TECHNICAL MEMORANDUM
MEADOW CREEK BRIDGE REPLACEMENT
MITIGATION PROCEDURES FOR WIDENING SECTION
HIGHWAY 577, SITE NO. 39E-077
APPROXIMATELY FROM STA. 19+938 TO 19+970
G.W.P. 181-92-00

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PML Ref.: 08TF009
Index No.: 052DOC
GEOCRES No.: 42A-75
November 5, 2010

Peto MacCallum Ltd.
CONSULTING ENGINEERS

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Mr. Mike Trader, P.Eng.
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1400 Rymal Road East
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Dear Mr. Trader

Technical Memorandum
Meadow Creek Bridge Replacement
Mitigation Procedures for Widening Section
Highway 577, Site No. 39E-077
Approximately from Sta. 19+938 to 19+970
G.W.P. 181-92-00

Further to MTO/Stantec meetings (September 22 and September 30, 2010), this memorandum provides our assessment of the slope failure and the suggested mitigation procedures to restore the stable condition of the northeast embankment widening at the Meadow Creek bridge replacement project.

The following three options are presented to discuss suggested mitigation measures and reconstruction of the embankment fill. All mitigation measures should be carried out between approximate Sta. 19+938 and 19+970.

Option 1: Excavate alluvium in water and construct toe stabilization berm and use of rockfill in road widening section

This option 1 requires excavation of alluvium soils below water to construct a toe stabilization berm. The construction of the toe stabilization berm should be carried out in 3 m wide panels in accordance with OPSS 206 and 209 progressing from north to south as shown on the Drawings 1 to 3.

Details of construction of the toe stabilization berm are presented in Appendix A.

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Option 2: Construct toe stabilization berm with rockfill and no excavation below water level and use of Light Weight Fill (EPS) above water in road widening section

This option 2 requires removal of the upper 3.5 m thick existing rockfill and construction of a toe stabilization berm with rockfill without any excavation below water. The construction of the toe stabilization berm should be carried out in 3 m wide panels in accordance with OPSS 206 and 209 progressing from north to south as shown on Drawing 4. EPS should be used to the required level and a minimum of about 0.7 m above water level (approximate elevation 248.3).

Further details of this option are provided in Appendix A.

The design and construction of the EPS should be in accordance with MTO Special Provision "Expanded Polystyrene Embankment" attached in Appendix B. An earth cover of 1.0 m should be incorporated over the EPS on the side slopes.

In addition, a 0.3 m thick Granular A levelling pad below and 125 mm thick concrete cover over the EPS should be incorporated in design.

The general design requirements for EPS design are as shown on the attached Figure B-1 in Appendix B.

Option 3: Use of EPS above water level in new northbound lanes without any excavation in water or toe stabilization berm construction

This option requires removal of the upper 2.5 m thick existing rockfill from the top of the embankment. Continue to remove the existing rockfill to the required level noted on Drawing 5 but not below elevation 248.3 that is about 0.7 m above water level. In addition, the existing embankment clay fill should be excavated under the new northbound lanes to the same level to provide benches for EPS block placement, as shown on Drawing 5. A roadway protection system will be required at the centreline of the Highway 577. EPS should be used to the required level but not below approximate elevation 248.3, which is about 0.7 m above water level.

The design and construction of the EPS should be in accordance with MTO Special Provision "Expanded Polystyrene Embankment" attached in Appendix B. An earth cover of 1.0 m should be incorporated over the EPS on the side slopes.

In addition, a 0.3 m thick Granular A levelling pad below and 125 mm thick concrete cover over the EPS should be incorporated in design.

Because the water level in the creek is at elevation 247.85 and constant for 2-year to 100-year storms being controlled by dam of the Iroquois Falls Generating Station and the underside of the EPS is higher than elevation 249.0 for a vertical separation of about 1.1 m, the provision of anchorage for uplift conditions is not required.

The general design requirements for EPS design are as shown on the attached Figure B-1 in Appendix B.

Further details of this option are provided in Appendix A.

Based on a revised computer model (*), the stability of the slopes was analyzed during the suggested mitigation measures listed above and following the reconstruction of the embankment fill. The results are summarized in the following table.

OPTION	FACTOR OF SAFETY (FOS)			
	EXISTING CONDITION	DURING MITIGATION	FINAL CONFIGURATION SHORT-TERM CONDITION (Total Stress Parameters)	FINAL CONFIGURATION LONG-TERM CONDITION (Effective Stress Parameters)
1	1.1 (Fig. 1)	1.5 (Fig. 2)	1.1 (Fig. 3)	1.7 (Fig. 4)
2	1.1 (Fig. 1)	2.1 (Fig. 5)	1.5 (Fig. 6)	1.6 (Fig. 7)
3	1.1 (Fig. 1)	2.0 (Fig. 8)	1.4 (Fig. 9)	1.5 (Fig. 10)

The computed factor of safety is considered to be low for Option 1 in the short-term condition.

The factor of safety of 1.3 for short-term condition and 1.5 for long-term condition is normally considered for design.

A summary of options, their advantages and disadvantages is provided in the following table.

OPTIONS	ADVANTAGES	DISADVANTAGES
Option 1 – Excavation below water and toe stabilization berm construction. Use of rockfill in road widening section	• Use of rockfill • Conventional method	• Turbidity curtain required • Requires underwater excavation (DFO approval) • Requires disposal of excavated material • Extra rockfill will be required
Option 2 – No excavation below water. Toe stabilization berm construction. Use of EPS above water level in shoulder of new northbound lanes	• Use of rockfill • No underwater excavation • Requires lesser amount of EPS than option 3	• Specialized equipment and installation procedures required • Requires filling in creek (DFO approval)
Option 3 – No excavation below water or toe stabilization berm required. Use of EPS above water level in new northbound lanes. Extend one layer of EPS into SBL	• No/minimal rockfill required • No DFO approval required • No underwater excavation required • Filling in creek not required	• Specialized equipment and installation procedures required • Requires larger volume of EPS than option 2 • EPS pavement required for stages 1 and 2 of roadway construction

Based on our analyses, options 2 and 3 are considered feasible and recommended from the foundation perspective. The selection of the mitigation option depends on other parameters or facets that are being considered by MTO/Stantec.

Upon consideration of schedule and to avoid further construction into the creek, option 3 was considered to be the preferred alternative in consultation with Stantec and was further illustrated in Drawings 5 to 7.

It is considered that a monitoring program based on a total station survey of points selected at 10 m intervals between Sta. 19+940 and 19+970 about 4 and 10 m Rt. offsets will be sufficient to provide an early warning of any movements caused by the construction of the toe stabilization berm. The surveys should be obtained at least three times daily (early morning, early afternoon and end of day) while the operation is in progress. The relative movements of the road and fill surfaces between readings should be obtained. Where the movements exceed 5 mm vertically and/or horizontally, the

contractor should be warned and the mitigation procedures reviewed. Should the movements exceed 8 mm vertically or horizontally, the procedures should be stopped and reconsidered.

We trust that the foregoing is sufficient for your present requirements. Please contact our office if you have any questions or require further input.

Sincerely

Peto MacCallum Ltd.

N. Balakumaran

Nesam Balakumaran, BSc.
Engineer-in-Training

Carlos M.P. Nascimento, P.Eng.
Manager, MTO Foundation Services

Brian R. Gray, MEng, P.Eng.
MTO Designated Principal Contact

CN/BRG:nb-lnr-mi

(*) (1) Sloping surface configuration is considered
(2) Transition of soil deposits is revised
(3) Remoulded undrained shear strength parameters is considered to access condition after failure.
(4) Soil parameters used for calculations are provided in Slope Stability Diagrams, Figures 1 to 10 attached.

Enclosure(s):
Figures 1 to 10
Appendix A – Mitigation Procedures
Appendix B – MTO Procedures for EPS Design; figure B-1
Drawings 1 to 7

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Condition after failure

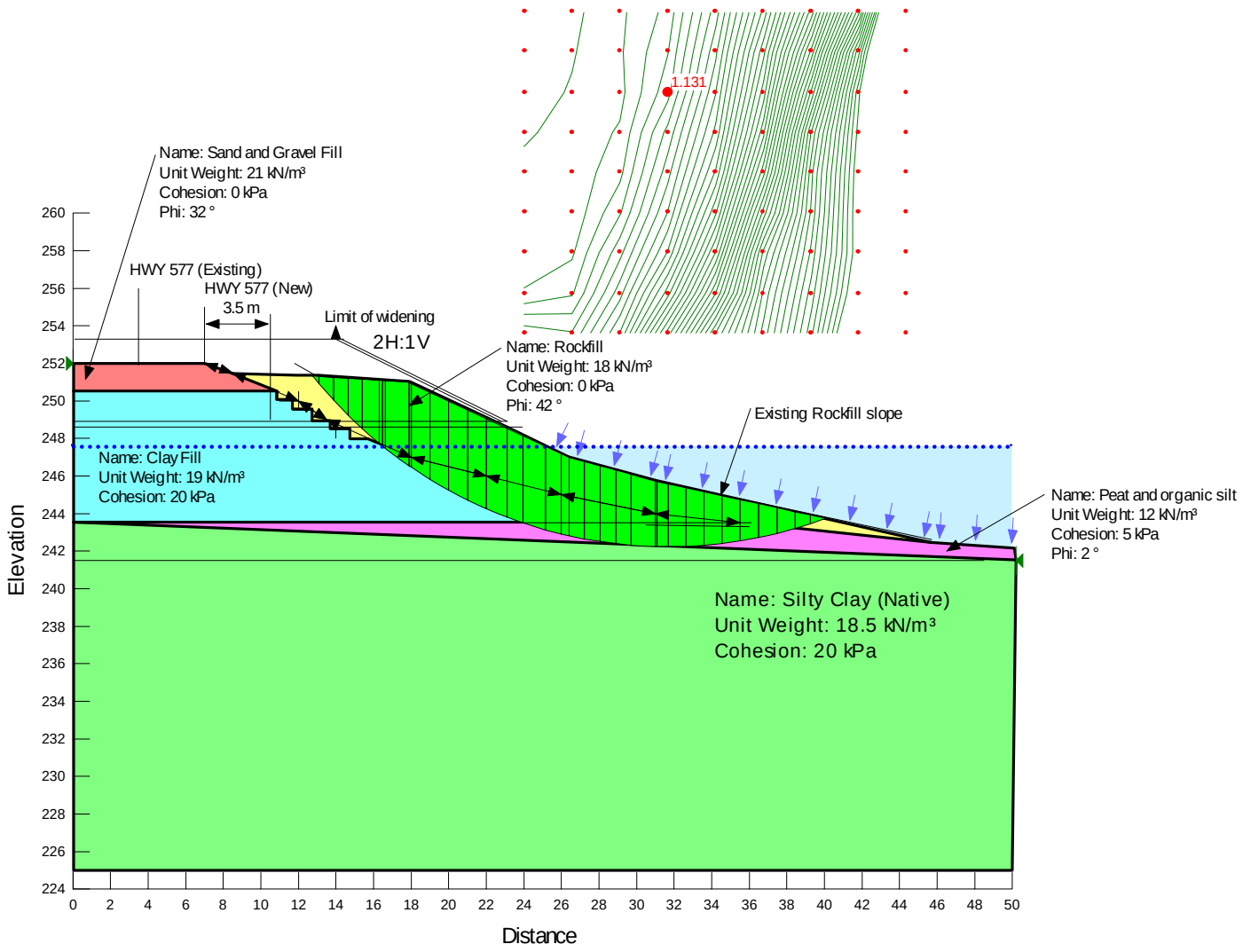


FIGURE 1

Option 1:

- Excavation in water
- Toe stabilization berm construction
- Rockfill in road widening section

Step 1: During Mitigation :Excavation and toe stabilazation berm construction completed

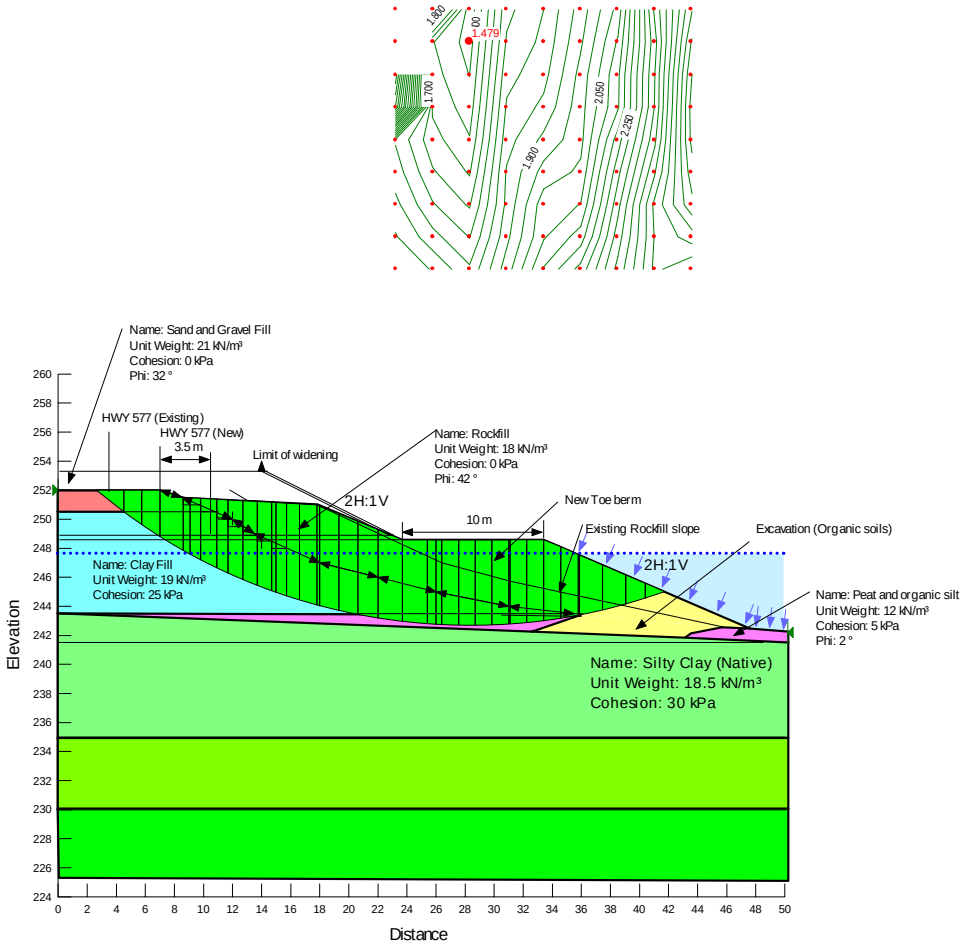


FIGURE 2

Option 1:

- Excavation in water
- Toe stabilization berm construction
- Rockfill in road widening section

Step 2: Final configuration (Pavement embankment in place) with short-term condition (total stress parameters)

