October 23, 2023 Project 0272101

BC Ministry of Transportation and Infrastructure
310-1500 Woolridge Street
Coquitlam, BC V3K 0B8

Via email: Maureen.Kelly@gov.bc.ca

Attention: Maureen Kelly, P.Eng.

Othello Road Site C Geotechnical Assessment – Final (Rev.0)

1.0 INTRODUCTION

The British Columbia Ministry of Transportation and Infrastructure (MoTI) is proceeding with the remediation of Othello Road Site C (Othello C), located about 10 km east of Hope, British Columbia (BC) on the north (right) bank of the Coquihalla River (Figure 1-1). Flooding on the Coquihalla River in November 2021 caused extensive erosion and damage (Figure 2-1 and 2-2) to infrastructure throughout the river valley, including bank erosion/scour of riprap protection and washouts of a portion of the Othello C embankment (Figure 2-1) and significant sections of Highway 5. The main channel of the Coquihalla River migrated to its historical position approximately 120 m to the north and damage was incurred along sections of an approximately 400 m long riprap revetment of Othello Road.

In 2022, during the response phase of the project, MoTI installed temporary riprap bank protection along a 30 m section of the road that experienced erosion during the flood and became severely over-steepened (Figure 2-2). The temporary riprap bank protection was constructed to reduce the potential for additional bank erosion and undermining of the road shoulder prior to the permanent design and construction phases.

BGC provided hydrotechnical design services under a separate report (BGC, July 17, 2023) including a qualitative assessment of potential bank protection options based on select evaluation criteria. Based on the assessment, MoTI selected a series of groynes as the preferred option to advance to detailed design. The proposed bank protection works span a length of approximately 325 m and include five rounded-end groynes, each spaced approximately 80 m apart.

BGC was requested to provide a geotechnical assessment for the permanent design. The purpose of the assessment was to determine whether the slope stability of the existing embankment (i.e., between the proposed groynes) met current MoTI criteria based on selected

design criteria and assumed subsurface conditions, or if additional riprap (or alternative mitigation) would be required to increase factors of safety of the existing revetment. Additional stabilization of the existing revetment could lead to the groyne design option being less cost effective compared to a continuous riprap revetment.

MoTI has retained McElhanney Consulting Ltd. (McElhanney) to complete the road design and act as the project management consultant. The design for final reinstatement of Othello C is currently at the 50% design stage (McElhanney, July 25, 2023). McElhanney assigned Station 200+144.235 (west, downstream) to 200+622.572 (east, upstream) for the project extents in their drawing set. Project chainages are referenced throughout this document and are shown in attached drawings R1-1064-101 and -101 at the end of the document.

The scope of services for this work was provided in a BGC change order entitled “Change Order Request – Othello Road Site B and Site C, and Peers Creek Road” (June 30, 2023). The geotechnical work scope outlined as part of a larger overall scope included:

1. Complete a desktop review of the site (aerial photographs, existing data from other BGC projects and/or MoTI sources).
2. Complete a global stability assessment of the existing fill embankment at the critical section to determine if the Factor of Safety (FoS) meets the requirements in Table 6.2b of the MoTI Supplement to the Canadian Highway Bridge Design Code (CHBDC) (MoTI, July 2022).
3. A site visit to review assumptions and field conditions for the assessment.
4. Provide a short report discussing the stability analysis results and recommendations.

No settlement or temporary conditions (e.g., construction phase) assessment was requested. No geotechnical subsurface investigation is proposed based on BGC’s understanding of the scope and following an email response from Maureen Kelly on May 1, 2023, to BGC’s initial emailed scope proposal (BGC, April 20, 2023). BGC used existing subsurface information from nearby boreholes and observations from the site visit.

The scope of work was accepted (email from M. Kelly) on July 24, 2023. All work was completed under the existing As & When General Engineering Services and Emergency Response for South Coast Region contract (Contract No. 861CS1183) between BGC and MoTI, dated September 16, 2021.

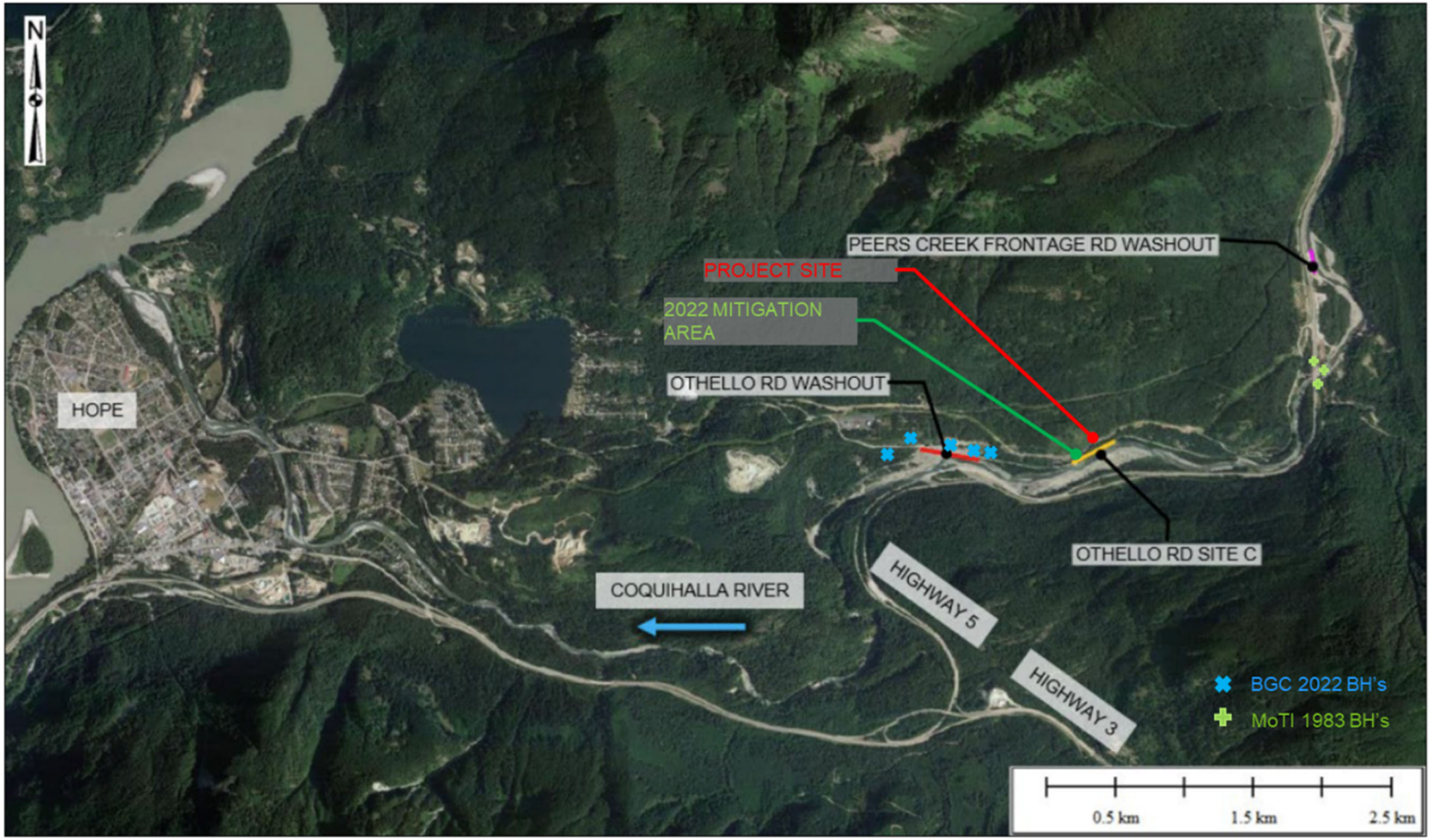


Figure 1-1 Site location with historical site investigation borehole locations (ESRI imagery dated July 30, 2022).

2.0 SITE RECONNAISSANCE

A site reconnaissance was carried out by BGC on July 7, 2023, along Othello C within the vicinity of the proposed reinstatement with the purpose of making observations on the current site conditions and work completed as part of the response phase. BGC also reviewed photographs collected after the November 2021 washout (Figure 2-2) The following notes summarize BGC's observations:

- BGC observed in boreholes and photos of eroded sections of Othello Road at the downstream Site B project area that road subgrade was constructed with sand and gravel and some cobbles below pavement, and underlain by compact or denser fluvial material.
- The observations of the eroded section of the road at the Othello C project area show similar sand and gravel with angular to subangular cobbles and material up to 50 cm diameter in the road subgrade.
- The upslope rock faces appeared to have been subjected to historical blasting and scaling, which suggests (based on known pre-1950 road construction practices) the Othello C section of road subgrade may have significant large angular cobbles and small boulders and an increased shear strength from the conditions visible.
- Based on the exposed section of Othello C and existing riprap observed elsewhere along the Coquihalla River, the existing riprap Othello C appears to be approximately 500 kg Class (though gap-graded) with a thickness of about 1100 mm, or roughly 1.5 times the D_{50} of 720 mm. BGC observed historical riprap ranging from 0.3 m to 2 m in diameter.
- BGC observed a potential large boulder (>5 m diameter) or bedrock outcrop on the riverside slope at approximately McElhanney Design Station 200+530.
- The paved road was measured in three locations and was approximately 6.5 m to 7 m total width. There was no paved shoulder on the river side and a small (approximately 1 m wide) V-shaped ditch present on the upslope side of the road. The lidar and McElhanney field survey appears to capture the existing features and topography well.

