBL 23+686 to 23+837)	RSS wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Appearance may be considered preferable to MSE slopes or toe walls 	<ul style="list-style-type: none"> Excavation of existing embankment may be required for installation of reinforcing strips 	<ul style="list-style-type: none"> More expensive than MSE slope or toe walls 	<ul style="list-style-type: none"> Most costly
	1H:1V MSE slope	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Simple to construct 	<ul style="list-style-type: none"> Can be difficult to carry out and maintain landscaping 	<ul style="list-style-type: none"> Less expensive than RSS wall 	<ul style="list-style-type: none"> May be difficult to achieve and maintain vegetation
	2H:1V slope with toe wall	<ul style="list-style-type: none"> Feasible 	<ul style="list-style-type: none"> Landscaping can be more easily carried out and maintained. Widely used construction (Unusual methods or materials are not required) 	<ul style="list-style-type: none"> More property required 	<ul style="list-style-type: none"> Less expensive than RSS wall 	<ul style="list-style-type: none"> N/A

TABLE 1 (REVISED)
COMPARISON OF RETAINING WALL / EMBANKMENT ALTERNATIVES
MAITLAND AVENUE TO ISLAND PARK DRIVE
HIGHWAY 417
W.P. 4058-01-00

Retaining Wall	Retaining Wall Option	Feasibility	Advantages	Disadvantages	Relative Costs	Risks/Consequences
6N (WBL 23+590 to 23+610)	Reinforced concrete wall	<ul style="list-style-type: none"> • Not feasible due to depth of existing fills 	<ul style="list-style-type: none"> • N/A 	<ul style="list-style-type: none"> • N/A 	<ul style="list-style-type: none"> • N/A 	<ul style="list-style-type: none"> • N/A
	RSS wall	<ul style="list-style-type: none"> • Feasible 	<ul style="list-style-type: none"> • Simple to construct 	<ul style="list-style-type: none"> • Excavation of existing embankment may be required for installation of reinforcing strips 	<ul style="list-style-type: none"> • Less expensive than concrete wall 	<ul style="list-style-type: none"> • N/A