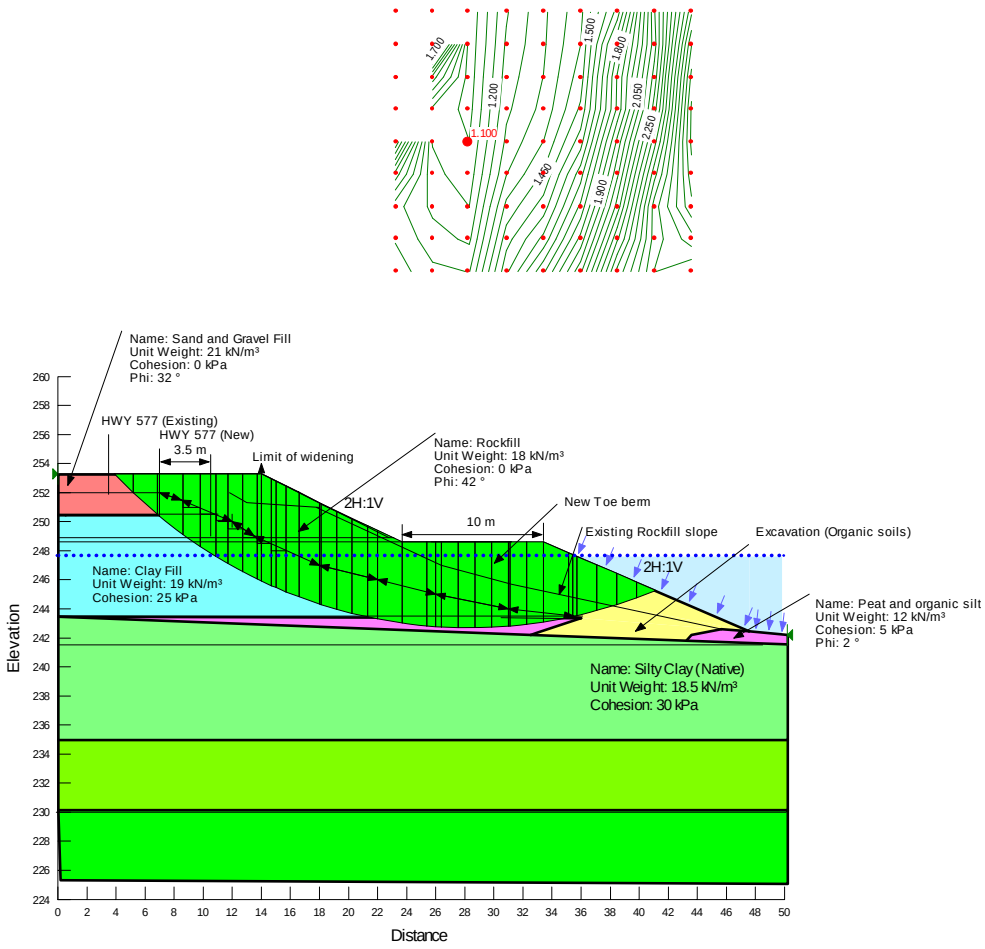
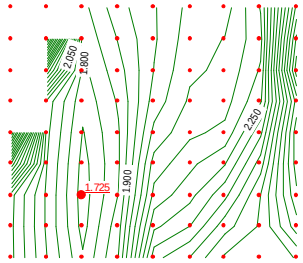


FIGURE 3

Option 1:

- Excavation in water
- Toe stabilization berm construction
- Rockfill in road widening section

Final configuration (Pavement embankment in place) with long-term condition (effective stress parameters)



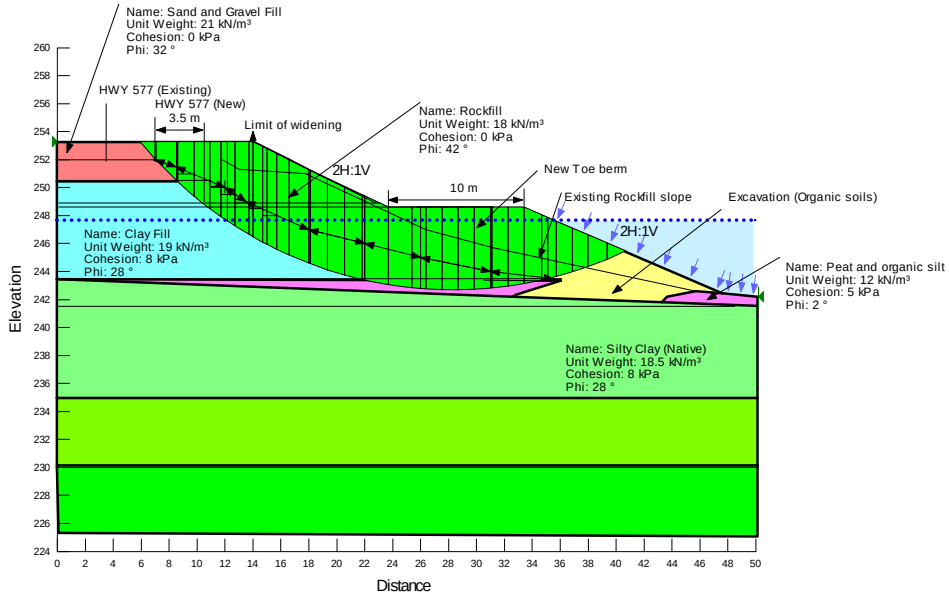


FIGURE 4

Option 2:

- No Excavation in water
- Toe stabilization berm construction
- EPS in road widening section

Step 1: During Mitigation :Remove existing rockfill to elevation 248.5 and toe stabilization berm construction completed

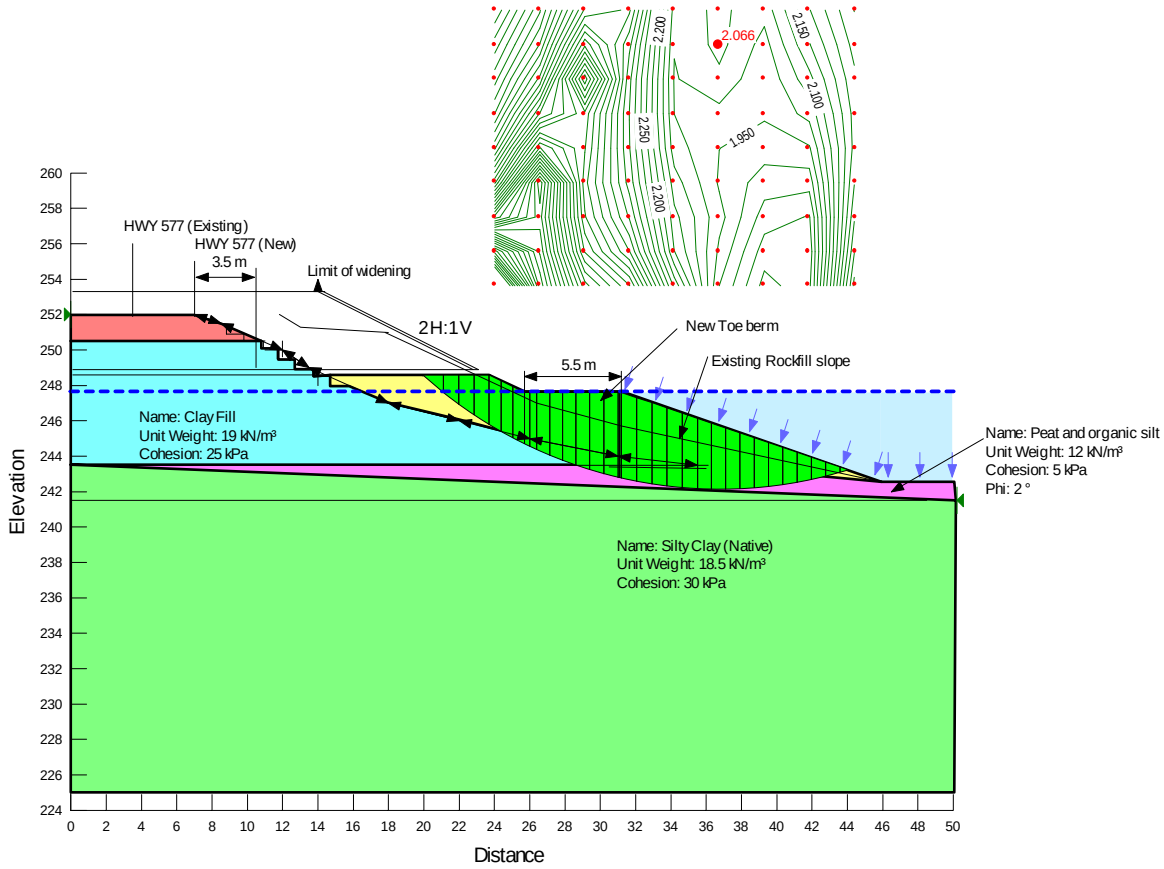


FIGURE 5

Option 2:

- No Excavation in water
- Toe stabilization berm construction
- EPS in road widening section

Step 2: Final configuration (Pavement embankment in place) with short-term condition (total stress parameters)

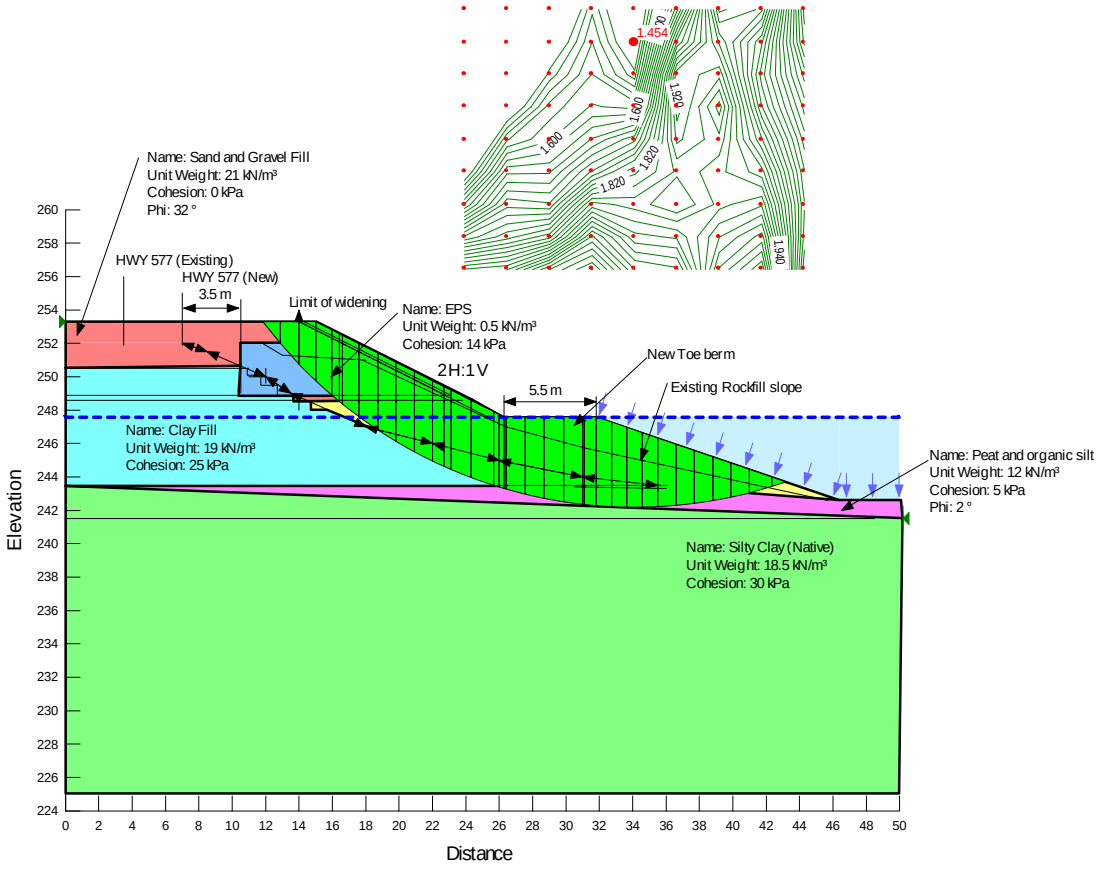


FIGURE 6

Option 2:

- No Excavation in water
- Toe stabilization berm construction
- EPS in road widening section

Final configuration (Pavement embankment in place) with long-term condition (effective stress parameters)

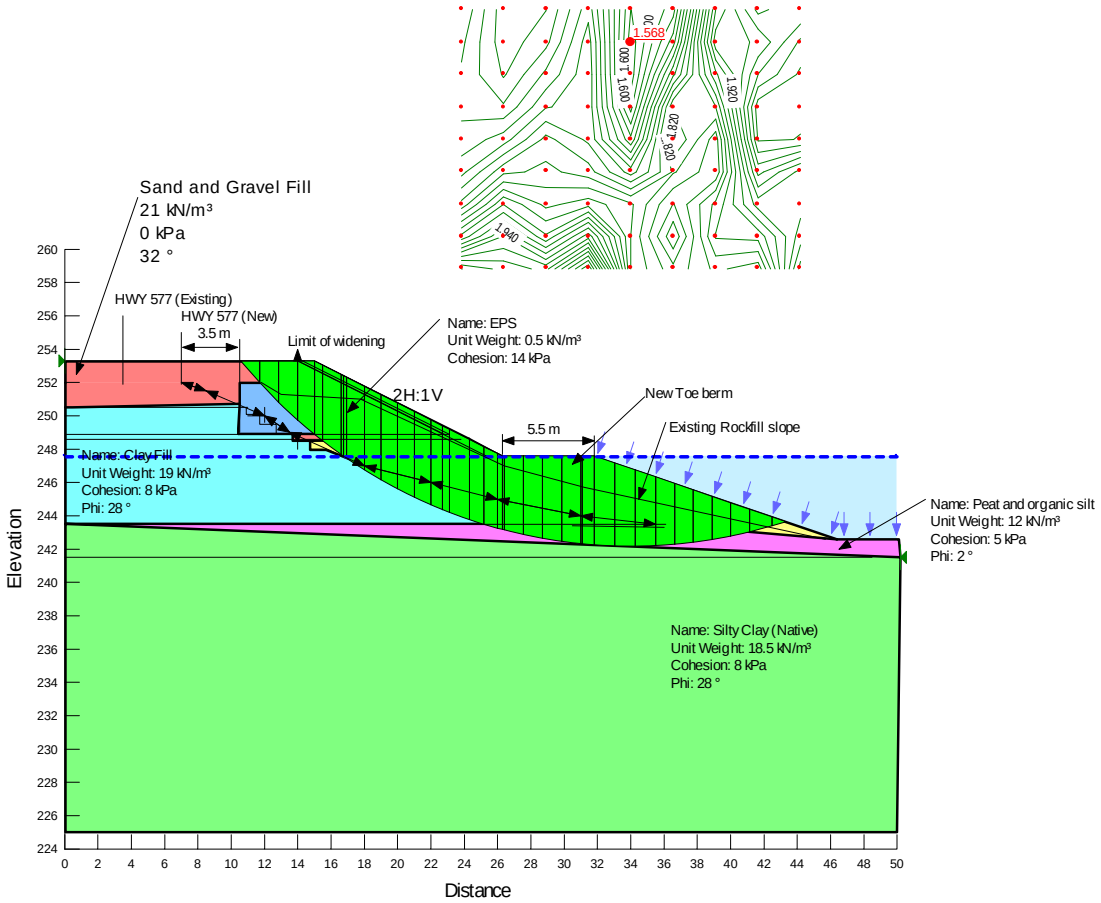


FIGURE 7

Option 3:

- No Excavation in water
- No Toe stabilization berm construction
- EPS in new northbound lanes

Step 1: During Mitigation :Remove existing rockfill to elevation 248.5

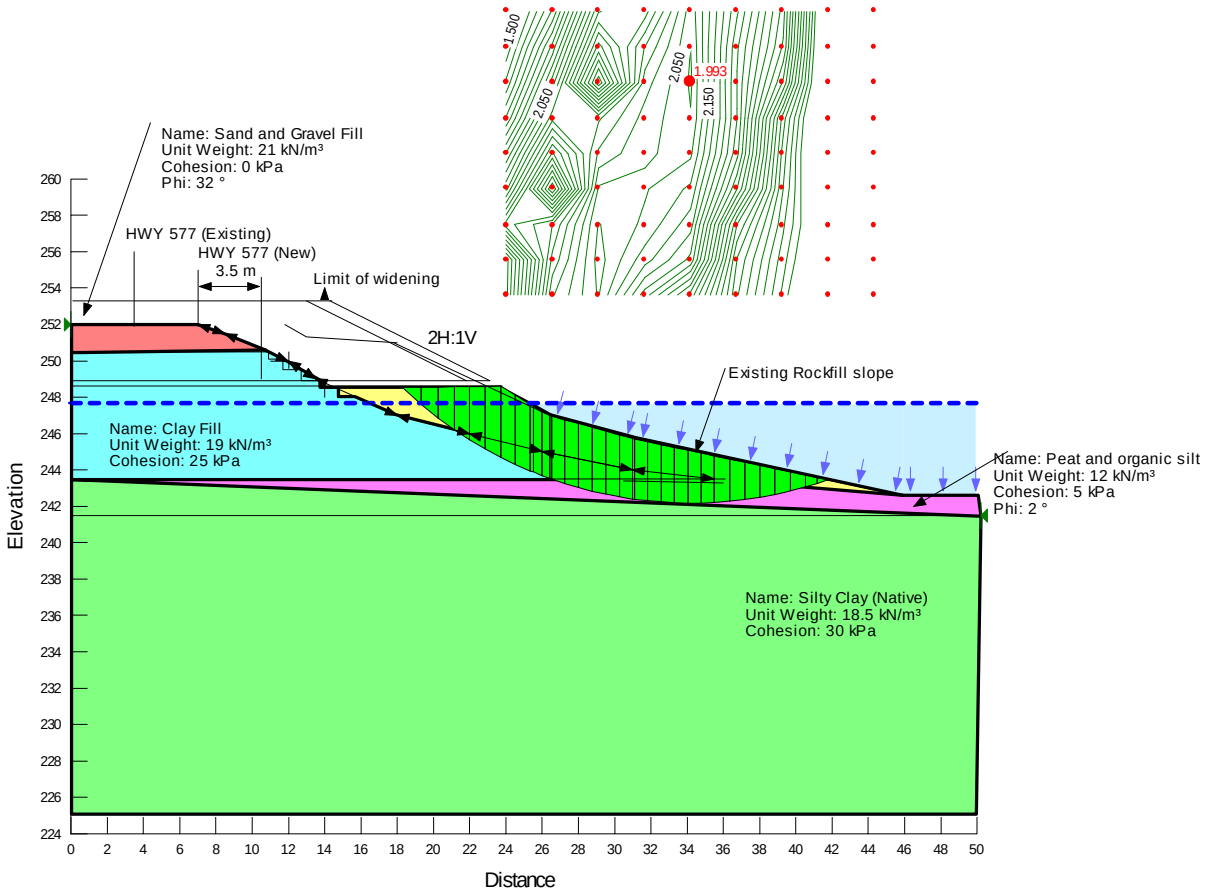


FIGURE 8

Option 3:

- No Excavation in water
- No Toe stabilization berm construction
- EPS in new northbound lanes

Step 2: Final configuration (Pavement embankment in place) with short-term condition (total stress parameters)

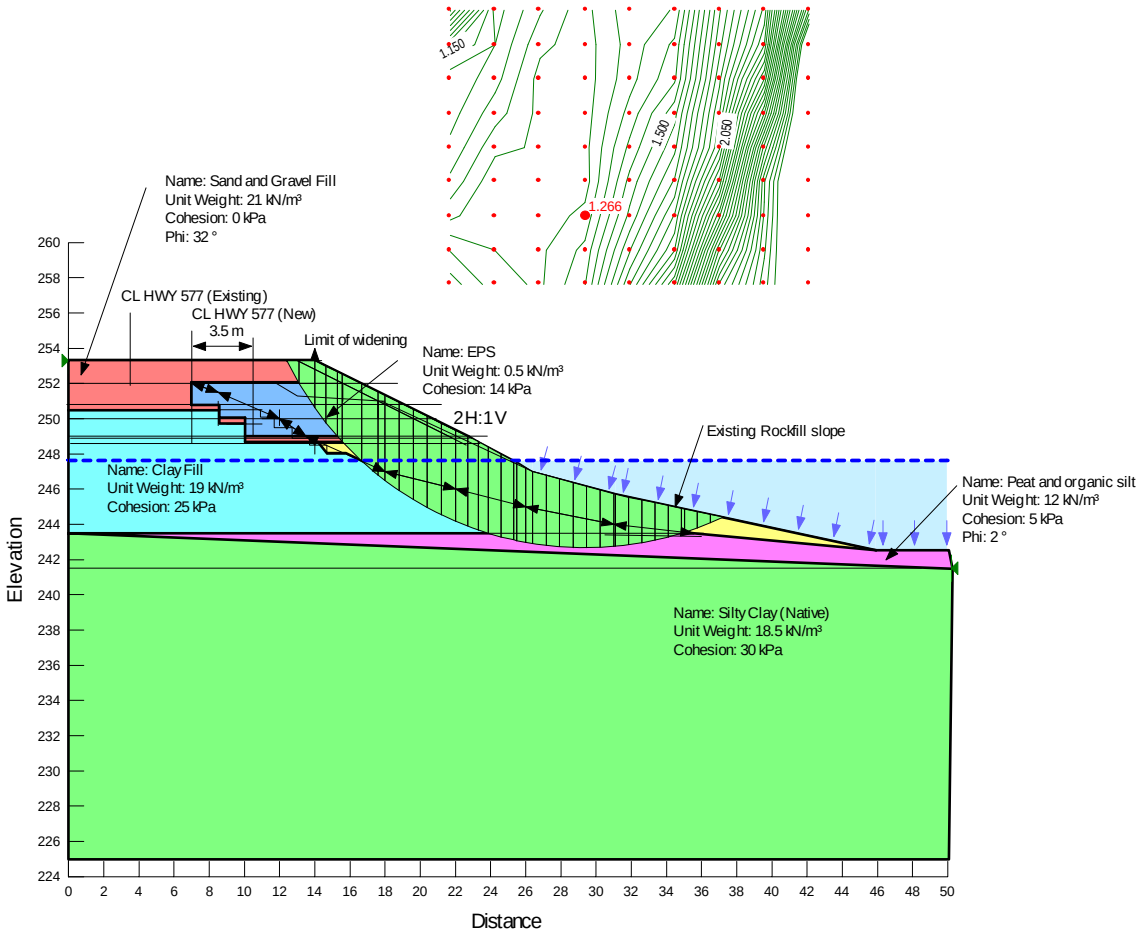


FIGURE 9

Option 3:

- No Excavation in water
- No Toe stabilization berm construction
- EPS in new northbound lanes

Final configuration (Pavement embankment in place) with long-term condition (effective stress parameters)

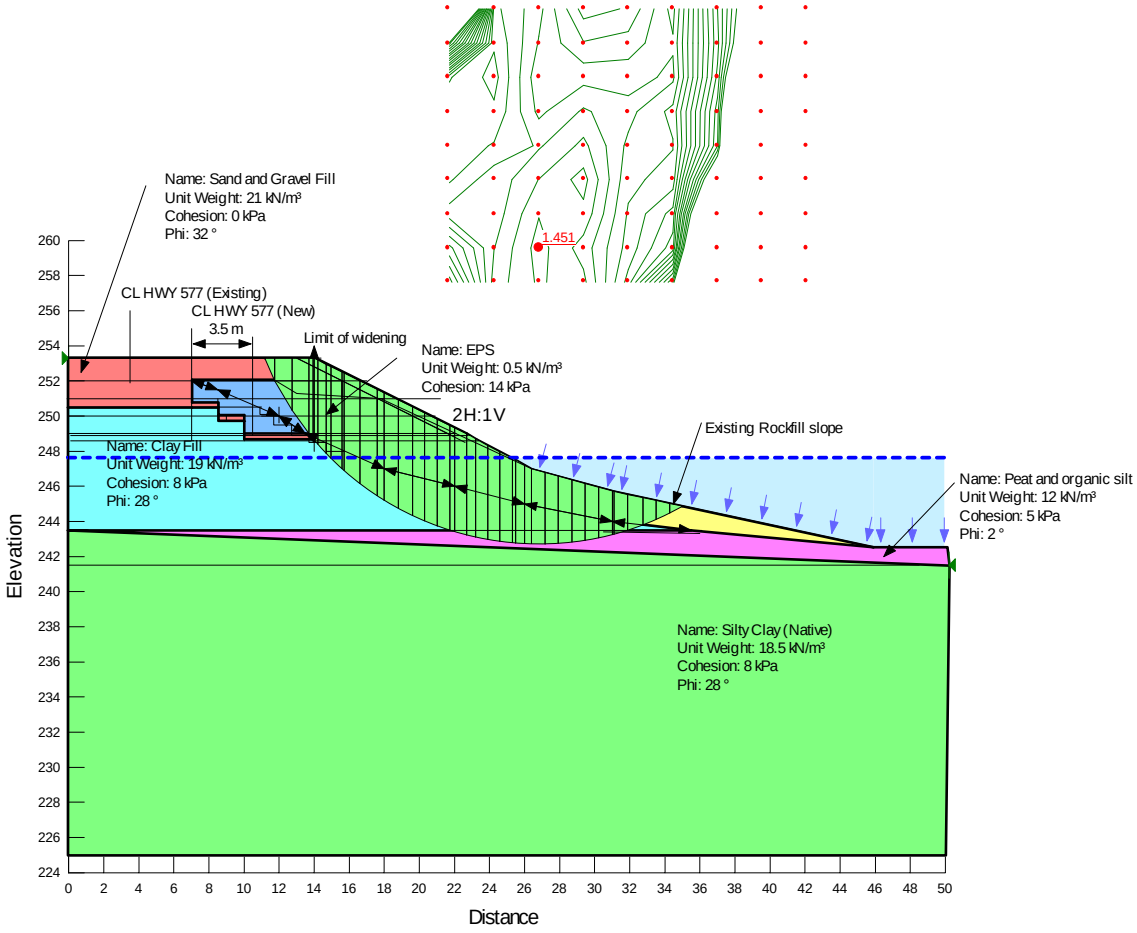


FIGURE 10

APPENDIX A

Mitigation Procedures

APPENDIX A
Meadow Creek Bridge Replacement
North Approach Embankment
Mitigation Procedures for Widening Section
Site No. 39E-077
Approximately from Sta. 19+938 to 19+970, Highway 577

The procedures described in this Appendix are considered to mitigate the slope failure which occurred during construction of the widening of Highway 577 for the new approach embankment on the north margin of the Meadow Creek and east of the existing bridge.

Option 1 – Excavation in water, toe stabilization berm construction and Rockfill in road widening section

A toe stabilizing berm should be constructed over the toe of the existing rockfill slope after removing any organic soils present at the level of the creek bed as outlined in the table below.

The excavated organic soils should be removed and discarded off-site. Excavated rockfill found over the organic soils may be incorporated into the toe berm construction.

The excavation and placement of the rockfill for this berm should be carried out using a backhoe capable of reaching the estimated maximum excavation depth of 6 m below the top of the toe berm. The material should be placed in layers and not end-dumped. The placement of the rockfill must follow expeditiously the removal of soils from the creek bottom.

<table>
<tr><td>Step 1
Cross Section A</td><td>Starting from the north edge of the water about Sta. 19+670, remove any loose or organic soils from the bottom of the creek to about 1 m depth within offsets ranging from about 19 to 24 m Rt. and replace with rockfill to elevation 248.0 (about 0.4 m above the creek level).</td></tr>
<tr><td>Step 2
Cross Sections B to F, Drawings 2 and 3</td><td>Continue the same procedure in a southerly direction. The width of the excavated soils at the toe of slope of the stabilizing berm is shown at each of the cross sections B to F and the off-sets and excavation levels are listed below at each of 6 additional stations:
<table>
<tr><th>Sta.</th><th>O/S Top of Berm</th><th>O/S Toe of Berm</th></tr>
<tr><td>19+968</td><td>19 to 24 Rt.</td><td>26 Rt.</td></tr>
<tr><td>19+963</td><td>19 to 24 Rt.</td><td>30 Rt.</td></tr>
<tr><td>19+955</td><td>19 to 27 Rt.</td><td>38 Rt.</td></tr>
<tr><td>19+950</td><td>19 to 29 Rt.</td><td>40 Rt.</td></tr>
<tr><td>19+947</td><td>18 to 28 Rt.</td><td>37 Rt.</td></tr>
<tr><td>19+942</td><td>16 to 25 Rt.</td><td>32 Rt.</td></tr>
</table></td></tr>
<tr><td>Step 3</td><td>Only after construction of the toe berm, complete the placement of rockfill for the construction of the top of the approach embankment to the design elevation.</td></tr>
<tr><td>Step 4</td><td>If it is required, remove the rockfill placed for the toe stabilizing above the creek water level. The level of the toe stabilizing berm below the water level should remain at elevation 247.0, about 0.6 m below water level.</td></tr>
</table>

Option 2 – No excavation in water, toe stabilization berm construction and EPS in road widening section

A toe stabilizing berm should be constructed over the toe of the existing rockfill slope as outlined in the table below.

The placement of the rockfill for this berm should be carried out using a backhoe capable of reaching the estimated maximum excavation depth of 6 m below the top of the toe berm. The material should be placed in layers and not end-dumped.

Step 1	Starting from Sta. 19+380 northerly about Sta. 19+970, remove upper 2.5 m layer of existing rockfill from top of embankment. Continue removing rockfill to level as required but not to below 0.7 m above water level (elevation 248.3).
Step 2 Cross Section at 19+950 (Drawing 4)	Construct toe stabilizing berm, starting from the north edge of the water about Sta. 19+670. Continue the same procedure in a southerly direction in 3 m wide panels. The typical section of the stabilizing berm is shown on Drawing 4, minimum width of 5.5 m at Sta. 19+950.
Step 3	Only after construction of the toe berm, EPS installation procedures should be carried out in accordance with MTO Special Provision for the construction of the top of the approach embankment to the design elevation.