Figure 2-1 **(Left) Looking north at temporary riprap mitigation post-construction (Feb 23, 2023). (Right) Looking west at a temporary mitigation design markup prior to construction (March 31, 2022). Both photos are described further in the BGC hydrotechnical report (July 17, 2023).**

Figure 2-2 **Photos of exposed bank slope and suspected embankment fill prior to construction of temporary riprap bank protection (March 31, 2022). (Left) Looking south at riprap and road base. (Right) Looking west upslope at road base and large riprap that remain in place.**

3.0 GEOTECHNICAL DESKTOP REVIEW

Surficial Geology

A limited desktop review of the geology surrounding the site was completed by BGC for this project using available information. The surficial geology was interpreted from studies completed by BGC for other clients whose sites overlap with the Othello C project limits. The work by BGC for others (BGC, August 2014) described the area in vicinity of the Othello C as fluvial plain (Fp) or active floodplain (Fap) subject to channel changes from the Coquihalla River. The polygon which the road is on is described as a colluvial veneer (Cv), with exposed bedrock and with anthropogenic changes (e.g., road construction).

Historical Subsurface Data

MoTI provided historical borehole records that were part of the New Coquihalla Highway Project that appear to have been drilled in 1983 approximately 1.5 km east and upstream away from Othello C at the nearest Coquihalla Highway bridge crossing abutments (Peers Creek Bridge). In two of the three boreholes, BH #83-2 (termination depth 15.5 m) and BH #83-3 (termination depth 30.6 m) the soils were described by others as very dense sandy gravel to gravelly sand with cobbles and inferred boulders. Standard Penetration Test (SPT) values indicated high blow counts between 50 and 100 for the majority of the boreholes.

BGC planned and supervised the drilling of five shallow boreholes in 2022 (BH22-OTH-01 to -05) approximately 1 km west of Othello C for the Othello Road Site B remediation project (BGC, December 22, 2022). The boreholes extended up to 6.7 m deep and two boreholes penetrated within the road fill. SPTs were conducted at regular intervals (approximately every 1.5 m). The boreholes generally indicated up to 0.6 m of compact gravel and sand (some cobbles) road fill overlying a compact to very dense (increasing density with depth) gravel and sand (some cobbles) fluvial unit.

A search of the BC Groundwater Wells and Aquifers online database (GWELL, 2023) indicates several water supply wells within 1 km of the project site. Well Tag Numbers 101398, 65982, and 93404 indicate sand and gravel (with boulders) to approximately 8 m depth overlying sand and gravel up to 13 m depth reported (though well drilling lithology is often simplified and may not report occasional cobbles or boulders encountered).

Air Photos

Air photos from 1947, 1948, 1951, and 1953 were reviewed to see if there was any indication of road construction practices used. Othello Road in this project area was already in existence in 1947 and the rock cut above the road already had been cleared. Therefore, no additional evidence was found to confirm BGC's assumption that rock cut material was used as the road subgrade. The road alignment appeared similar to the present-day alignment and riprap was observed on the river side of the road in the 1947 photo. Though, due to the scale of the photo (1:20,000), the dimensions of the riprap could not be determined.

4.0 ENGINEERING ASSESSMENT

4.1 Design Criteria

BGC had previously reviewed the McElhanney proposed design criteria for the Othello Road Site B remediation design west of this project site (BGC, December 22, 2022) and found:

- Othello Road appears to be a collector road but is assumed to be a Rural Collector Undivided roadway based on its direct connection to the Coquihalla Highway. It is an alternate emergency route out of Hope, BC.
- There is no traffic volume data available for this road, but it is expected that higher volume will occur in the summer months due to access to the Othello Tunnels tourist attraction.
- The roads should ideally retain their existing paved width post-event.

The existing section of Othello C has an approximately 6.5 m to 7 m total paved width (edge of pavement (EOP)) with no paved shoulder. McElhanney has proposed in the 50% design drawings widening the pavement on the river side of the road to include a minimum paved shoulder width of 1.3 m to the inside of a concrete roadside barrier (Figure 4-1).

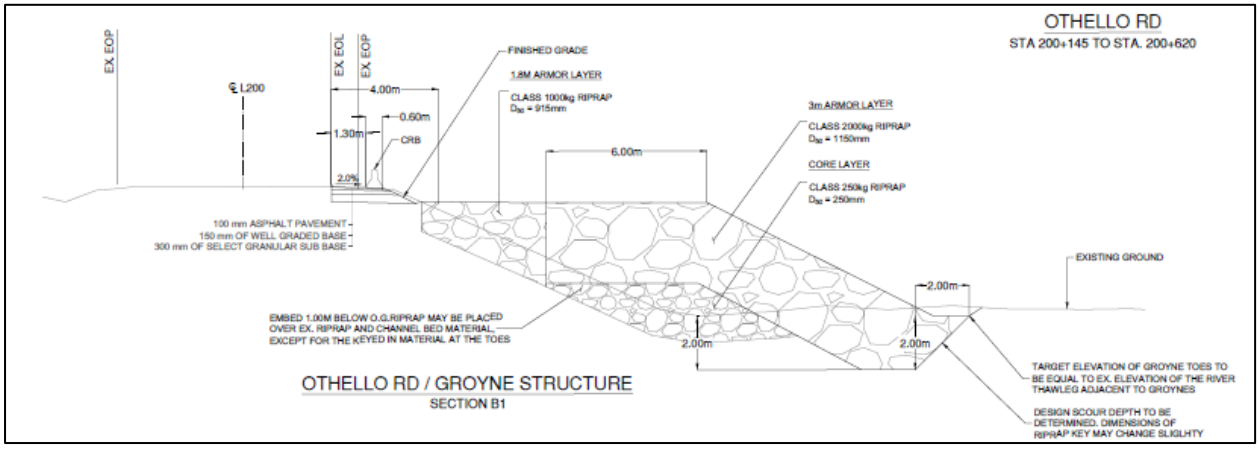


Figure 4-1 Typical Road Design (at groyne section) (McElhanney, July 25, 2023). Riprap details are expected to undergo further refinement.

BGC discussed the consequence of the road with MoTI based on their standards and it is proposed that Othello C be consider low consequence (notes from teleconference with MoTI and McElhanney, August 10, 2023), because:

- It is only an unofficial detour road in the winter during a lower traffic volume period (MoTI representative).
- If part of a lane is lost, there would be significantly more loss expected on Highway 5. A single lane would be sufficient in a critical case event for temporary mitigation and construction (MoTI representative).
- There are riprap and road building resource stockpiles nearby at Nicola Quarry to support temporary remediation of short sections of Othello C.

- Section 6.5.1 of the CHBDC S6:19 allows for use of low consequence "where life safety is not a concern" and only requires owner approval/consent for bridge locations.

In determination of the global stability of embankment design criteria, the following was considered for the understanding and consequence. A low degree of understanding was applied given the assessment relied on available historical boreholes provided by MoTI for a site approximately 1.5 km east and BGC boreholes from 2022 in the same road construction, but approximately 1 km west of the project area. While BGC does have a moderate understanding from the open and undermined road section in 2022 (Figure 2-2) of the general geology and road construction practices it is considered more of an investigative trench or test pit and the MoTI requirements for typical understanding require "a minimum of one borehole" (Table 6.2c, MoTI, July 2022). Groundwater conditions were estimated based on the fluctuations of the Coquihalla River and the granular nature of the material and levels seen in nearby Othello Road Site B (BGC, December 22, 2023) and Peers Creek investigative data. A low consequence was applied as noted in the section above.

MoTI Technical Circular Geotechnical Design Criteria T-04/17 provides direction for soil slope and embankment design. Based on Table 6.2b of MoTI's Supplement to CHBDC (MoTI, July 2022), the required minimum FoS for global stability of embankments with a low degree of understanding and low consequence factor is 1.45 for permanent conditions (Case 1, 5, 6, 7) and 1.24 for temporary conditions (Case 2) and 1.10 (MoTI, March 22 2017) or seismic conditions using a pseudo static analysis (Case 4). The rapid drawdown scenario does not have a FoS defined; however, the analysis is provided (Case 3) for completeness.

4.2 Material Properties

Subsurface soil conditions were based on available observations from the site reconnaissance and historical geotechnical borehole data (as discussed above in Section 2) from a nearby sites on or adjacent to Othello Road. The subsurface profile, including thickness of the existing road embankment material and location of the bedrock contact, are estimates. The material parameters used for the slope stability analyses are summarized in Table 4-1 and estimated based on BGC's observed SPT's in nearby similar geology and engineering judgement.

Table 4-1 Soil parameters for slope stability analyses.

Subsurface Unit	Unit Weight (kN/m^3)	Effective Cohesion (kPa)	Friction Angle (degrees)
Existing embankment (compact to dense sand and gravel)[1]	20	0	36
Fluvial (compact to very dense gravel, sand and cobbles)	20	0	35
Riprap (D_{50} > 500 mm)	24	0	45

Note:

1. Assumes less than 5% fines, some compaction during construction and ignores the increased shear strength that observed angular cobbles and boulders would provide.

4.3 Embankment Stability Assessment

Slope stability analyses were performed using the two-dimensional limit equilibrium method in Slope/W (GEO-SLOPE, 2021), a commercially available limit equilibrium stability analysis software program. The Morgenstern-Price method of analysis was used, which considers both force and moment equilibrium. The optimized failure surface and minimum FoS were calculated by the software. The optimized failure surface allows for incrementally altering portions (from one defined geometric shape) of slip surfaces and thereby refining the critical slip surface geometry and FoS.