Note that this option was not further developed because option 3 was selected as the preferred alternative.

Option 3 – No excavation in water, No toe stabilization berm construction and EPS in new northbound lanes

A. Stage 1 Roadway Construction

Step 1	Starting from Sta. 19+380 northerly about Sta. 19+970, remove upper 2.5 m layer of existing rockfill from top of embankment. Continue removing rockfill to level as required but not to below 0.7 m above water level (elevation 248.3). Contractor to verify the adequacy of using the previously installed roadway protection along centreline of realigned Highway 577.
Step 2 Cross Sections A to F, Option 3, Drawings 6 and 7	Remove the existing clay fill under new northbound lanes (roadway protection will be required) to a benched configuration to facilitate the EPS installation. For this removal refer to the design levels for EPS installation provided in Drawing 5.

Step 3 Cross Sections A to F, Option 3, Drawings 6 and 7	EPS installation procedures should be carried out in accordance with MTO Expanded Polystyrene Material Special Provision for the construction of the embankments. The typical sections are shown on Drawings 6 and 7. The upper layer of EPS should be 1.2 m thick and made with 0.6 m thick blocks placed at 90 degrees with respect to their long dimension. The EPS should be placed to a maximum 10.5 m Rt offset from the centreline. From the bridge north abutment to Sta. 19+944, the EPS should extend to the wing wall of the bridge north abutment.
Step 4	For frost treatment taper EPS northerly in two steps from Sta. 19+965 to Sta. 19+970. North of Sta. 19+970 taper using OPSS Granular A material placed at a 12H:1V slope.
Step 5	Complete stage 1 roadway construction.

B. Stage 2 Roadway Construction

Step 6	Starting from approximate Sta. 19+944 to Sta. 19+970 remove existing pavement and underlying clay fill to approximate elevations as follows at centreline.			
	Sta.	Elev.	Sta.	Elev.
	19+968	251.6	19+950	250.9
	19+963	251.4	19+947	250.8
	19+955	251.1	19+944	250.7
Step 7	Place the EPS to an offset of 7.0 m Lt. The EPS should be a single layer 1.2 m thick made with 0.6 m thick blocks placed at 90 degrees with respect to their long dimension.			
Step 8	Complete stage 2 roadway construction. Northerly from Sta. 19+970 include a frost treatment taper of the subgrade matching the stage 1 roadway construction taper described in Step 4.			

APPENDIX B

MTO Procedures for EPS Design

APPENDIX B
Meadow Creek Bridge Replacement
North Approach Embankment
Mitigation Procedures for Widening Section
Site No. 39E-077
Approximately from Sta. 19+355 to 19+970, Highway 577

EXPANDED POLYSTYRENE EMBANKMENT – Item No.

Special Provision

REQUIREMENTS FOR EXPANDED POLYSTYRENE EMBANKMENT FILL

1.0 SCOPE

This special provision covers the requirements for the supply and construction of the rigid expanded polystyrene embankment fill and associated works as shown on the contract drawings.

2.0 REFERENCES

This special provision refers to the following standards, specifications or publications.

2.1 National Standards of Canada

CAN/CGSB - 51.20 M87

2.2 ASTM

ASTM D1621	Test Method for Compressive Properties of Rigid Cellular Plastics
ASTM C203	Test Method for Breaking Load and Flexural Properties of Block Type Thermal Insulation
ASTM C177	Test Method for Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Apparatus
ASTM D2842	Test Method for Water Absorption by Rigid Cellular Plastics
ASTM D2863	Test Method for Measuring the Minimum Oxygen Content
ASTM D2126	Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging

2.3 OPSS - Ontario Provincial Standard Specification

OPSS 212	Borrow
OPSS 501	Compaction
OPSS 517	Dewatering
OPSS 1010	Aggregates – Granular A, B, M, and Selected Subgrade Material
OPSS 1605	Expanded Extruded Polystyrene Pavement Insulation
OPSS 1860	Geotextiles

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3.0 SUBSURFACE CONDITIONS

The subsurface conditions at the site are described in the Foundation Investigation Report for this Contract.

4.0 DEFINITIONS

For the purpose of this special provision, the following definitions apply:

Rigid Expanded Polystyrene: Moulded rigid blocks produced by a process of pre-expansion, aging and forming of petroleum based raw material.

Rigid Extruded Expanded Polystyrene: Rigid boards made by extrusion of expanded polystyrene beads.

Production Lot: The quantity of rigid polystyrene blocks produced in a continuous period of manufacturing the same grade and thickness of product within the same production day.

Quality Verification Engineer: Quality Verification Engineer means an Engineer with a minimum of five (5) years experience related to the design and/or construction of expanded polystyrene systems of similar scope to that in the Contract, or alternatively has demonstrated expertise by providing satisfactory quality verification services for the work at a minimum of two (2) projects of similar scope to the Contract. The Quality Verification Engineer shall be retained by the Contractor to ensure conformance with the contract documents and issue of certificate(s)of conformance.

5.0 QUALIFICATION

The Contractor shall have on site at the commencement of the work, a representative of the supplier of the rigid expanded polystyrene to advise on recommended construction procedure.

The Contractor shall maintain liaison with the supplier throughout the construction of the embankment for advice and guidance as required. Periodic site visits by the supplier should be coordinated as required.

6.0 SUBMISSION AND DESIGN REQUIREMENTS

6.1 Submission of Shop Drawings

At least three weeks before the commencement of work, the Contractor shall submit to the Contract Administrator six copies of the shop drawings and method statement signed and sealed by the Quality Verification Engineer that provides full details of materials and construction procedure.

6.2 Delivery, Storage, Handling, and Protection

The Contractor shall submit the method of delivery, storage, handling and protection from damage by weather, traffic, construction staging and other causes as per the rigid expanded polystyrene manufacturers requirement.

6.3 Construction

The contractor shall submit full details of the following.

a) The method of foundation excavation and preparation.

b) Construction of levelling pad.

c) The method of placement of expanded polystyrene blocks including temporary ballasting and protection of blocks during installation. The shop drawings shall indicate laying pattern and block dimensions on a layer-by-layer basis.

d) The method and limits of placement of polyethylene sheeting.

e) The method of placement of 125 mm reinforced concrete base pad (or equivalent).

f) The method of placement of subbase material.

g) The method of placement of side slope cover.

6.4 Quality Verification Engineer

(1) The Contractor shall submit details of the sequence and method of installation to the Quality Verification Engineer for review. The submittals shall satisfy the specifications and at a minimum include a detailed description of proposed installation procedures. The details shall be submitted at least three weeks prior to the installation of the rigid expanded polystyrene embankments the Contractor shall also submit to the Contract Administrator, for information purposes, details of the sequence and method of installation. The submittals shall satisfy the specifications and at a minimum contain the above information as provided to the Contractor's Quality Verification Engineer.

(2) The Contractor shall submit to the Contract Administrator a Certificate of Conformance sealed and signed by the Quality Verification Engineer a minimum of one week prior to commencement of work under this item. The Certificate shall state that the installation procedures are in conformance with the requirements and specifications of the contract documents. Quality test certificates for each production lot supplied, showing compliance with all requirements of this special provision shall be obtained by the Contractor and submitted to the Contract Administrator prior to installation. Upon completion of the Expanded Polystyrene Embankment the Contractor shall submit to the Contract Administrator a Certificate of Conformance sealed and signed by the Quality Verification Engineer stating that the Expanded Polystyrene Embankment has been constructed in conformance with the installation procedures and specifications of the contract documents.

7.0 MATERIALS

7.1 Granular Levelling Pad

The levelling pad shall consist of a Granular "A" material with gradation and physical requirements as specified in OPSS 1010.

7.2 Rigid Expanded Polystyrene

7.2.1 General

7.2.1.1 The Contractor shall submit:

1. A general statement as to the type, composition, and method of production of the material.

2. The manufacturer's name, address, phone number, identification of a contact person and description of experience background in the manufacturing of the rigid expanded polystyrene.

3. Certification of compliance of physical and mechanical properties.

4. An identification of a laboratory accredited by the Standards Council of Canada to conduct the testing of the physical and mechanical properties of the rigid expanded polystyrene.

5. The physical and mechanical properties of the rigid expanded polystyrene including:

    1. Geometry
    2. Nominal Density
    3. Compressive Strength
    4. Flexural Strength
    5. Thermal Resistance
    6. Dimensional Stability
    7. Flammability
    8. Water Absorption

6. Aging and durability characteristics of the polystyrene including the chemical, biological and ultra-violet degradation resistance of the rigid polystyrene.

7. A sample of the expanded polystyrene material to the Quality Verification Engineer for review.

8. To the Contract Administrator a Certificate of Conformance sealed and signed by the Quality Verification Engineer a minimum of one week prior to commencement of work under this item. The Certificate shall state that the expanded polystyrene material is in conformance with the requirements and specifications of the contract documents.

7.2.1.2 Production Lots

Each block of the same production lot shall be stamped with the same production code showing plant identification, type and date of production. The polystyrene shall be free from defects affecting serviceability.

7.2.2 Detail Requirements

Requirements shall be as shown in Table 1 and as described below.

Table 1 – Material Properties

PROPERTY	UNIT	REQUIREMENTS	TEST PROCEDURE
Geometry - Linear - Flatness - Squareness - Thickness	mm	1200 x 600 x 300 with tolerances ± 1% 10 mm in 3 m ± 0.5% -3, +5	
Compressive Strength	kPa (min)	110	ASTM D1621 (Procedure A)
Flexural Strength	kPa (min)	240	ASTM C203
Dimensional Stability	% linear change (max)	1.5	ASTM D2126
Thermal Resistance	m^2.°C/W (min for 25 mm thickness)	0.7	ASTM C177 or C518
Flammability	Limiting Oxygen Index (min)	24	ASTM D2863
Water Absorption	% by Volume (max)	4	ASTM D2842

7.2.2.1 Geometry

The expanded polystyrene shall be supplied in the form of rectangular parallel blocks of minimum acceptable dimensions of 1200 mm x 600 mm x 300 mm.

The maximum deviation from the specified linear dimensions shall be ± 1%. The flatness of the block faces shall be within ± 10 mm of a line formed by a 3 m straight edge.

The maximum difference in corner-to-corner dimensions (squareness) shall be 0.5%. The thickness shall be within –3 to +5 mm.

7.2.2.2 Compressive Strength

The minimum compressive strength, measured in accordance with ASTM D1621, Procedure A, shall be 110 kPa at a strain of not more than 5%. The maximum permissible permanent stress level should not exceed 30% of the compressive strength of the material at 5% strain.

7.2.2.3 Flexural Strength

The minimum flexural strength of the polystyrene shall be 240 kPa. The flexural strength shall be determined in accordance to ASTM C203, method 1, Procedure B.2.7.4 Dimensional Stability.

7.2.2.4 Dimensional Stability

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Dimensional Stability shall be determined in accordance with ASTM D2126, Procedure G. A tolerance of 1.5% shall be satisfied.

7.2.2.5 Thermal Resistance

The thermal resistance shall be 0.7 m^2.°C/W for a 25 mm thickness using the following equation and using the average value from three specimens:

$$R_{25mm} = \frac{R_{measured}}{\text{thickness (mm)}} \times 25$$

The thermal resistance shall be measured in accordance with ASTM C177 or C518.

7.2.2.6 Flammability

The expanded polystyrene shall be classified as to surface burning characteristics in accordance with CAN/ULC - 51022 having a flame spread rating less then 500. The expanded polystyrene shall have a minimum limiting oxygen index measured in accordance with ASTM D2863

7.2.2.7 Water Absorption

The water absorption as measured by ASTM D2842 shall be limited to 4% by volume.

7.2.2.8 Chemical Resistance

The expanded polystyrene shall be resistant to common inorganic acids and alkalies. A table identifying the chemical resistance as either resistant limited or not resistant shall be submitted.

7.2.2.9 Biological Resistance

The expanded polystyrene shall be resistant to biological degradation caused by organisms or enzymes.

7.2.2.10 Environmental

The expanded polystyrene shall be inert, non-nutritive and highly stable and shall not produce undesirable gases or leachate.

8.0 DELIVERY, STORAGE AND HANDLING

The product shall be suitably marked to identify its type, number and the manufacturer's name or trademark.

The Contractor shall protect the expanded polystyrene from exposure to sunlight to avoid ultraviolet degradation as per manufacturer's recommendation.

Protection of materials and works from damage by weather, traffic, construction staging, fire or vandalism and other causes shall be the responsibility of the Contractor.

9.0 CONSTRUCTION

9.1 Foundation Excavation

Foundation excavation shall be carried out to the design elevations shown on the drawings. Any softened, loosened or deleterious materials at the foundation footing elevation shall be subexcavated and replaced with Granular 'A' or Granular 'B' material.

9.2 Leveling Pad

Place, level and compact a layer of Granular 'A' or Granular 'B' material in accordance with OPSS 501 to within ± 30 mm of the design elevation. The leveling pad shall not deviate by more than 10 mm at any place on a 3 m straight edge over the limits of the bottom course of blocks. The leveling pad shall not be placed on frozen ground.

9.3 Installation of Blocks

(1) The individually marked blocks shall be placed on the prepared leveling pad. The top surface of the first layer of blocks is to be set plane and level. Local trimming of the blocks may be necessary.

(2) Subsequent successive layers shall be oriented with the long axis of blocks positioned at 90° to the previous layer in order to avoid continuous joints. Block joints shall be offset and staggered between layers.

(3) A continuous check shall be kept to ensure the evenness of the blocks is satisfactory in each layer. Blocks shall be laid with joints with maximum opening of 10 mm between blocks. Differences in heights between adjacent blocks in the same layer should not exceed 5 mm.

(4) Sloping end adjustments at the abutments shall be accomplished by leveling terraces in the subsoil in accordance with the block thickness.

(5) Temporary ballast shall be provided as necessary to prevent movement of expanded polystyrene both in storage and as placed due to windy conditions. Timber fasteners or equivalent shall be used as necessary.

(6) The expanded polystyrene embankment shall be protected from accidental ignition due to welding, smoking, grinding or cutting tools, etc. The Contractor shall take all necessary precautions to prevent ignition of the expanded polystyrene.

(7) The expanded polystyrene shall be protected from organic solvents and other aggressive, harmful chemicals during construction. The proposed method of protection during construction shall be submitted to the Contractor's Quality Verification Engineer for review and to the Contract Administrator for information purposes.

(8) Exposed blocks shall be covered immediately to avoid possible burrowing by animals.

(9) Individually marked blocks shall be fabricated and placed to ensure the top surface matches the elevation and crossfall shown on the drawings.

(10) The top surface and side surfaces of the expanded polystyrene shall be covered with 0.6 mil polyethylene sheeting extending onto adjacent work at the longitudinal ends of the

embankment. All joints shall be lapped a minimum of 300 mm to provide a fully sealed enclosure.

(11) The contractor shall install the concrete base pad as detailed elsewhere in the contract.

(12) The side slope of the rigid expanded polystyrene embankment shall be covered with Lightweight fill and waste material as detailed elsewhere in this contract.

10.0 EQUIPMENT

All cutting of polystyrene materials shall be by electric equipment or by hand.

Heavy equipment shall be limited in weight and size and restricted in operation to avoid damaging the expanded polystyrene as per the manufacturer's requirement.

11.0 QUALITY ASSURANCE

General

The Contract Administrator may undertake an independent testing program of the expanded polystyrene. Sampling and testing will be carried out in conformance with the relevant test procedure. The physical and thermal property testing identified in Table 1 will be conducted. A recognized testing laboratory accredited by the Standards Council of Canada shall conduct the testing.

Sampling Frequency

Sufficient sample material shall be obtained from blocks randomly selected by the Contract Administrator from each production lot as soon as the material arrives on site. As a minimum, three blocks shall be tested.

Acceptance/Rejection

Failure of any one of the sample blocks to comply with any requirements of this special provision shall be cause for rejection of the production lot from which it was taken. Replacement of the blocks shall be at the Contractor's expense.

12.0 MEASUREMENT FOR PAYMENT

Actual Measurement

Measurement will be by volume in cubic metres measured in its original position and based on cross-sections.

13.0 PAYMENT

Basis of Payment

The Concrete Base pad and granular leveling pad shall be paid for with the appropriate tender items as detailed elsewhere in the contract.

Payment at the contract price for the above tender item shall be full compensation for all labour, materials and equipment to do the work as described above and no extra payments will be made.

WARRANT: Always with this tender item.

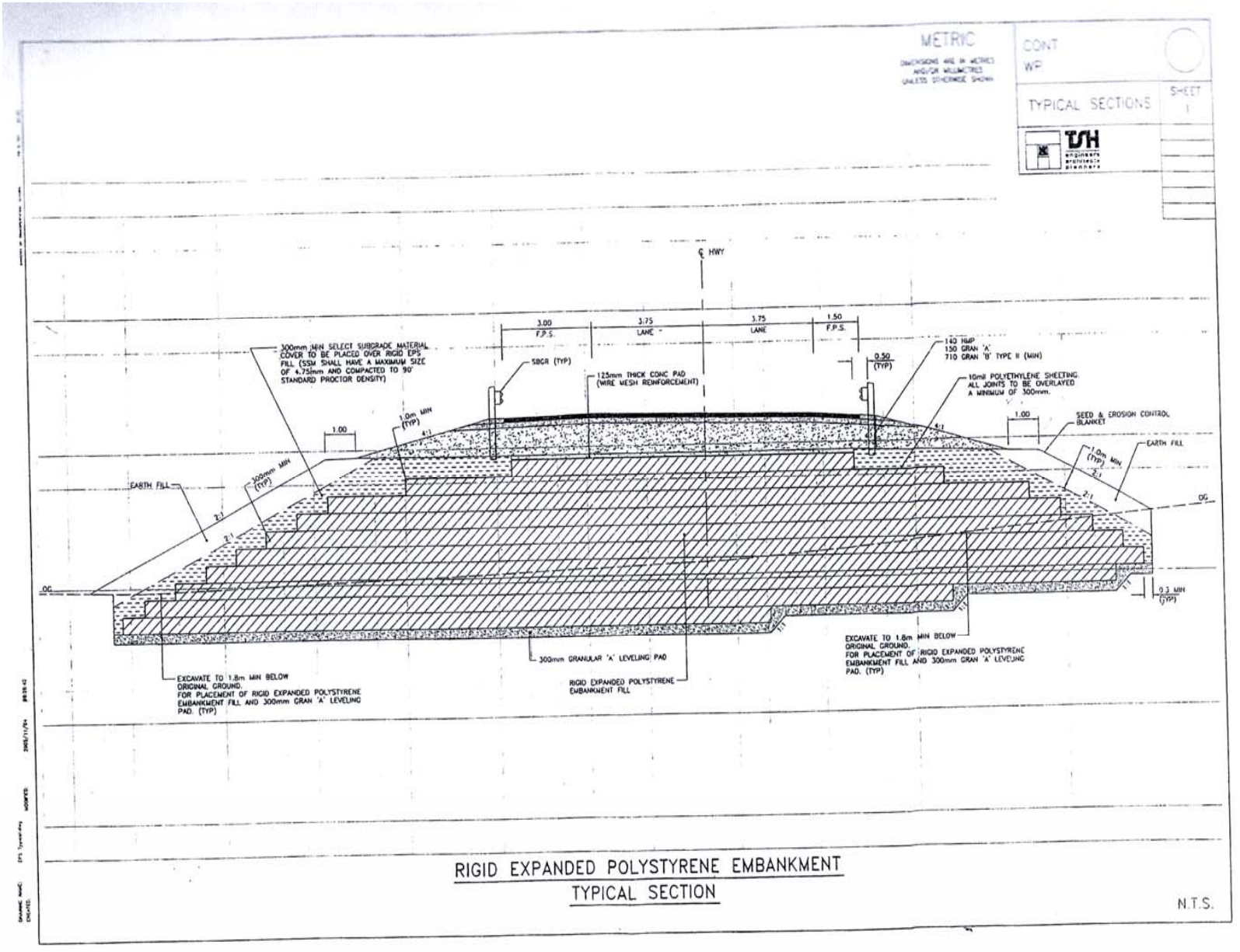

METRIC
CONT
WP
TYPICAL SECTIONS
SHEET
℄ HWY
3.00 F.P.S.
3.75 LANE
3.75 LANE
1.50 F.P.S.
0.50 (TYP)
300mm MIN SELECT SUBGRADE MATERIAL COVER TO BE PLACED OVER RIGID EPS FILL (SSM SHALL HAVE A MAXIMUM SIZE OF 4.75mm AND COMPACTED TO 90' STANDARD PROCTOR DENSITY)
SBGR (TYP)
125mm THICK CONC PAD (WIRE MESH REINFORCEMENT)
140 HMP
150 GRAN 'A'
710 GRAN 'B' TYPE II (MIN)
10mil POLYETHYLENE SHEETING. ALL JOINTS TO BE OVERLAYED A MINIMUM OF 300mm.
SEED & EROSION CONTROL BLANKET
EARTH FILL
1.00
1.0m MIN (TYP)
4:1
2:1
300mm MIN (TYP)
OG
0.3 MIN (TYP)
EXCAVATE TO 1.8m MIN BELOW ORIGINAL GROUND. FOR PLACEMENT OF RIGID EXPANDED POLYSTYRENE EMBANKMENT FILL AND 300mm GRAN 'A' LEVELING PAD. (TYP)
300mm GRANULAR 'A' LEVELING PAD
RIGID EXPANDED POLYSTYRENE EMBANKMENT FILL
RIGID EXPANDED POLYSTYRENE EMBANKMENT
TYPICAL SECTION
N.T.S.

FIGURE B-1

METRIC

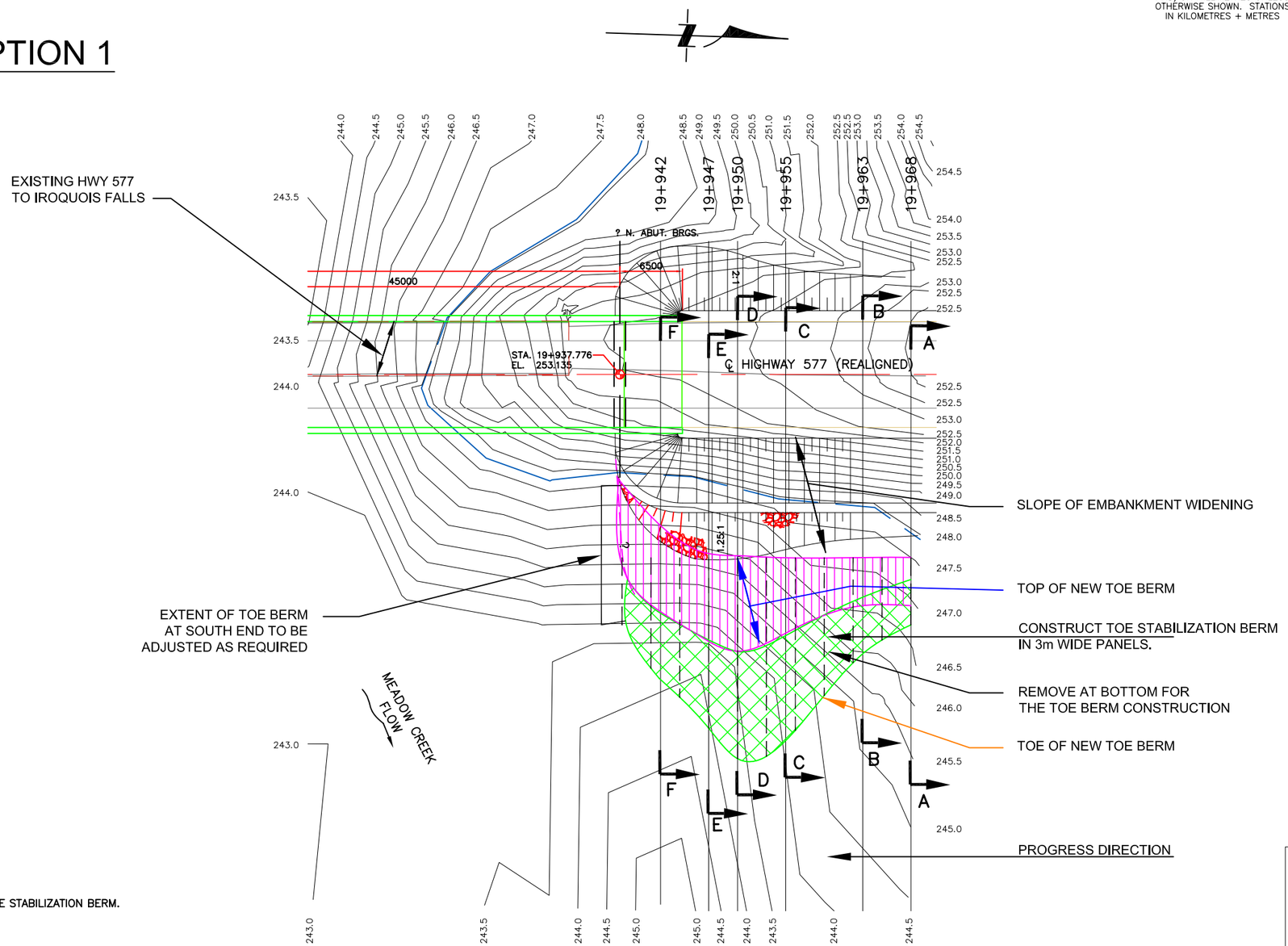
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES

CONT No 2010-5113
GWP No 181-92-00

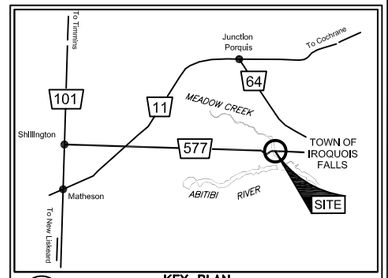
MEADOW CREEK BRIDGE
HIGHWAY 577
MITIGATION MEASURES

SHEET

OPTION 1



PLAN
SCALE
5 0 5 10m



KEY PLAN
SCALE
10 0 10 20 30km

LEGEND

TOP OF NEW BERM

REMOVAL AT BOTTOM FOR TOE BERM CONSTRUCTION

BH No	ELEVATION	CO-ORDINATES NORTHINGS	EASTINGS

OPTION 1 NOTES:

1. USE OPSS 206 AND OPSS 209 TO CONSTRUCT TOE STABILIZATION BERM.
2. PROGRESS FROM NORTH SHORE SOUTHERLY.
3. USE TURBIDITY CURTAIN AS REQUIRED.
4. REFER TO ATTACHED DRAWINGA 2 AND 3 FOR DETAILS OF CONSTRUCTION.

NOTE:

1. REFER TO DRAWINGS 2 AND 3 FOR CROSS SECTIONS AT STA. 19+942, 19+947, 19+950, 19+955, 19+963 AND 19+968.

REF No. STANTEC DRAWING: 165000672_MeadowCreek-GA.dwg; DATED DECEMBER 2008

Pete MacCallum Ltd. CONSULTING ENGINEERS

C M P Nascimento
Nov. 05, 2010
PROVINCE OF ONTARIO

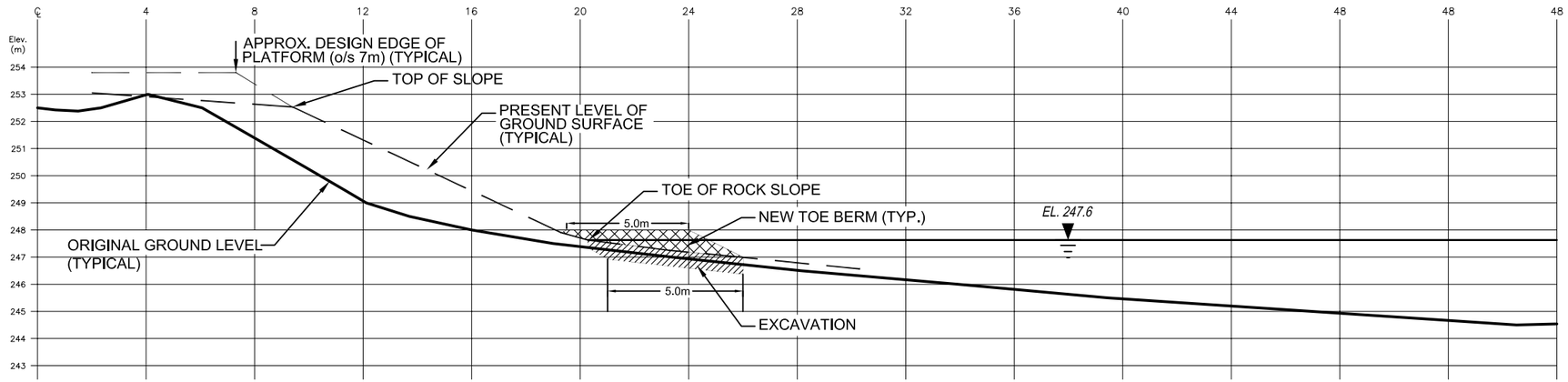
B. R. GRAY
NOV. 05, '10
PROVINCE OF ONTARIO