One critical cross section was analyzed for multiple load cases (Section 200+430) and an additional typical section (Section 200+285) was considered for comparison. The cross-section ground (lidar) and bathymetry were taken from a model surface prepared by McElhanney (Figure 4-2). The critical section was selected based on field observations of a steep embankment slope with a thin riprap coverage at the crest of the slope. The typical section was selected based on a review of lidar and finding a section that was representative of average conditions for the river facing slope grade.

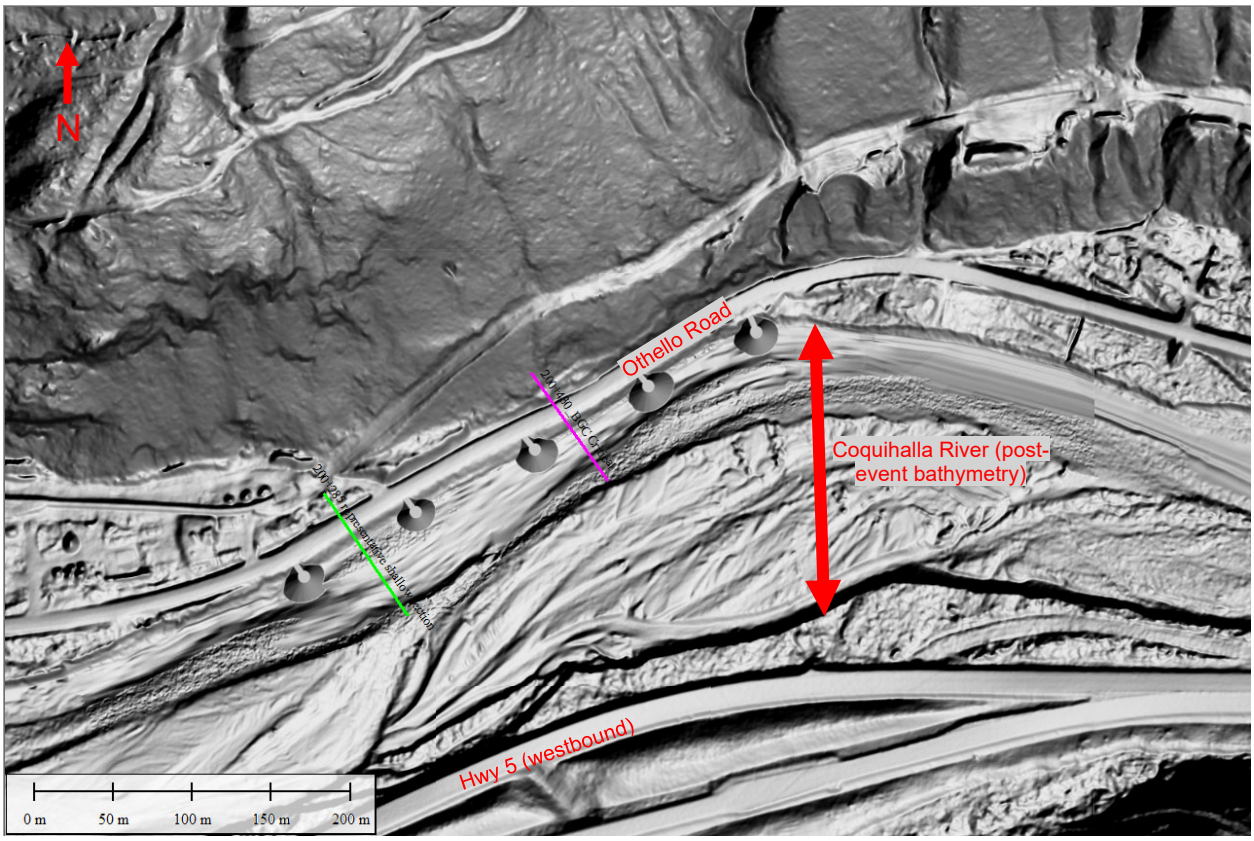


Figure 4-2 Location of stability cross sections analyzed (pink line = critical, green line = typical) with BGC proposed groyne design, lidar (MoTI, December 3, 2021) and bathymetry shown.

The following cases were analyzed for the section at 200+430:

1. Case 1: Steady State conditions with water level near the toe of the proposed embankment, this represents a 2-year return period flood and long-term condition.
2. Case 2: Flood conditions for the assumed 200-year return period flood (BGC, July 17, 2023). Scour and loss of embankment material has not been considered (see below).
3. Case 3: A rapid drawdown case has been assessed with a quickly dropping river level and subsurface groundwater remaining higher in the embankment from the westbound ditch and in the river the water elevation at the 2-year flood and approximately toe of the embankment slope as a temporary condition. Given the relatively free draining nature of anticipated foundation soils (fluvial unit), the relatively small embankment heights (less than 6 m), and the proposed embankment fills consisting of sand and gravel with less than 5% fines, a rapid drawdown condition within the embankment is unlikely to occur and is provided for information only. Note that Table 6.2b (MoTI, July 2022) does not provide a specific design criteria FoS for this condition.
4. Case 4: Seismic case considering “other geotechnical systems” shall have at least 50% of the travelling lanes (one lane for Othello C) available following ground motions with a return period of at least 475-years, as outlined in Section 6.14.2.3 of the MoTI Supplement (MoTI, July 2022). The seismic case analysis considers a horizontal seismic load of 50% of the peak ground acceleration (PGA) based on 475-year return period for PGA from 2020 National Building Code of Canada (NBCC) which corresponds to 0.063 g.
5. Case 5: Similar to Case 1 with a toe berm size based on an assumed simplified riprap end tipped method from the crest of the existing slope. The case was assessed to determine the approximate volume of riprap to increase the FoS to meet the “typical” consequence requirement.
6. Case 7: Similar to Case 1, but with a paved shoulder added 1.3 m closer to the crest and river and therefore also allowing the critical slip place to start 1.3 m closer to the slope. Additionally, this case considered full traffic loading (12 kPa) in that section.

Additionally at Section 200+285 the following case was analyzed:

1. Case 6: A typical section with the same estimated phreatic subsurface water and modelled river conditions as Case 1.

Other considerations for the slope stability analyses are as follows:

1. In all cases the entry surface was restricted to be no closer than the paved road shoulder. BGC assumes that more than this amount of loss could adversely impact normal traffic operations.
2. A typical live load surcharge to simulate parked traffic in each of the two travelling lanes was considered and has been represented by a 12 kPa strip load across the travelling lanes.
3. Scour of the toe of the existing slope in the sections was not considered in the analysis, as the hydraulic modelling of the proposed design with groynes shows less than 1 m/s velocities in this area during the design flood condition after construction (Figure 4-3).

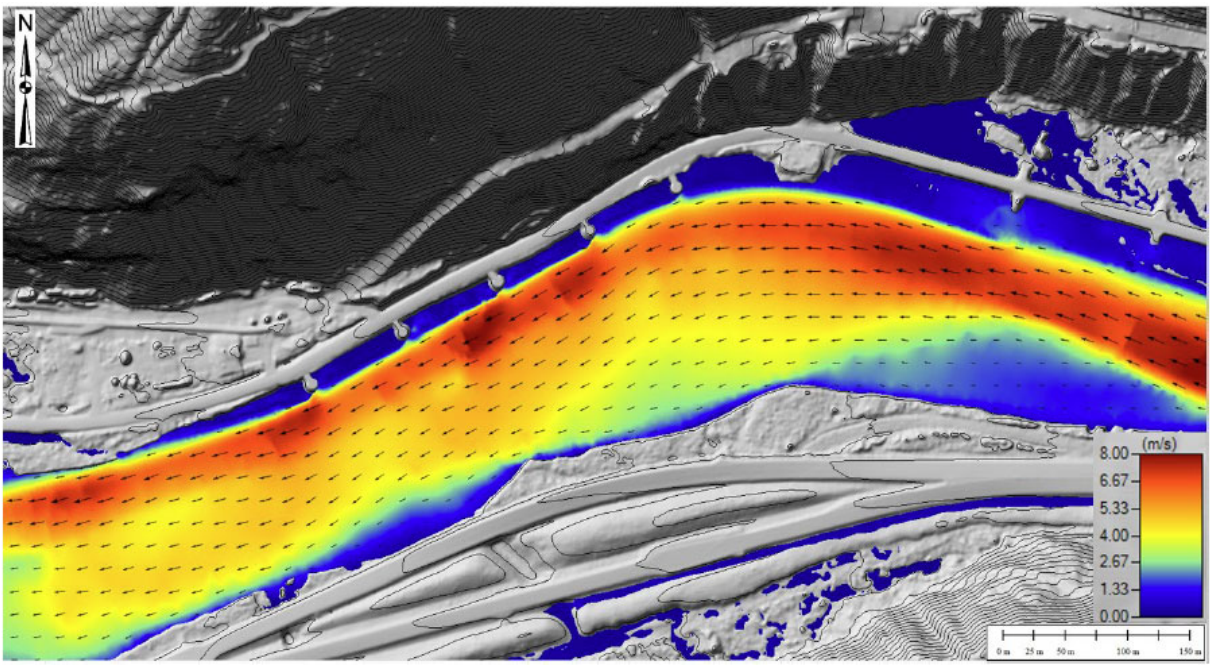


Figure 4-3 Flow velocity for design condition during the design flood event (BGC, July 17, 2023).

The results of the stability analyses are presented in Table 4-2 below and shown in Appendix A Figures A-1 to A-7. Cases 1 to 5 and 7 were evaluated using the Critical section and Case 6 was evaluated using the Typical section.

Table 4-2 Results of stability analyses for the Critical and the Typical sections.

Case Description	Factor of Safety
Case 1: steady state	1.53
Case 2: flood	1.55
Case 3: rapid drawdown	1.41
Case 4: seismic	1.31
Case 5: steady state with toe berm	1.65
Case 6: **Typical section** – steady state	1.95
Case 7: Case 1 with additional wider paved road (for shoulder) and includes normal loading	1.46

The existing embankment slopes and estimated subsurface profile were able to meet the required design criteria for the assumed river and groundwater conditions at the Critical section for existing loading conditions. The additional loading conditions considered (Case 3, Case 7) are above temporary FoS requirements. The Typical section meets the minimum FoS (Case 6). Given the analysis results, BGC validated that the existing slopes are suitable between the groynes as-is, if MoTI accepts the low understanding and low consequence design criteria and the estimated soil profiles. Otherwise, Case 5 shows that approximately 5 m^3 per m of critical

section of toe berm would be required to increase the FoS at the critical sections for a low understanding and typical consequence design criterion.

5.0 GEOTECHNICAL RECOMMENDATIONS

Construction for the proposed project is to conform to the MoTI Standard Specifications for Highway Construction Volume 1 and Volume 2 (MoTI, November 1, 2020). As this assessment is based on no disturbance of the existing conditions, except where additional groynes will be added and the FoS of the existing slope is increased, there are no project specific geotechnical recommendations with the current design.

6.0 FIELD REVIEWS

The record documentation for any interim works that modify the geometry and/or slope revetment prior to permanent construction should be shared with the geotechnical engineer of record (EOR) of the final reinstatement works.

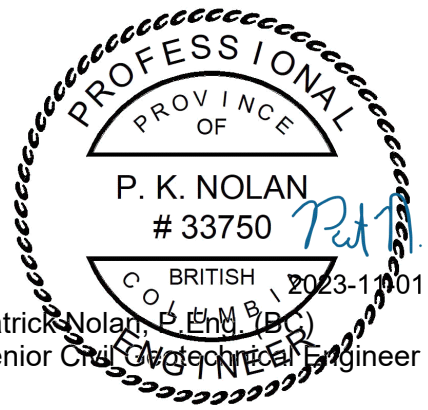
BGC's change order (June 30, 2023) includes geotechnical support during construction to be confirmed once the final design has been submitted. Assuming full time monitoring by the Ministry Representative, allowance for a BGC field review frequency of about 10% should be considered, as per the EoR and Field Review guidelines provided in Technical Circular T-06/09.

7.0 CLOSURE

We trust the above satisfies your requirements. Should you have any questions or comments, please do not hesitate to contact us.

Yours sincerely,

BGC Engineering Inc.
per:



Patrick Nolan, P.Eng. (BC)
Senior Civil Geotechnical Engineer

Reviewed by:

Martin Devonald, M.Sc., P.Eng. (BC)
Principal Geotechnical/Geological Engineer

EGBC Permit to Practice, BGC Engineering Inc. 1000944

ES/MD/rm/th

Attachment(s): Limitations
50% design drawings with chainage
Appendix A – Stability Analysis Results

LIMITATIONS

BGC Engineering Inc. ("BGC") prepared this document[1] for the exclusive use of BC Ministry of Transportation and Infrastructure (the "Client"). This document is only intended for the Client's use for the specific purpose or project identified herein. This document may not be used for any other purpose, modified, or published (either on the Internet, through open-source artificial intelligence (AI) tools, or through any other form of print or electronic media) without BGC's express written consent. BGC is not liable for any loss, injury, or damages arising from any unapproved use or unauthorized modification of this document.

No third party may use or rely on this document unless BGC provides express written consent. Any use or reliance which a third party makes of this document is the responsibility of the third party and is at such third party's own risk. BGC accepts no responsibility for damages, if any, suffered by any third parties as a result of their use of this document.

This document contains BGC's professional opinions on the specific issues identified herein, based on the information available to BGC when BGC prepared this document. While preparing this document, BGC relied on information BGC received from the Client or other sources. Unless otherwise stated in this document, BGC did not independently verify such information, and BGC assumed that such information is accurate, complete, and reliable. BGC is not responsible for any deficiency, misstatement, or inaccuracy in this document due to errors or omissions in information provided by the Client or third parties.

This document may include or rely upon estimates, forecasts, or modeling analyses (e.g., results or outputs of numerical modeling) that are based on available data. Such estimates, forecasts, or modeling analyses do not provide definitive or certain results. The Client is solely responsible for deciding what action (if any) to take based on any estimates, forecasts, or modeling analyses.

BGC prepared this document in accordance with generally accepted practices for similar services in the applicable jurisdiction. BGC makes no warranty (either express or implied) related to this document. BGC is not responsible for any independent conclusions, interpretations, extrapolations, or decisions made by the Client or any third party based on this document. The record copy of this document in BGC's files takes precedence over any other copy or reproduction of this document.

[1] References in these Limitations to the "document" include the document to which these Limitations are attached, any content contained in this document, and any content referenced in this document but located in one of BGC's proprietary software applications (e.g., Cambio).

REFERENCES

BGC Engineering Inc. (2014, August). Terrain Map RK 1023 to 1047. Prepared for TransMountain.

BGC Engineering Inc. (December 22, 2022). Geotechnical Investigation and Recommendations for Othello Road Remediation – FINAL. Prepared for the Ministry of Transportation and Infrastructure.

BGC Engineering Inc. (June 30, 2023). *Change Order Request – Othello Road Site B and Site C, and Peers Creek Road*. Prepared for the Ministry of Transportation and Infrastructure.

BGC Engineering Inc. (2023, July 17). *Hydrotechnical Assessment and Design for Othello Road - Site C.* Prepared for the Ministry of Transportation and Infrastructure.

British Columbia Ministry of Transportation and Infrastructure (MoTI). (2020, November 1). Standard Specifications for Highway Construction Volume 1 and 2. Adopted November 1, 2020.

British Columbia Ministry of Transportation and Infrastructure (MoTI). (2022 July). Bridge Standards and Procedures Manual Volume Supplement to CHBDC S6:19. Adopted July 2022.

British Columbia Ministry of Transportation and Infrastructure (MoTI). (March 22, 20217) Technical Circular T-04/17: Geotechnical Design Criteria.

GEO-SLOPE International. (2021). Slope/w Slope Stability Software, Version 11.0. Calgary, AB, Canada

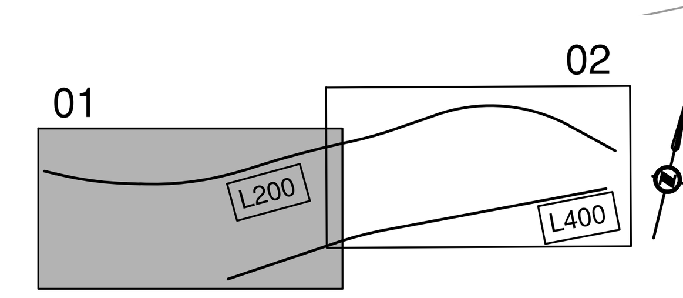
GWELL. (2023). Groundwater Wells and Aquifers. Accessed on August 24, 2023 at https://apps.nrs.gov.bc.ca/gwells/?map_centre=49.381204,-121.336572&map_zoom=13

McElhanney Ltd. (July 25, 2023). OTHELLO ROAD SITE C WASHOUT RECOVERY – 50% Design. Project No. 14138. Prepared for the Ministry of Transportation and Infrastructure.

National Research Council of Canada (NRC) (2020). National Building Code of Canada (NBCC).

RIGHT OF WAY
Rem PART OF THE NW 1/4 Sec 8 TP 5 R25 W6M YD YD
POT 200+000
TS 200+001.349
Ls 30.000
Θs 1°54'35"
SC 200+031.349
R 450.000 Lt
Δ 10°08'50"
Tc 39.953
Arc 79.696
Ec 1.770
PRC 200+111.046
R 400.000 Lt
Δ 18°00'59"
Tc 63.412
Arc 125.778
Ec 4.995
CS 200+255.382
Ls 30.000
Θs 2°08'55"
LIVE STAKING IN EX. RIPRAP (TYP.). SEE SHEET 352. FOLLOW NOTES AND DETAIL.
PI 200+348.586
TO HWY 5
L200
200+300
58°59'45"
S22
R 1300.000 Lt
Δ 5°22'44"
Tc 61.068
Arc 122.046
Ec 1.434
200+000
90°24'00"
1079
TO HOPE
OTHELLO ROAD
200+100
200+200
PLAN A238
KETTLE VALLEY RAILWAY
PART OF NE 1/4 SEC 7
S21
BC 200+287.518
ST 200+285.382
L200 P.O.T. STA. 200+317.000 = S22 P.O.T. STA. 22+00.000
COQUIHALLA RIVER
PI 200+063.482
PRC 200+129.604
LIMIT OF CONSTRUCTION POT 200+144.234
TIE TO EX. ROAD
PI 200+201.000
L200 P.O.T. STA. 200+236.999 = S21 P.O.T. STA. 21+00.000
LWD TO BE EMBEDDED WITHIN GROYNE. 2000KG RIPRAP TO PROVIDE ANCHORING. SEE SHEET 352.
MATCH LINE - FOR CONTINUATION SEE DWG R1-NNN-102
BC 4001+52.068
LWD PIECES TO LAY OVERTOP CHANNEL (TYP.) SET ON TOP OF BANKS. SEE SHEET 352
TEMPORARY DIVERSION CHANNEL
LIMIT OF CONSTRUCTION POT 400+006.115
TIE TO EX. GROUND
POT 4000+00
400+100
58°02'45"
L400
400+000
PLAN 9632
LOT 1
Rem PART OF NW 1/4 LYING SOUTH OF OF THE LEFT BANK OF THE COQUIHALLA RIVER
TEMPORARY DIVERSION CHANNEL LOC : APPROX. 135m FROM OTHELLO RD