– NOTE –
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

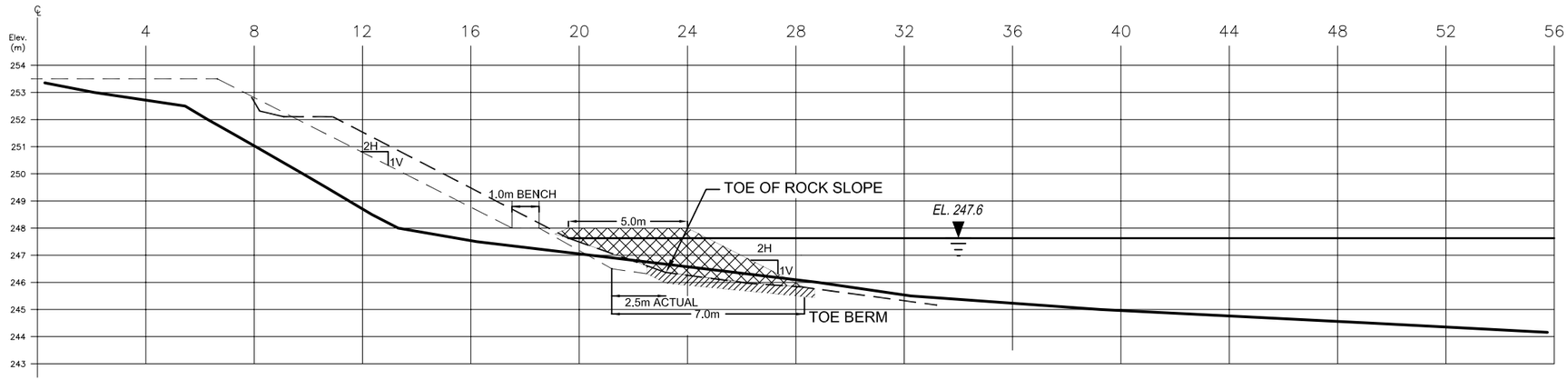
REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 42A-75

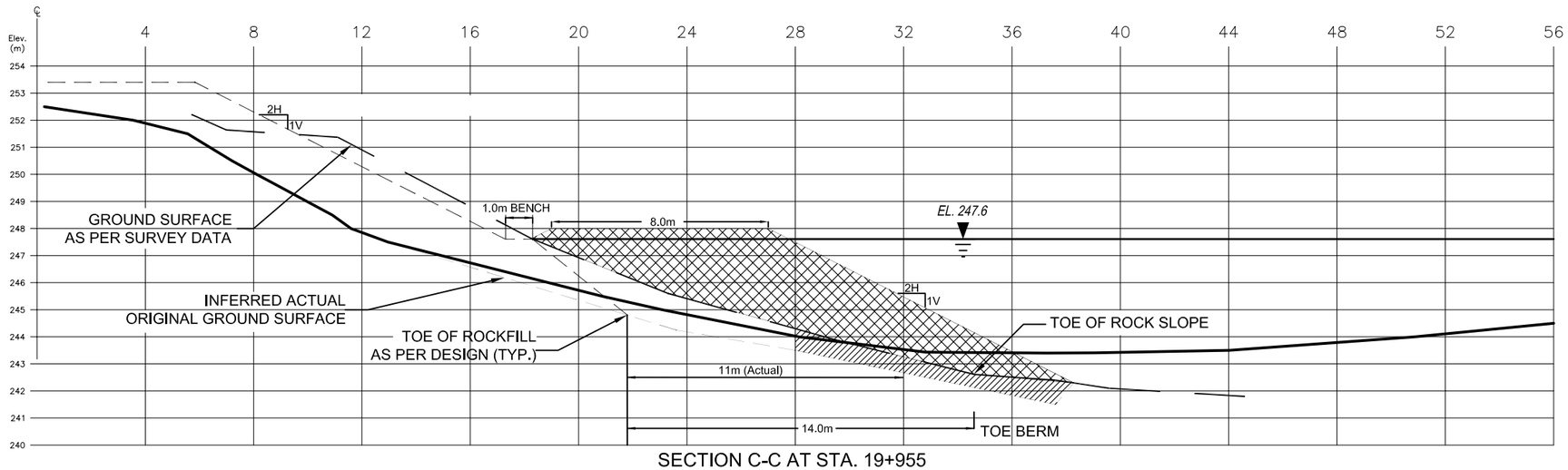
HWY No	577					DIST	COCHRANE
SUBM'D	NB	CHECKED	NB	DATE	NOV. 05, 2010	SITE	39E-077
DRAWN	NA	CHECKED	CN	APPROVED	BRG	DWG	1



SECTION A-A AT STA. 19+968



SECTION B-B AT STA. 19+963



SECTION C-C AT STA. 19+955

SCALE
2 0 2 4m

NOTES:

1. REFER TO DRAWING 1 FOR LOCATION OF SECTIONS AND DRAWING 2 FOR SECTIONS AT STA. 19+942, 19+947 AND 19+950.

CONT No 2010-5113
GWP No 181-92-00

MEADOW CREEK BRIDGE
HIGHWAY 577
MITIGATION MEASURES

SHEET

Pete MacCallum Ltd.
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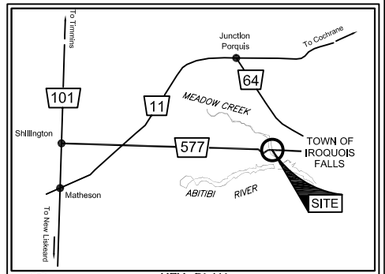


KEY PLAN
SCALE
10 0 10 20 30km

LEGEND

TOP OF NEW BERM

REMOVAL AT BOTTOM FOR TOE BERM CONSTRUCTION

REGISTERED PROFESSIONAL ENGINEER
C M P Nascimento
Nov. 05, 2010
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
B. R. GRAY
NOV. 05, '10
PROVINCE OF ONTARIO

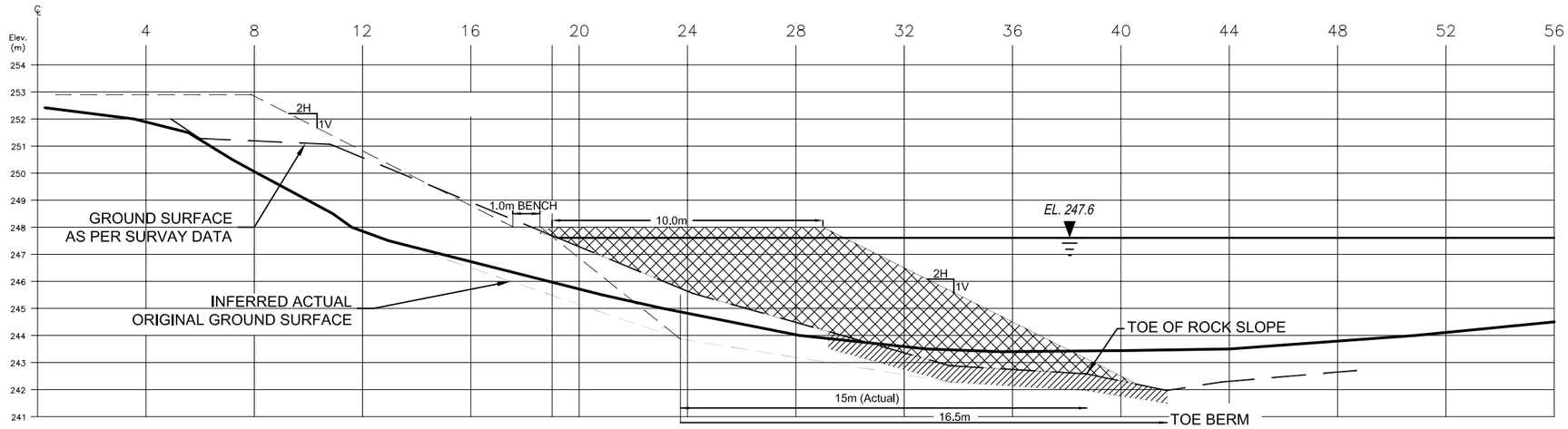
— NOTE —
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS		
DATE	BY	DESCRIPTION

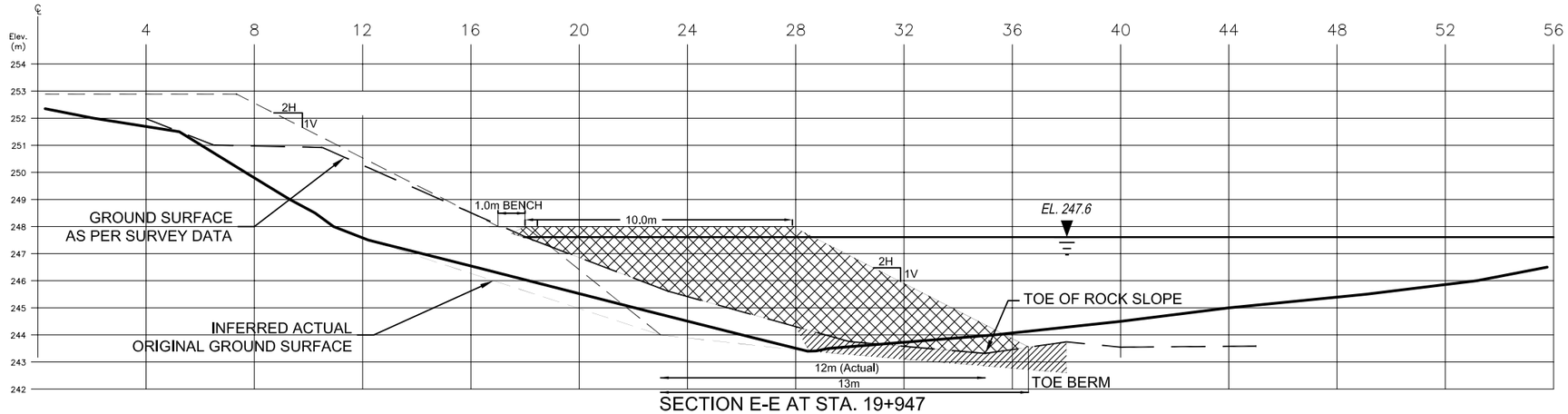
Geocres No. 42A-75

HWY No	577					DIST	COCHRANE
SUBM'D	NB	CHECKED	NB	DATE	NOV. 05, 2010	SITE	39E-077
DRAWN	NA	CHECKED	CN	APPROVED	BRG	DWG	2

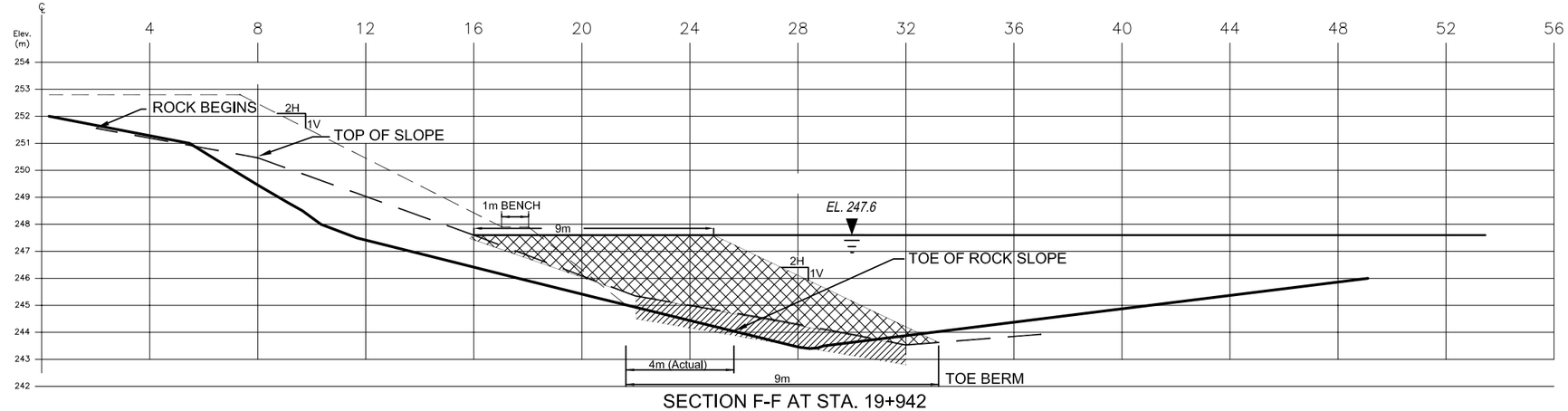
REF No. STANTEC DRAWING: 165000672_MeadowCreek-GA.dwg; DATED DECEMBER 2008



SECTION D-D AT STA. 19+950



SECTION E-E AT STA. 19+947



SECTION F-F AT STA. 19+942

NOTES:

1. REFER TO DRAWING 1 FOR LOCATION OF SECTIONS AND DRAWING 3 FOR SECTIONS AT STA. 19+955, 19+963 AND 19+968
2.

SCALE
2 0 2 4m

CONT No 2010-5113
GWP No 181-92-00

MEADOW CREEK BRIDGE
HIGHWAY 577
MITIGATION MEASURES

SHEET

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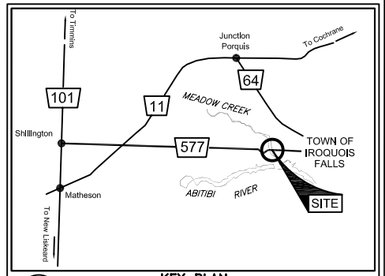


KEY PLAN
SCALE
10 0 10 20 30km

LEGEND

TOP OF NEW BERM

REMOVAL AT BOTTOM FOR TOE BERM CONSTRUCTION

REGISTERED PROFESSIONAL ENGINEER
C M P Nascimento
NOV. 05, 2010
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
B. R. GRAY
NOV. 05, '10
PROVINCE OF ONTARIO