ALIGNMENT CLASSIFICATION		
ALIGNMENT	CLASSIFICATION	DESIGN SPEED
L200	RLU	50KMH



SHEET INDEX

REFERENCE DRAWINGS

FOR PROFILE SEE DWG. R1-1064-201 TO 202
FOR TYPICAL SECTIONS SEE DWG. R1-1064-301
FOR GROYNE DETAILS SEE DWG. R1-1064-351
FOR GEOMETRICS AND LANING SEE DWG. R1-1064-401 TO 402

INFORMATION ON EXISTING UNDERGROUND FACILITIES MAY NOT BE COMPLETE OR ACCURATE. McELHANNEY, ITS EMPLOYEES AND DIRECTORS ARE NOT RESPONSIBLE NOR LIABLE FOR THE LOCATION OF ANY UNDERGROUND CONDUITS, PIPES, CABLES OR OTHER FACILITIES WHETHER SHOWN OR OMITTED FROM THIS PLAN. PRIOR TO CONSTRUCTION CONTRACTOR SHALL EXPOSE LOCATIONS OF ALL EXISTING FACILITIES BY HAND DIGGING OR HYDROVAC AND ADVISE THE ENGINEER OF POTENTIAL CONFLICTS.

FOR DISCUSSION ONLY

PERMIT TO PRACTICE
McElhanney Ltd.
PERMIT NUMBER: 1003299
Engineers and Geoscientists of British Columbia

APPROVED SEAL

McElhanney
Suite 200
858 Beatty Street
Vancouver BC
Canada V6B 1C1
Tel 604 683 8521

SCALE 0 5 1:500 25m
CAD FILENAME R1-1064-100
PLOT DATE 9/25/2023

REV	DATE	REVISIONS	NAME
A	7/25/2023	50% DESIGN	R. BEDARD
B	8/14/2023	50% DESIGN	R. BEDARD
C	9/22/2023	ISSUED FOR REGULATORY APPROVAL	R. BEDARD

BRITISH COLUMBIA
MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE
SOUTH COAST REGION
HIGHWAY ENGINEERING AND GEOMATICS

PLAN

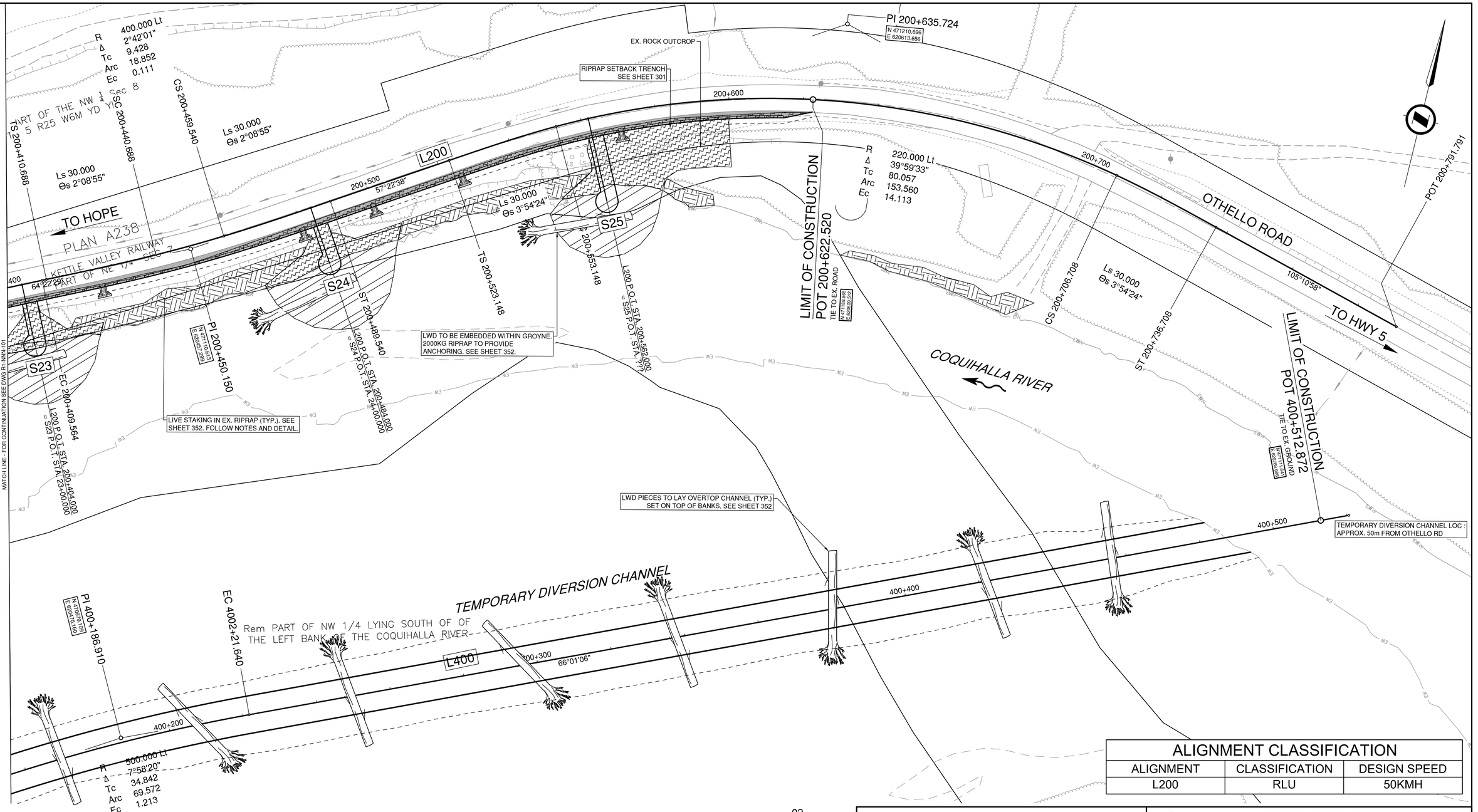
OTHELLO ROAD SITE C
WASHOUT RECOVERY
STA. 200+000.000 TO 200+400.000

SENIOR DESIGNER
DATE 2023-09-15

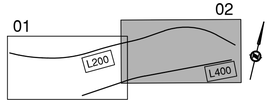
DESIGNED J. JAVIER DATE 2023-09-15
QUALITY CONTROL R. BEDARD DATE 2023-09-15
QUALITY ASSURANCE DATE 2023-09-15
DRAWN J. JAVIER DATE 2023-09-15

FILE NUMBER	PROJECT NUMBER	REG	DRAWING NUMBER	REV
2121-00865-16	14138	1	R1-1064-101	C

PLOT DATE: 2023/09/25 X:\2121\2121-00865-16 MoTI - Othello Road Site C\10.0 DRAWINGS\10.3 Engineering\OthelloRoad\DrawingProduction\100_Plans\R1-1064-100.dwg



ALIGNMENT CLASSIFICATION		
ALIGNMENT	CLASSIFICATION	DESIGN SPEED
L200	RLU	50KMH



SHEET INDEX

REFERENCE DRAWINGS

FOR PROFILE SEE DWG. R1-1064-201 TO 202
FOR TYPICAL SECTIONS SEE DWG. R1-1064-301
FOR GROYNE DETAILS SEE DWG. R1-1064-351
FOR GEOMETRICS AND LANING SEE DWG. R1-1064-401 TO 402

FOR DISCUSSION ONLY

PERMIT TO PRACTICE

McElhanney Ltd.
PERMIT NUMBER: 1003299

Engineers and Geoscientists of British Columbia

APPROVED SEAL

McElhanney
Suite 200
858 Beatty Street
Vancouver BC
Canada V6B 1C1
Tel 604 683 8521

SCALE 0 5 1:500 25m

CAD FILENAME R1-1064-100
PLOT DATE 9/25/2023

REV	DATE	REVISIONS	NAME
A	7/25/2023	50% DESIGN	R. BEDARD
B	8/14/2023	50% DESIGN	R. BEDARD
C	9/22/2023	ISSUED FOR REGULATORY APPROVAL	R. BEDARD

BRITISH COLUMBIA
MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE
SOUTH COAST REGION
HIGHWAY ENGINEERING AND GEOMATICS