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

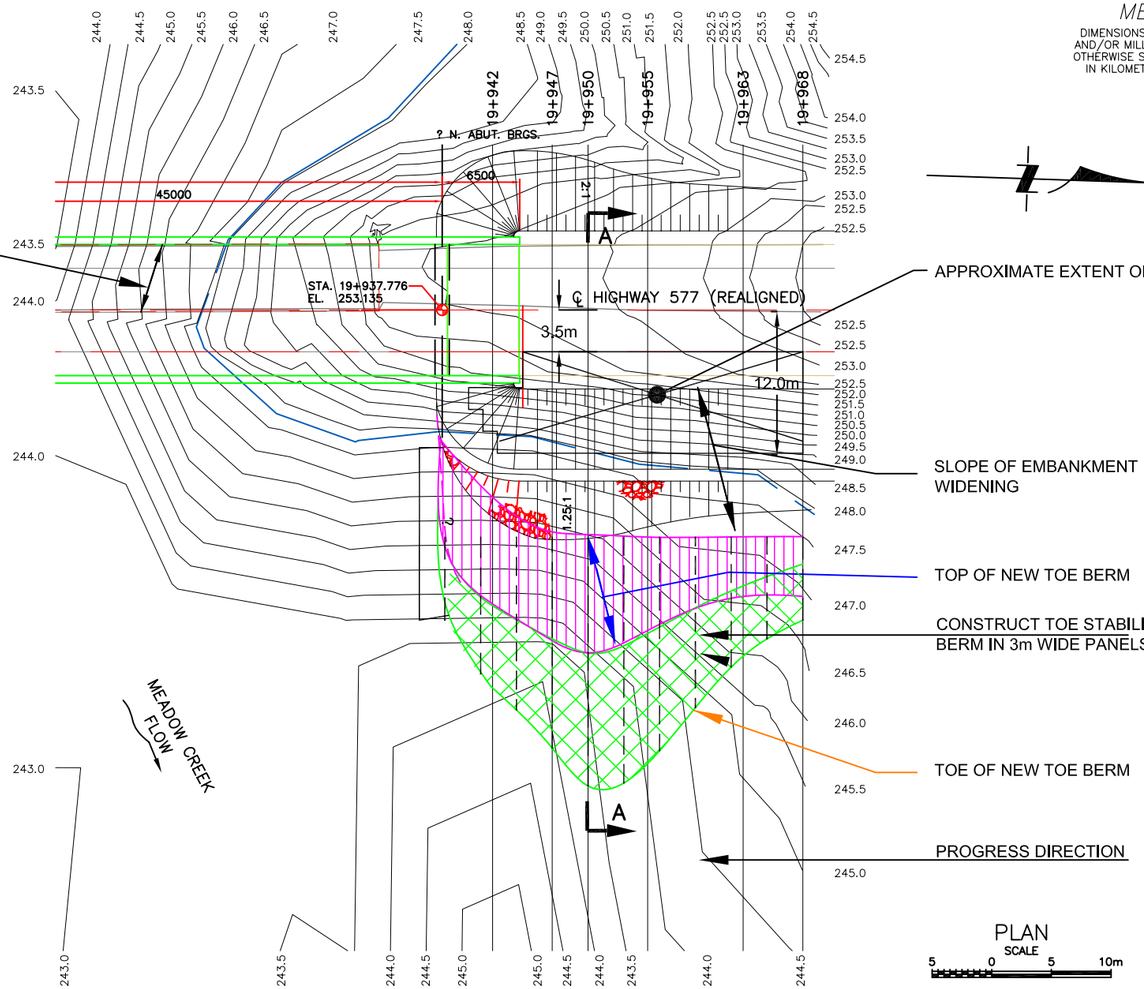
REVISIONS		
DATE	BY	DESCRIPTION

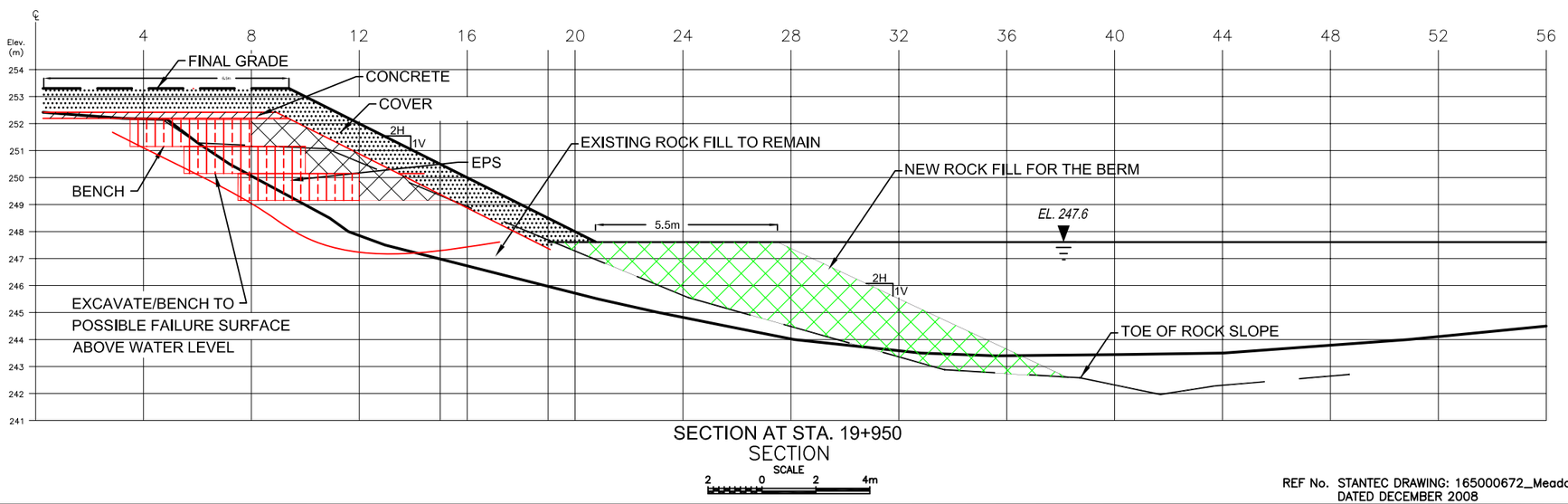
Geocres No. 42A-75

HWY No	577					DIST	COCHRANE
SUBM'D	NB	CHECKED	NB	DATE	NOV. 05, 2010	SITE	39E-077
DRAWN	NA	CHECKED	CN	APPROVED	BRG	DWG	3

REF No. STANTEC DRAWING: 165000672_MeadowCreek-GA.dwg; DATED DECEMBER 2008

OPTION 2





OPTION 2 NOTES:

1. USE OPSS 206 AND OPSS 209 TO CONSTRUCT TOE STABILIZATION BERM.
2. PROGRESS FROM NORTH SHORE SOUTHERLY.
3. REMOVE UPPER 2.5m LAYER OF EXISTING ROCKFILL FROM TOP OF EMBANKMENT. CONTINUE REMOVING AS REQUIRED A MINIMUM TO 0.7m ABOVE WATER LEVEL FROM NORTH END OF SLOPED ROCKFILL SOUTHERLY.

METRIC

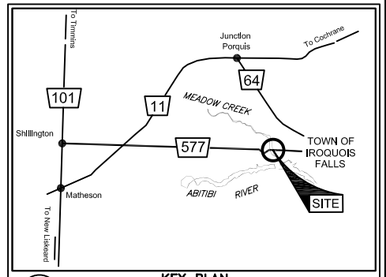
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES

CONT No 2010-5113
GWP No 181-92-00

MEADOW CREEK BRIDGE
HIGHWAY 577
MITIGATION MEASURES

SHEET

PML Pete MacCallum Ltd. CONSULTING ENGINEERS



KEY PLAN
SCALE
10 0 10 20 30km

LEGEND

TOP OF NEW BERM

BH No	ELEVATION	CO-ORDINATES NORTHINGS	EASTINGS

C M P Nascimento
NOV. 05, 2010
PROVINCE OF ONTARIO

B. R. GRAY
NOV. 05, '10
PROVINCE OF ONTARIO

– NOTE –
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS			
	DATE	BY	DESCRIPTION

Geocres No. 42A-75

HWY No	577			DIST	COCHRANE
SUBM'D	NB	CHECKED	NB	DATE NOV. 05, 2010	SITE 39E-077
DRAWN	NA	CHECKED	CN	APPROVED BRG	DWG 4

REF No. STANTEC DRAWING: 165000672_MeadowCreek-GA.dwg; DATED DECEMBER 2008

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES

CONT No 2010-5113
GWP No 181-92-00

MEADOW CREEK BRIDGE
HIGHWAY 577
MITIGATION MEASURES

SHEET

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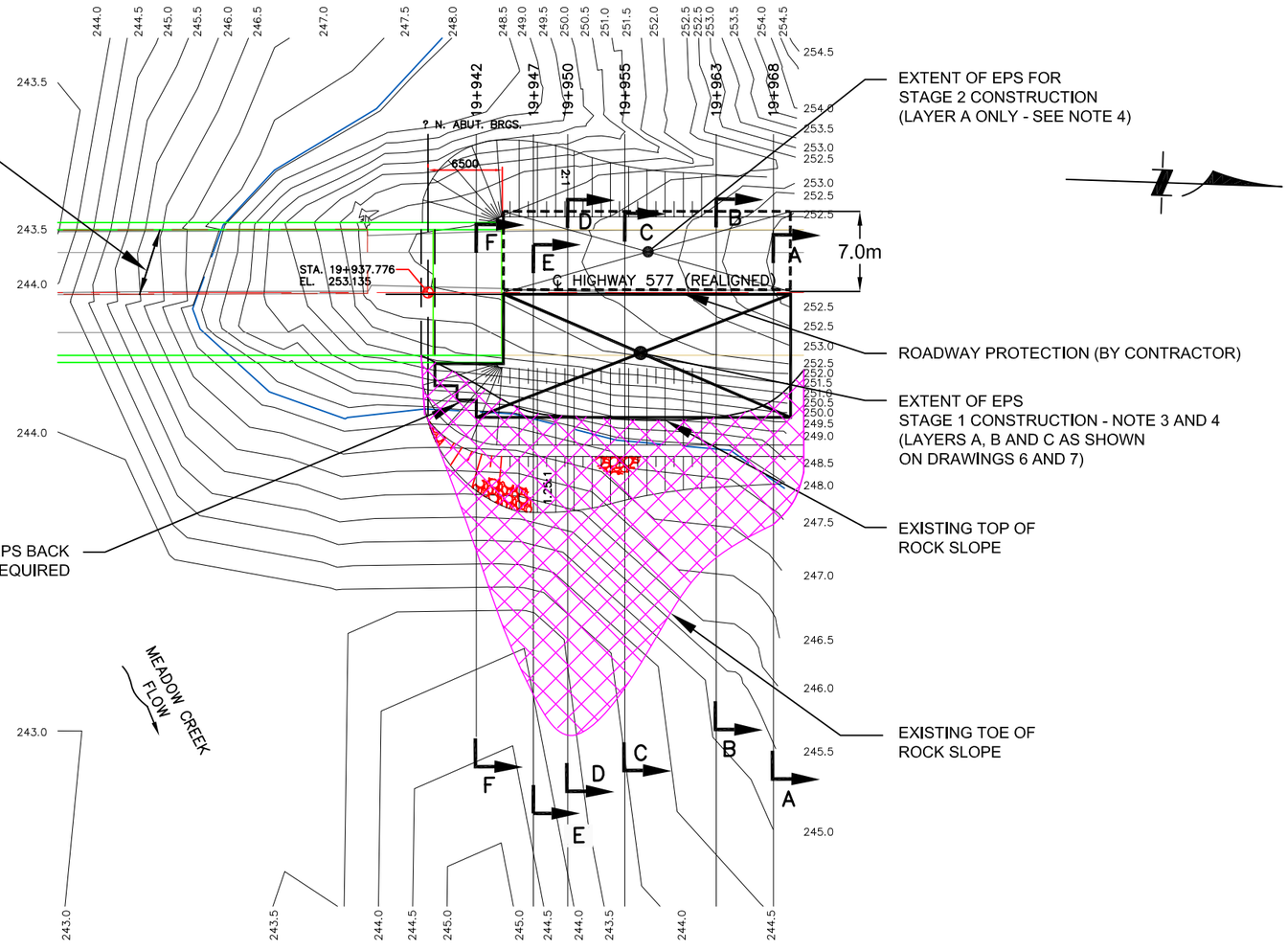
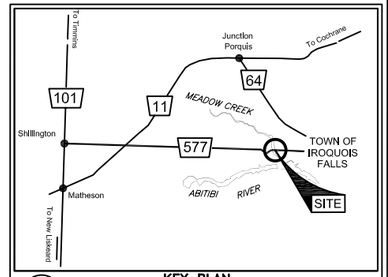
OPTION 3



PLAN
SCALE
5 0 5 10m



KEY PLAN
SCALE
10 0 10 20 30km

LEGEND

BH No	ELEVATION	CO-ORDINATES NORTHINGS	EASTINGS

SECTION	TOP OF CONCRETE ELEVATION (m)	TOP OF EPS (APPROXIMATE) ELEVATION (m)		
		LAYER A	LAYER B	LAYER C
A - A	253.2	253.1	251.9	250.9
B - B	253.0	252.9	251.7	250.7
C - C	252.7	252.6	251.4	250.4
D - D	252.5	252.4	251.2	250.2
E - E	252.4	252.3	251.1	250.1
F -F	N/A	252.2	251.0	250.0

REGISTERED PROFESSIONAL ENGINEER — C M P Nascimento — NOV. 05, 2010 — PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER — B. R. GRAY — NOV. 05, '10 — PROVINCE OF ONTARIO

– NOTE –
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS

DATE	BY	DESCRIPTION

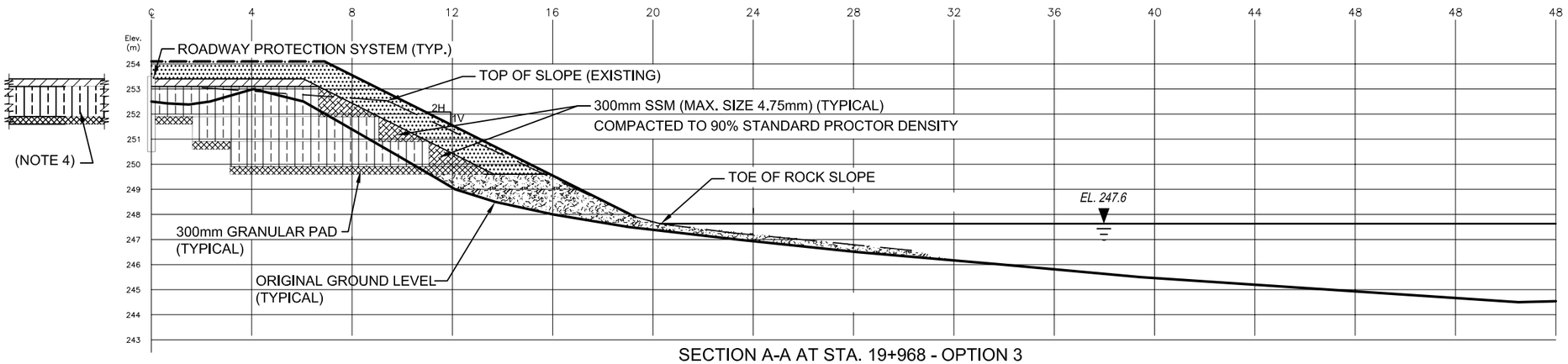
Geocres No. 42A-75

HWY No	577			DIST	COCHRANE
SUBM'D	NB	CHECKED	NB	DATE NOV. 05, 2010	SITE 39E-077
DRAWN	NA	CHECKED	CN	APPROVED BRG	DWG 5

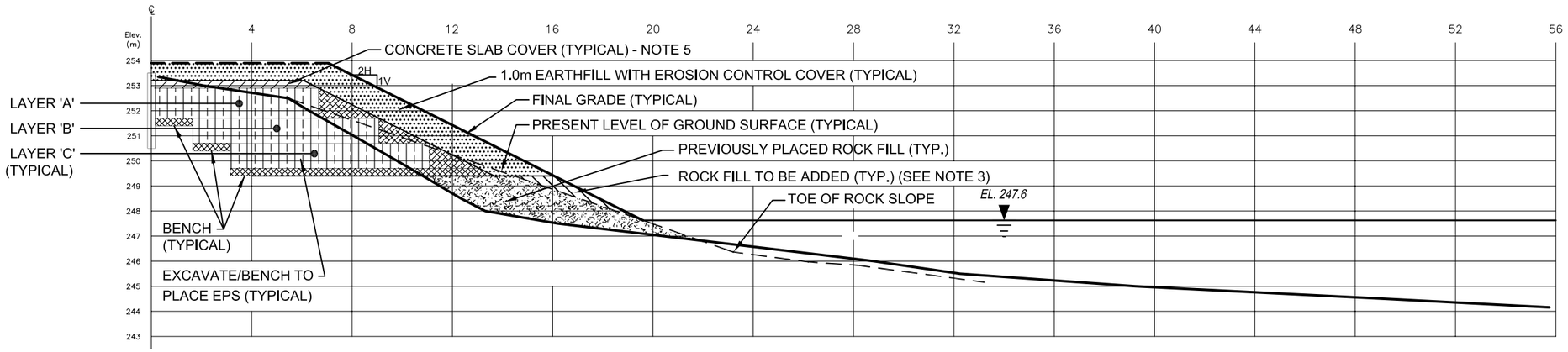
OPTION 3 NOTES:

1. REFER TO DRAWINGS 6 AND 7 FOR SECTIONS A–A TO F–F.
2. USE MTO SPECIAL PROVISION "EXPANDED POLYSTRENE EMBANKMENT".
3. REMOVE UPPER 2.5m LAYER OF EXISTING ROCKFILL FROM TOP OF EMBANKMENT. CONTINUE REMOVING TO REQUIRED LEVEL FROM NORTH END OF SLOPED ROCKFILL SOUTHERLY.
4. REMOVE EXISTING EARTHFILL (CLAYEY FILL) FOR EPS INSTALLATION UNDER PAVEMENT.
5. 1.2m THICK LAYER A OF EPS TO BE MADE OUT OF 2 EPS BLOCKS 0.6m THICK PLACED ACCORDING TO MTO SPECIAL PROVISION FOR EXPANDED POLYSTYRENE EMBANKMENT.