PLAN

OTHELLO ROAD SITE C
WASHOUT RECOVERY

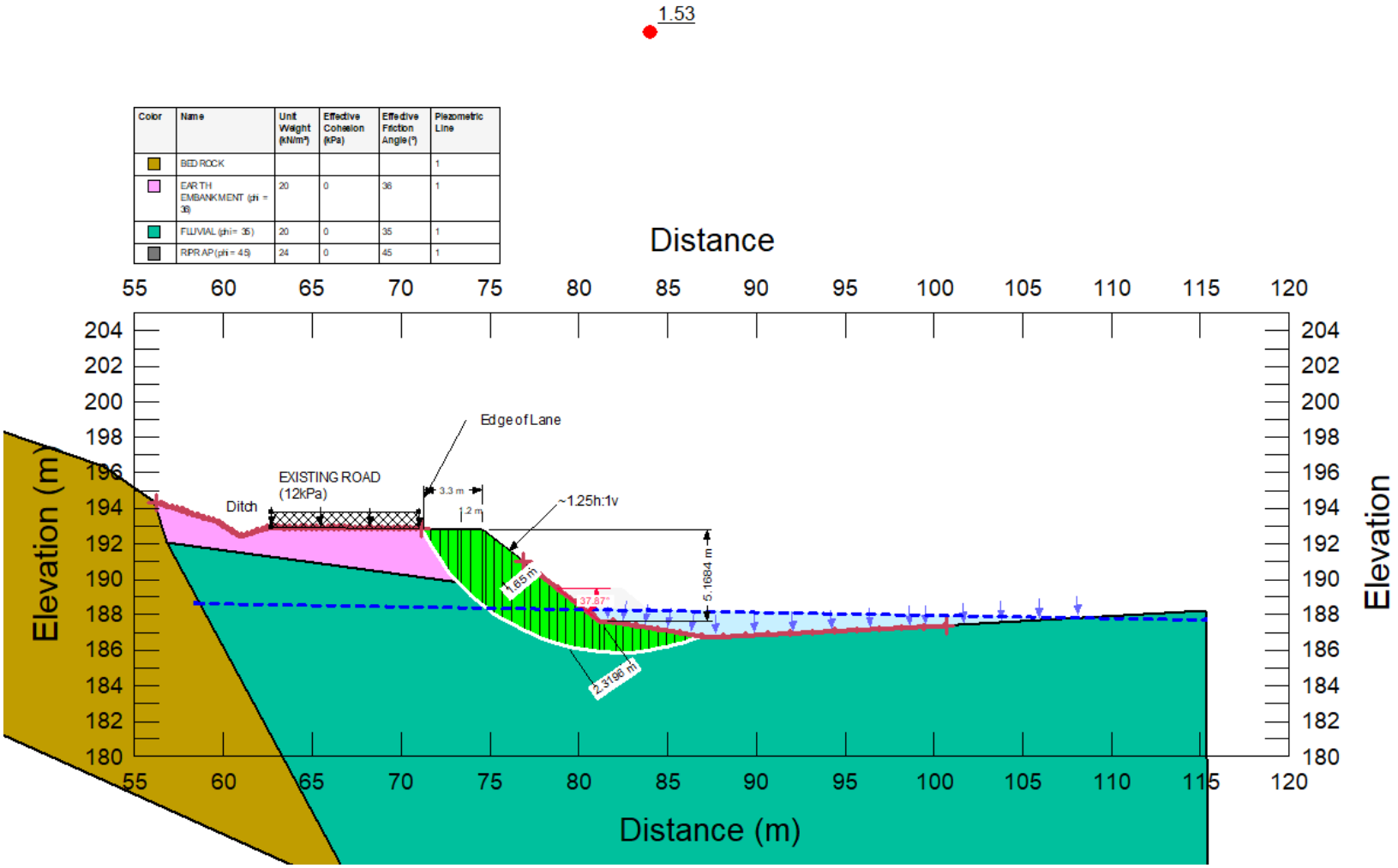
STA. 200+400.000 TO 200+600.000

SENIOR DESIGNER
DATE 2023-09-15

DESIGNED J. JAVIER DATE 2023-09-15
QUALITY CONTROL R. BEDARD DATE 2023-09-15
QUALITY ASSURANCE -- DATE 2023-09-15
DRAWN J. JAVIER DATE 2023-09-15

FILE NUMBER	PROJECT NUMBER	REG	DRAWING NUMBER	REV
2121-00865-16	14138	1	R1-1064-102	C

APPENDIX A
STABILITY ANALYSIS RESULTS



NOTES:

1. THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH BGC'S LETTER REPORT TITLED "OTHELLO ROAD SITE C GEOTECHNICAL ASSESSMENT – FINAL (REV.0)" AND DATED OCTOBER 2023.
2. THE ROAD AND EMBANKMENT ARE DESIGNED BY MCELHANNEY LTD. AND SHOWN IN DRAWINGS TITLED "OTHELLO ROAD SITE C WASHOUT RECOVERY – 50% DESIGN" AND DATED JULY 25, 2023.
3. THE SECTION SHOWS THE CONCEPTUAL GEOLOGICAL INTERPRETATION BASED ON SITE OBSERVATIONS AND BOUNDARIES BETWEEN MATERIAL UNITS SHOULD BE CONSIDERED APPROXIMATE.

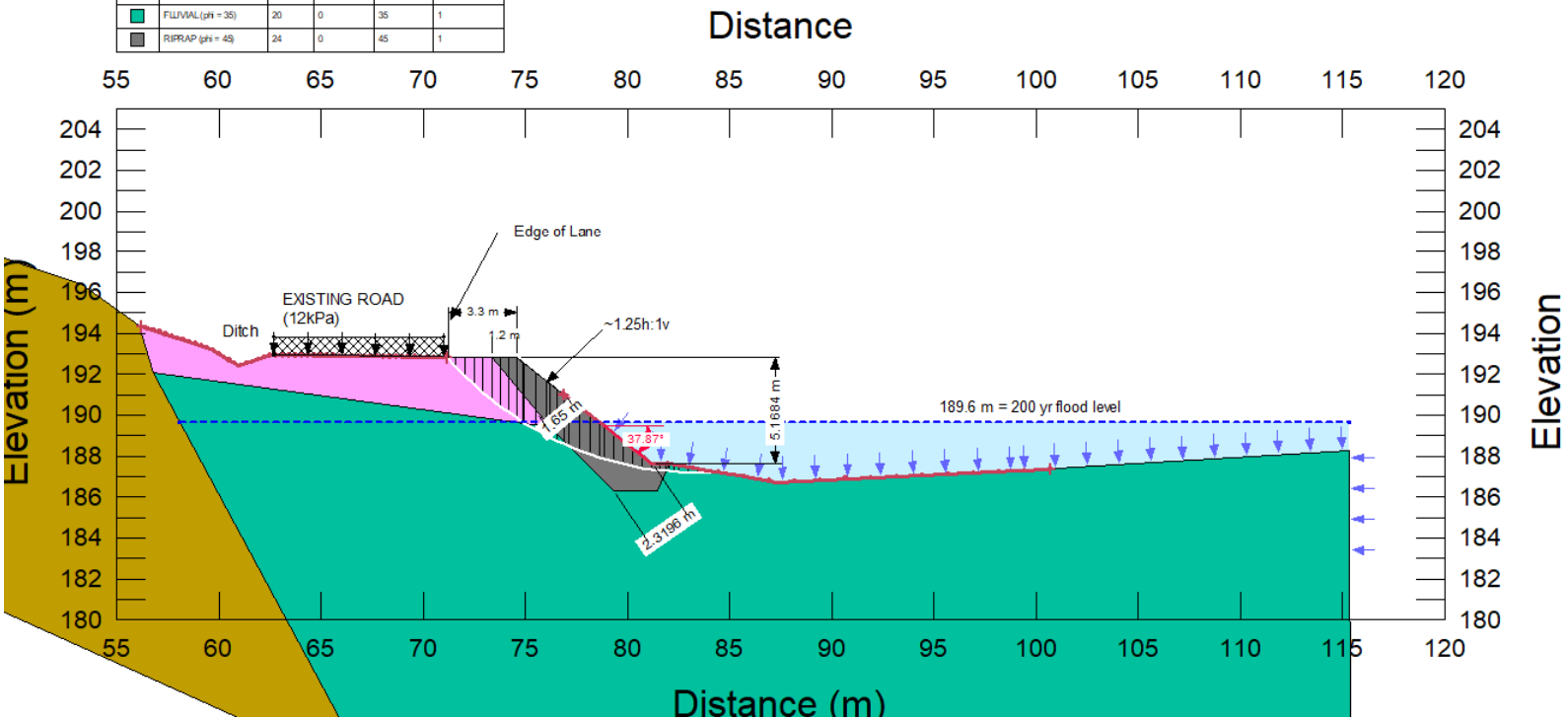
PREPARED BY: PN	FIGURE TITLE: OTHELLO C - CASE 1 (CRITICAL SECTION) - STATIC STEADY STATE STABILITY		
CHECKED BY: MD	CLIENT: BRITISH COLUMBIA MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE		
APPROVED BY: ES	SCALE: NTS	PROJECT NO: 0272101	FIGURE NO: A-1

0 5 10 mm in ANSI A sized paper

BGC ENGINEERING INC.