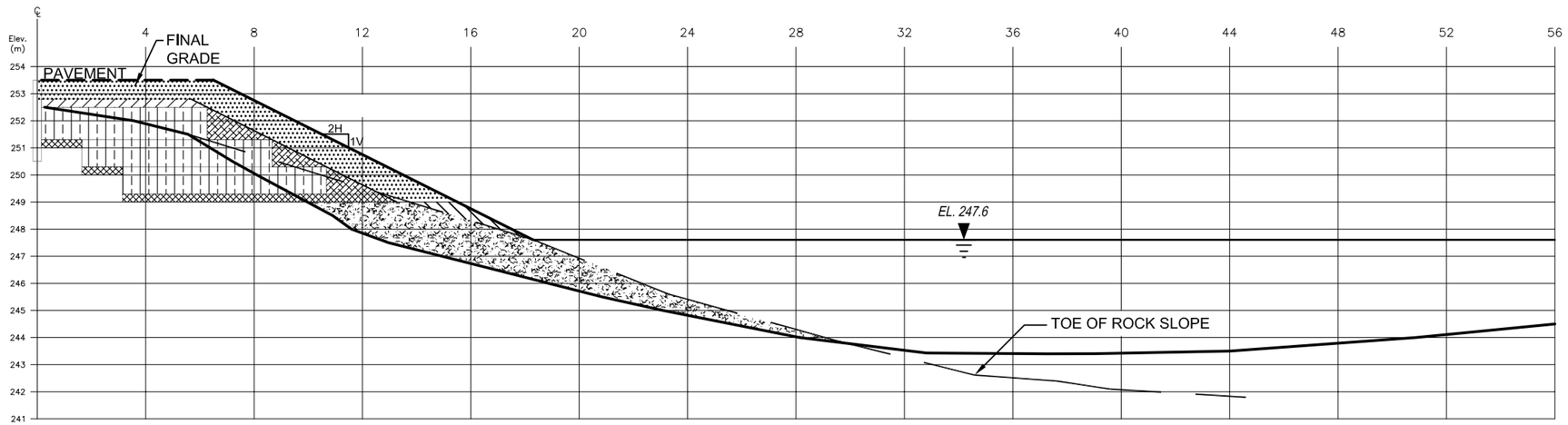
REF No. STANTEC DRAWING: 165000672_MeadowCreek-GA.dwg; DATED DECEMBER 2008



SECTION A-A AT STA. 19+968 - OPTION 3



SECTION B-B AT STA. 19+963 - OPTION 3



SECTION C-C AT STA. 19+955 - OPTION 3

NOTES:

1. REFER TO DRAWING 5 FOR LOCATION OF SECTIONS AND DRAWING 7 FOR SECTIONS AT STA. 19+942, 19+947 AND 19+950.
2. EPS DENOTES 'EXPANDED POLYSTYRENE MATERIAL'SEE DRAWING 5 FOR EPS PLACEMENT LEVELS.
3. ROCKFILL TO BE ADDED AS REQUIRED ONLY AFTER EXCAVATION FOR BENCHING REACHES EL. 250.0.
4. LAYER 'A' AND CONCRETE COVER TO EXTEND UNDER SBL PAVEMENT AS SHOWN ON DRAWING 5.
5. 5.5 TO 8.5% AIR ENTRAINED 30MPA CONCRETE TO BE 125mm THICK WITH WIRE MESH REINFORCEMENT.

SCALE
2 0 2 4m

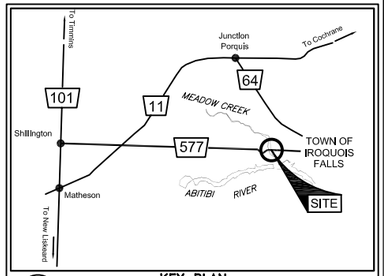
REF No. STANTEC DRAWING: 165000672_MeadowCreek-GA.dwg; DATED DECEMBER 2008

CONT No 2010-5113
GWP No 181-92-00

MEADOW CREEK BRIDGE
HIGHWAY 577
MITIGATION MEASURES

SHEET

Pete MacCallum Ltd.
CONSULTING ENGINEERS



KEY PLAN
SCALE
10 0 10 20 30km

LEGEND

- CONCRETE SLAB
- EPS
- EXISTING ROCKFILL
- ADDITIONAL ROCKFILL
- SELECTED SUBGRADE MATERIAL
- EARTH FILL COVER AND PAVEMENT

REGISTERED PROFESSIONAL ENGINEER
C M P Nascimento
NOV. 05, 2010
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
B. R. GRAY
NOV. 05, '10
PROVINCE OF ONTARIO

— NOTE —
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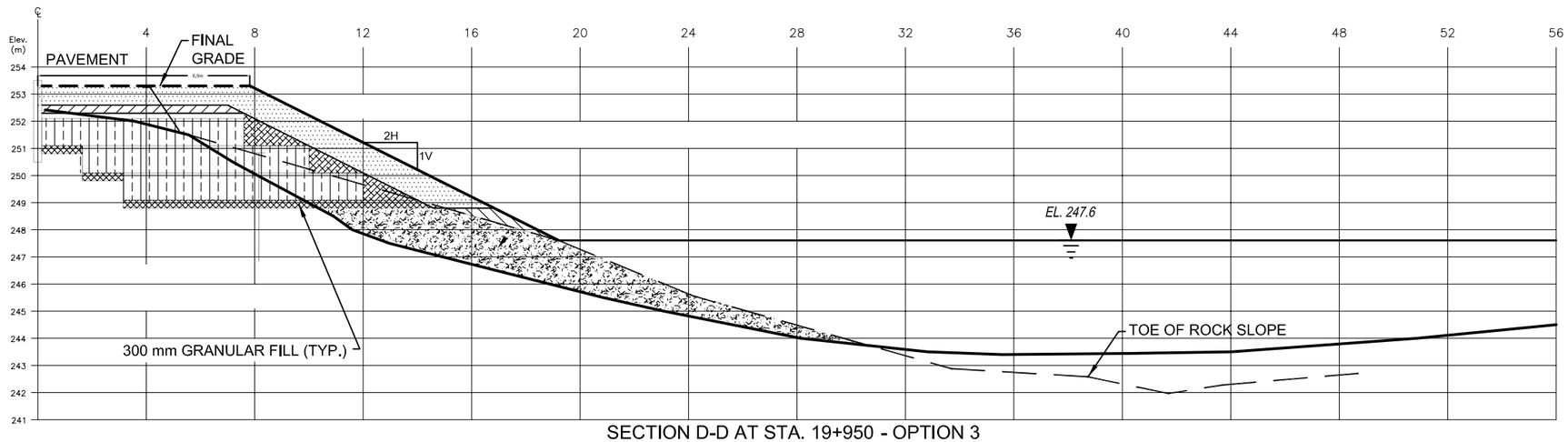
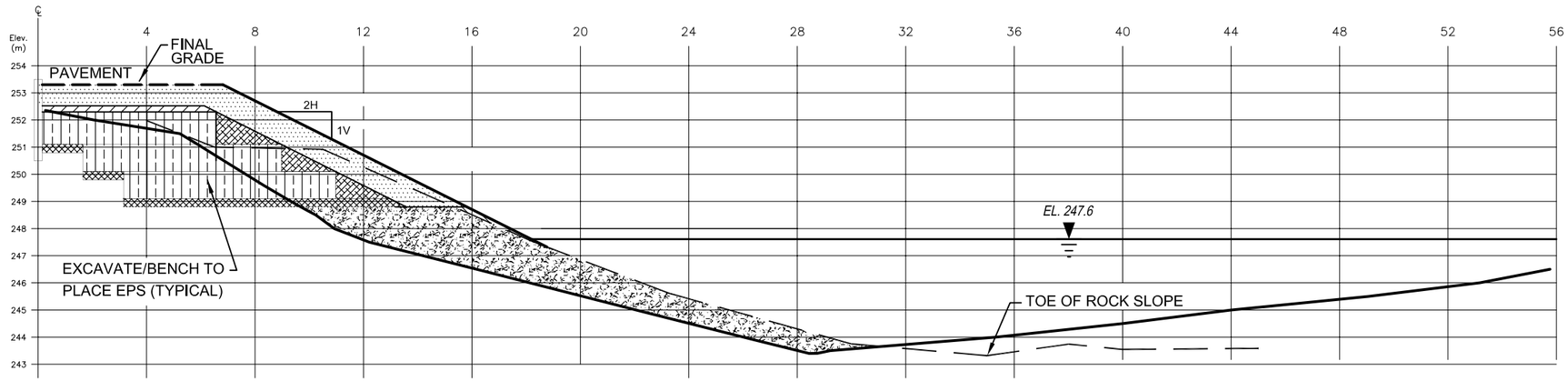
REVISIONS			
	DATE	BY	DESCRIPTION

Geocres No. 42A-75

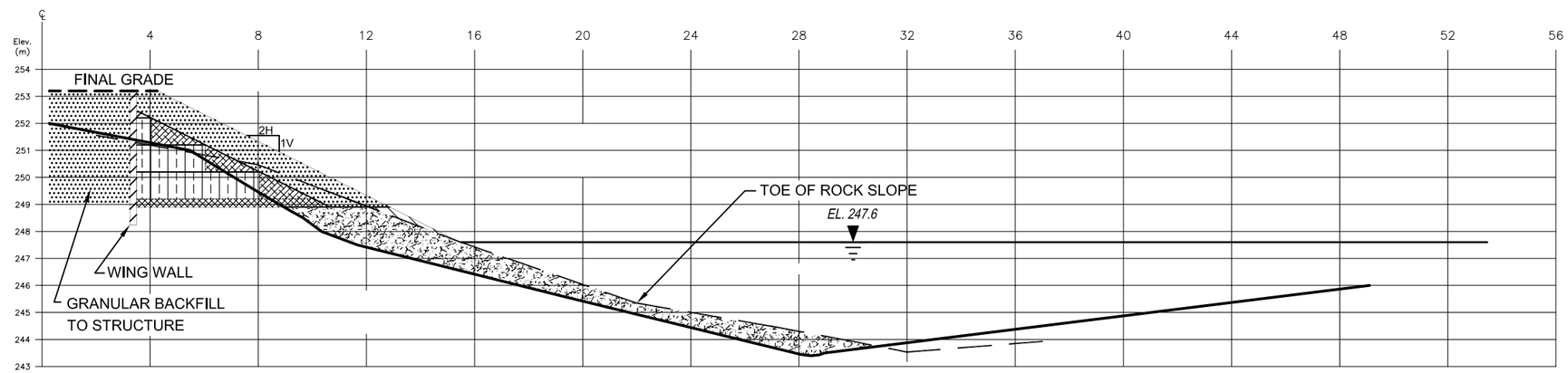
HWY No	577					DIST	COCHRANE
SUBM'D	NB	CHECKED	NB	DATE	NOV. 05, 2010	SITE	39E-077
DRAWN	NA	CHECKED	CN	APPROVED	BRG	DWG	6



SECTION D-D AT STA. 19+950 - OPTION 3



SECTION E-E AT STA. 19+947 - OPTION 3



SECTION F-F AT STA. 19+942 - OPTION 3

NOTES:

1. REFER TO DRAWING 1 FOR LOCATION OF SECTIONS AND DRAWING 6 FOR SECTIONS AT STA. 19+955, 19+963 AND 19+968.
2. EPS DENOTES 'EXPANDED POLYSTYRENE MATERIAL'SEE DRAWING 5 FOR EPS PLACEMENT LEVELS.
3. ROCKFILL TO BE ADDED AS REQUIRED ONLY AFTER EXCAVATION FOR BENCHING REACHES EL. 250.0.
4. LAYER 'A' AND CONCRETE COVER TO EXTEND UNDER SBL PAVEMENT AS SHOWN ON DRAWING 5.
5. 5.5 TO 8.5% AIR ENTRAINED 30MPA CONCRETE TO BE 125mm THICK WITH WIRE MESH REINFORCEMENT.

SCALE
2 0 2 4m

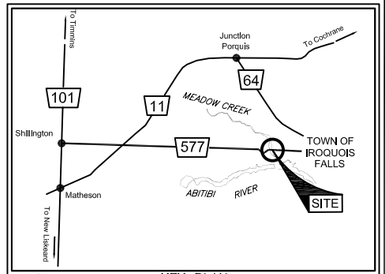
REF No. STANTEC DRAWING: 165000672_MeadowCreek-GA.dwg; DATED DECEMBER 2008

CONT No 2010-5113
GWP No 181-92-00

MEADOW CREEK BRIDGE
HIGHWAY 577
MITIGATION MEASURES

SHEET

Pete MacCallum Ltd.
CONSULTING ENGINEERS



KEY PLAN
SCALE
10 0 10 20 30km

LEGEND

- CONCRETE SLAB
- EPS
- EXISTING ROCKFILL
- ADDITIONAL ROCKFILL
- SELECTED SUBGRADE MATERIAL
- EARTH FILL COVER AND PAVEMENT

REGISTERED PROFESSIONAL ENGINEER
C M P Nascimento
Nov. 05, 2010
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
B. R. GRAY
NOV. 05, '10
PROVINCE OF ONTARIO

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DATE	BY	DESCRIPTION

Geocres No. 42A-75

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DRAWN	NA	CHECKED	CN	APPROVED	BRG	DWG	7