1.55

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Piezometric Line
	BEDROCK				1
	EARTH EMBANKMENT (phi = 36)	20	0	36	1
	FLUVIAL (phi = 35)	20	0	35	1
	RIPRAP (phi = 45)	24	0	45	1



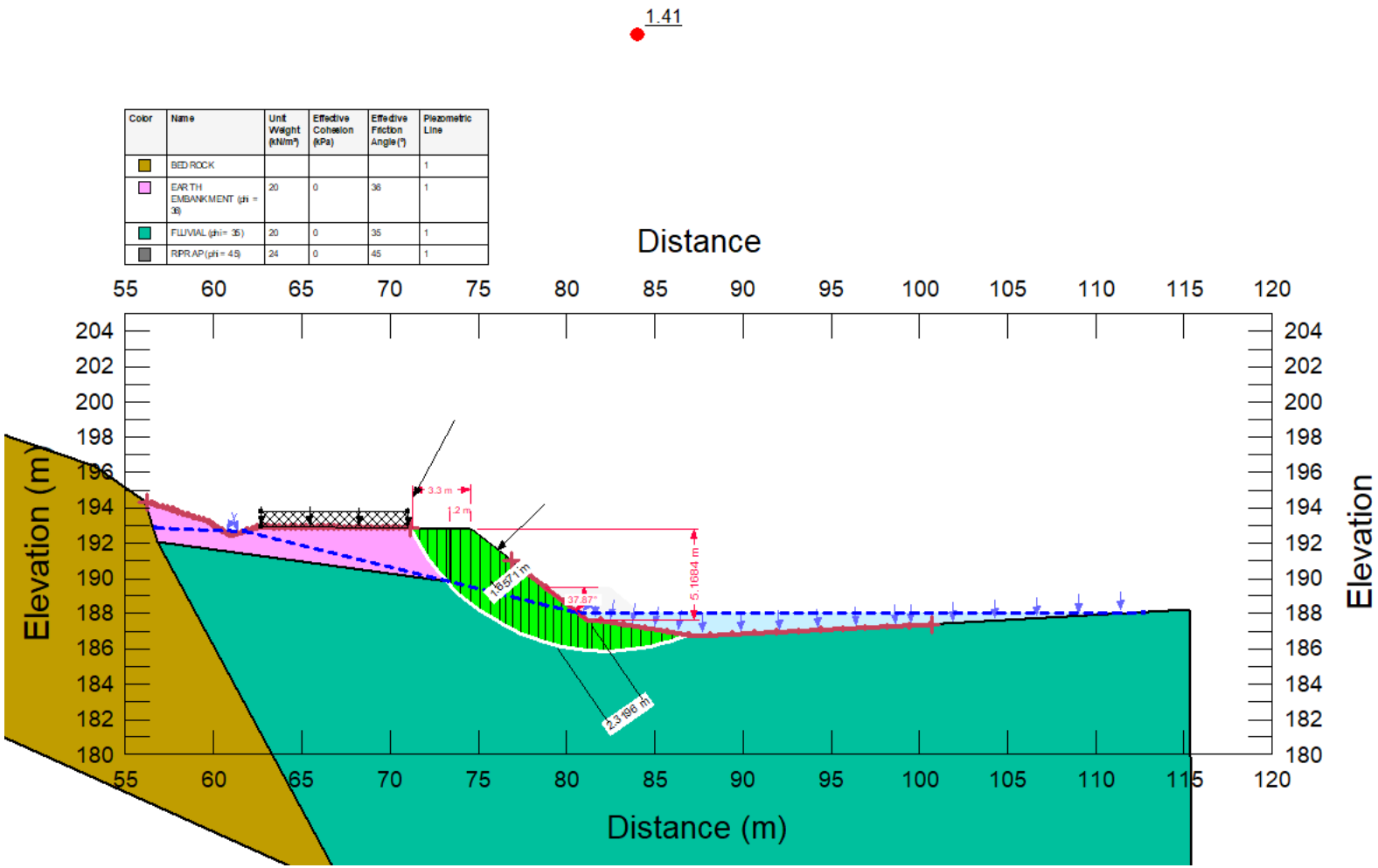
NOTES:

1. THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH BGC'S LETTER REPORT TITLED "OTHELLO ROAD SITE C GEOTECHNICAL ASSESSMENT – FINAL (REV.0)" AND DATED OCTOBER 2023.
2. THE ROAD AND EMBANKMENT ARE DESIGNED BY MCELHANNEY LTD. AND SHOWN IN DRAWINGS TITLED "OTHELLO ROAD SITE C WASHOUT RECOVERY – 50% DESIGN" AND DATED JULY 25, 2023.
3. THE SECTION SHOWS THE CONCEPTUAL GEOLOGICAL INTERPRETATION BASED ON SITE OBSERVATIONS AND BOUNDARIES BETWEEN MATERIAL UNITS SHOULD BE CONSIDERED APPROXIMATE.

PREPARED BY:	FIGURE TITLE:		
PN	OTHELLO C - CASE 2 (CRITICAL SECTION) - 200 YR FLOOD CONDITION		
CHECKED BY:	CLIENT:		
MD	BRITISH COLUMBIA MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE		
APPROVED BY:	SCALE:	PROJECT NO:	FIGURE NO:
ES	NTS	0272101	A-2

0 5 10 mm in ANSI A sized paper

BGC ENGINEERING INC.



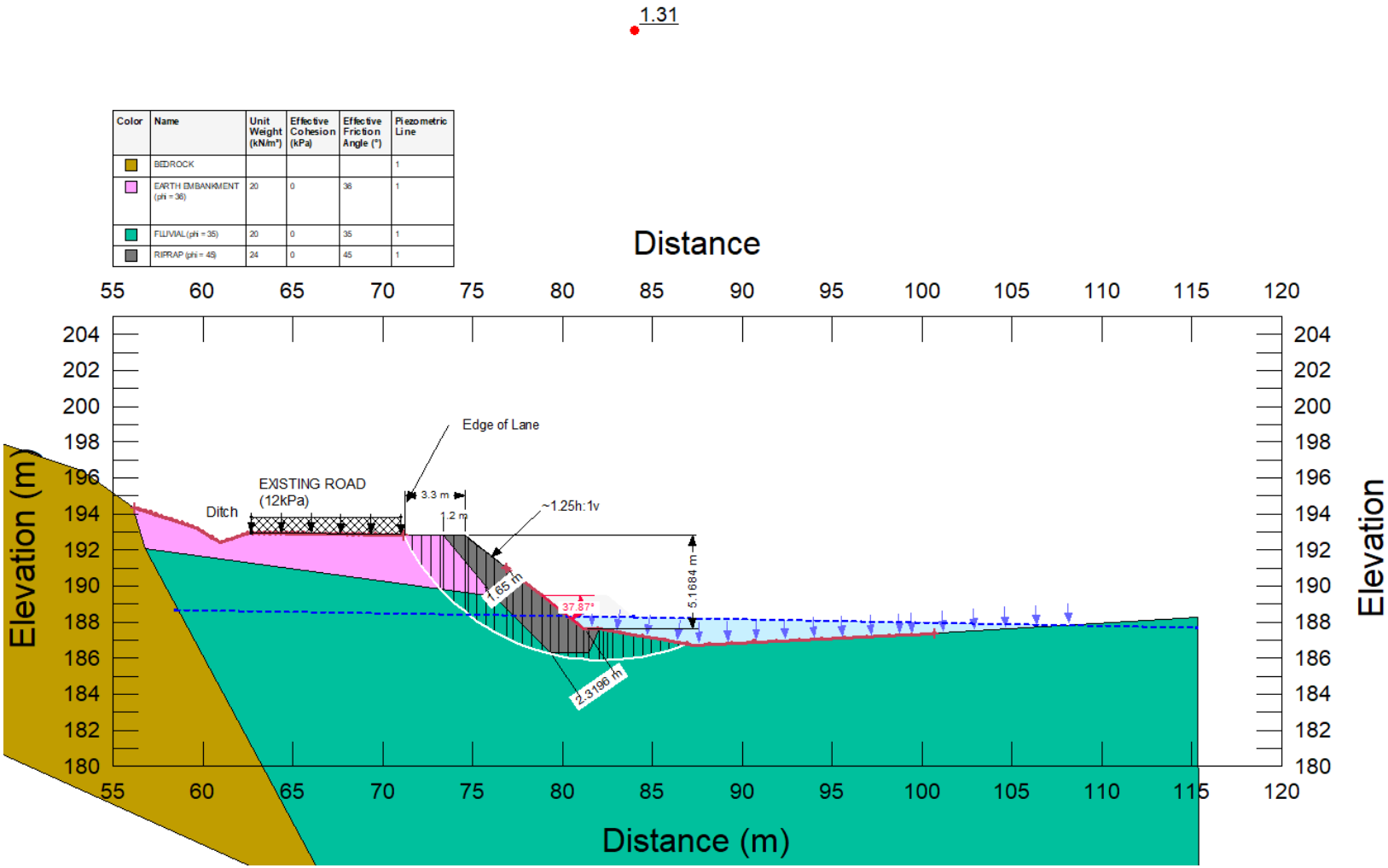
NOTES:

1. THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH BGC'S LETTER REPORT TITLED "OTHELLO ROAD SITE C GEOTECHNICAL ASSESSMENT – FINAL (REV.0)" AND DATED OCTOBER 2023.
2. THE ROAD AND EMBANKMENT ARE DESIGNED BY MCELHANNEY LTD. AND SHOWN IN DRAWINGS TITLED "OTHELLO ROAD SITE C WASHOUT RECOVERY – 50% DESIGN" AND DATED JULY 25, 2023.
3. THE SECTION SHOWS THE CONCEPTUAL GEOLOGICAL INTERPRETATION BASED ON SITE OBSERVATIONS AND BOUNDARIES BETWEEN MATERIAL UNITS SHOULD BE CONSIDERED APPROXIMATE.

PREPARED BY: PN	FIGURE TITLE: OTHELLO C - CASE 3 (CRITICAL SECTION) - RAPID DRAWDOWN		
CHECKED BY: MD	CLIENT: BRITISH COLUMBIA MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE		
APPROVED BY: ES	SCALE: NTS	PROJECT NO: 0272101	FIGURE NO: A-3

0 5 10 mm in ANSI A sized paper

BGC ENGINEERING INC.



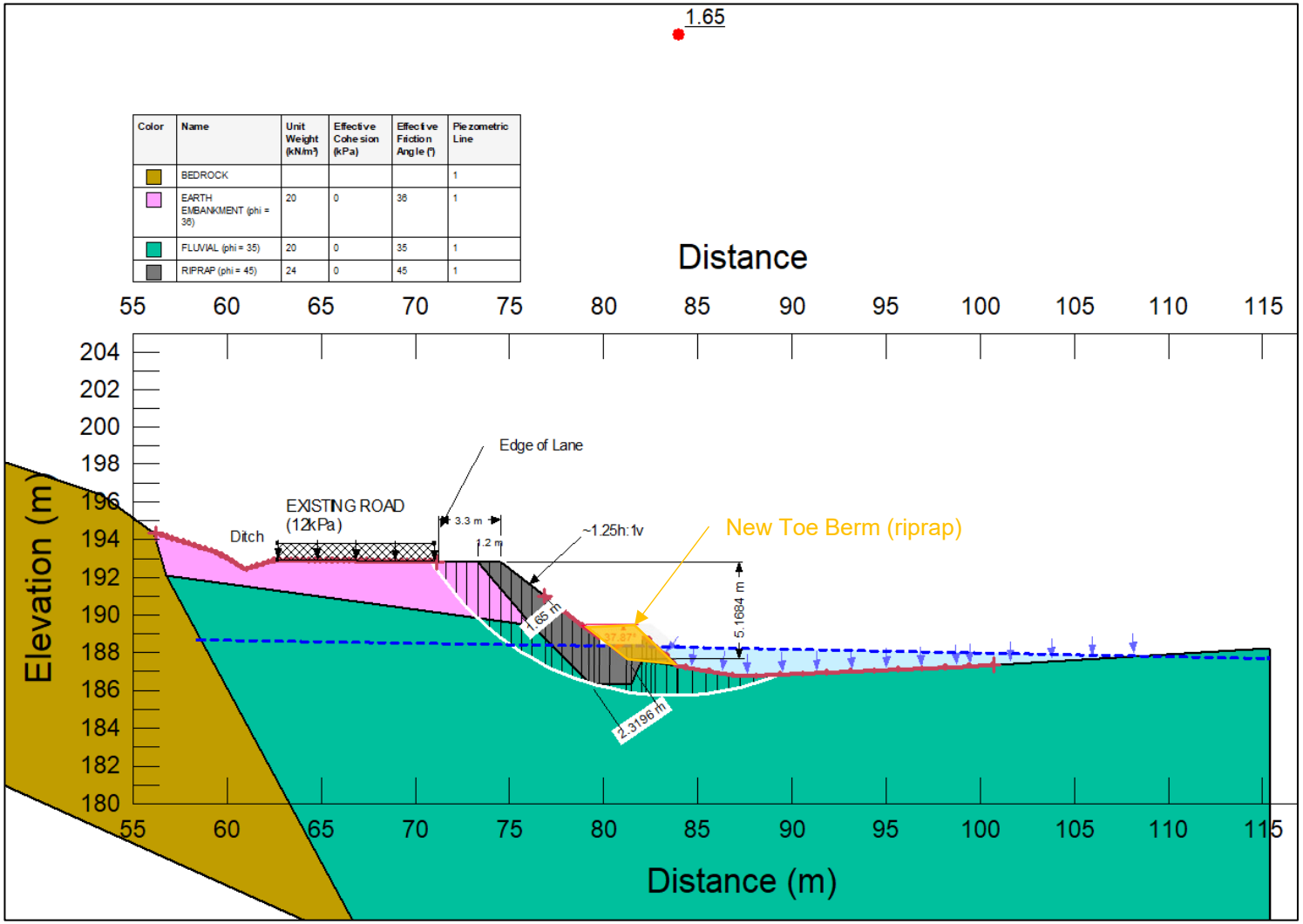
NOTES:

1. THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH BGC'S LETTER REPORT TITLED "OTHELLO ROAD SITE C GEOTECHNICAL ASSESSMENT – FINAL (REV.0)" AND DATED OCTOBER 2023.
2. THE ROAD AND EMBANKMENT ARE DESIGNED BY MCELHANNEY LTD. AND SHOWN IN DRAWINGS TITLED "OTHELLO ROAD SITE C WASHOUT RECOVERY – 50% DESIGN" AND DATED JULY 25, 2023.
3. THE SECTION SHOWS THE CONCEPTUAL GEOLOGICAL INTERPRETATION BASED ON SITE OBSERVATIONS AND BOUNDARIES BETWEEN MATERIAL UNITS SHOULD BE CONSIDERED APPROXIMATE.

PREPARED BY: PN	FIGURE TITLE: OTHELLO C - CASE 4 (CRITICAL SECTION) - SEISMIC STABILITY		
CHECKED BY: MD	CLIENT: BRITISH COLUMBIA MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE		
APPROVED BY: ES	SCALE: NTS	PROJECT NO: 0272101	FIGURE NO: A-4

0 5 10 mm in ANSI A sized paper

BGC ENGINEERING INC.



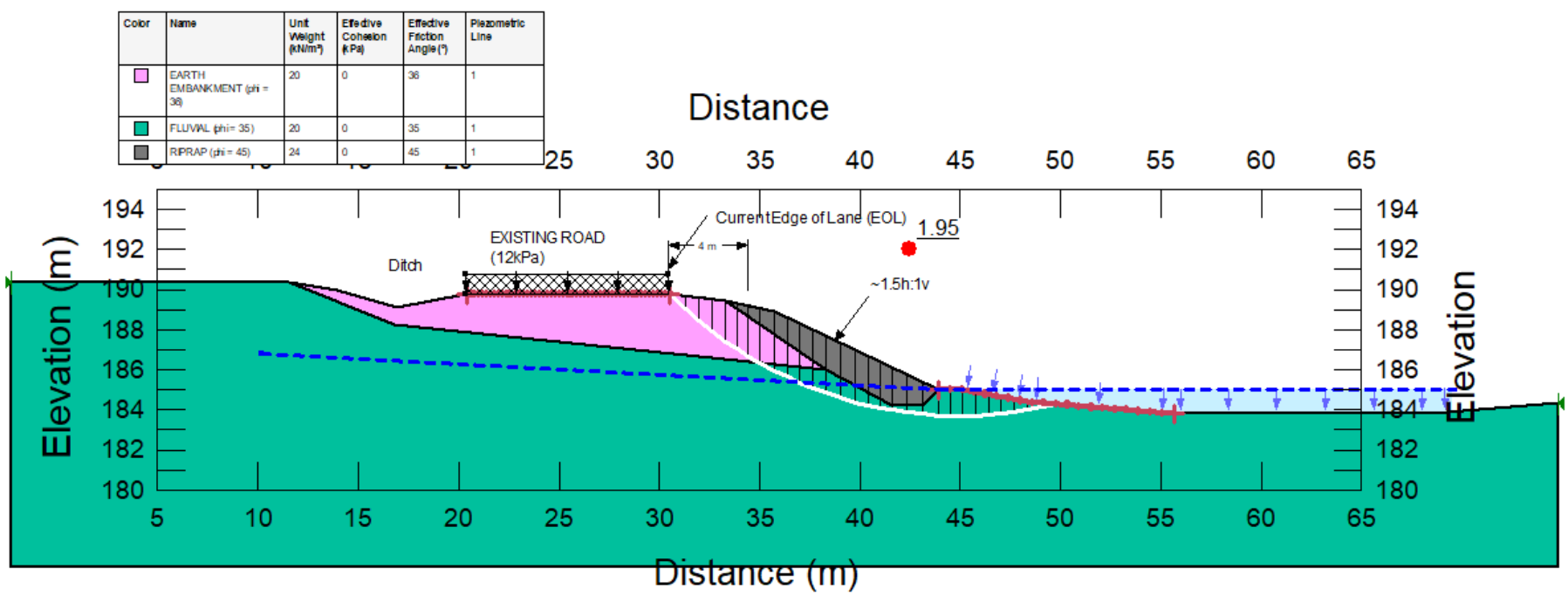
NOTES:

1. THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH BGC'S LETTER REPORT TITLED "OTHELLO ROAD SITE C GEOTECHNICAL ASSESSMENT – FINAL (REV.0)" AND DATED OCTOBER 2023.
2. THE ROAD AND EMBANKMENT ARE DESIGNED BY MCELHANNEY LTD. AND SHOWN IN DRAWINGS TITLED "OTHELLO ROAD SITE C WASHOUT RECOVERY – 50% DESIGN" AND DATED JULY 25, 2023.
3. THE SECTION SHOWS THE CONCEPTUAL GEOLOGICAL INTERPRETATION BASED ON SITE OBSERVATIONS AND BOUNDARIES BETWEEN MATERIAL UNITS SHOULD BE CONSIDERED APPROXIMATE.

PREPARED BY: PN	FIGURE TITLE: OTHELLO C - CASE 5 (CRITICAL SECTION) - STATIC STEADY STATE WITH TOE BERM		
CHECKED BY: MD	CLIENT: BRITISH COLUMBIA MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE		
APPROVED BY: ES	SCALE: NTS	PROJECT NO: 0272101	FIGURE NO: A-5

0 5 10 mm in ANSI A sized paper

BGC ENGINEERING INC.



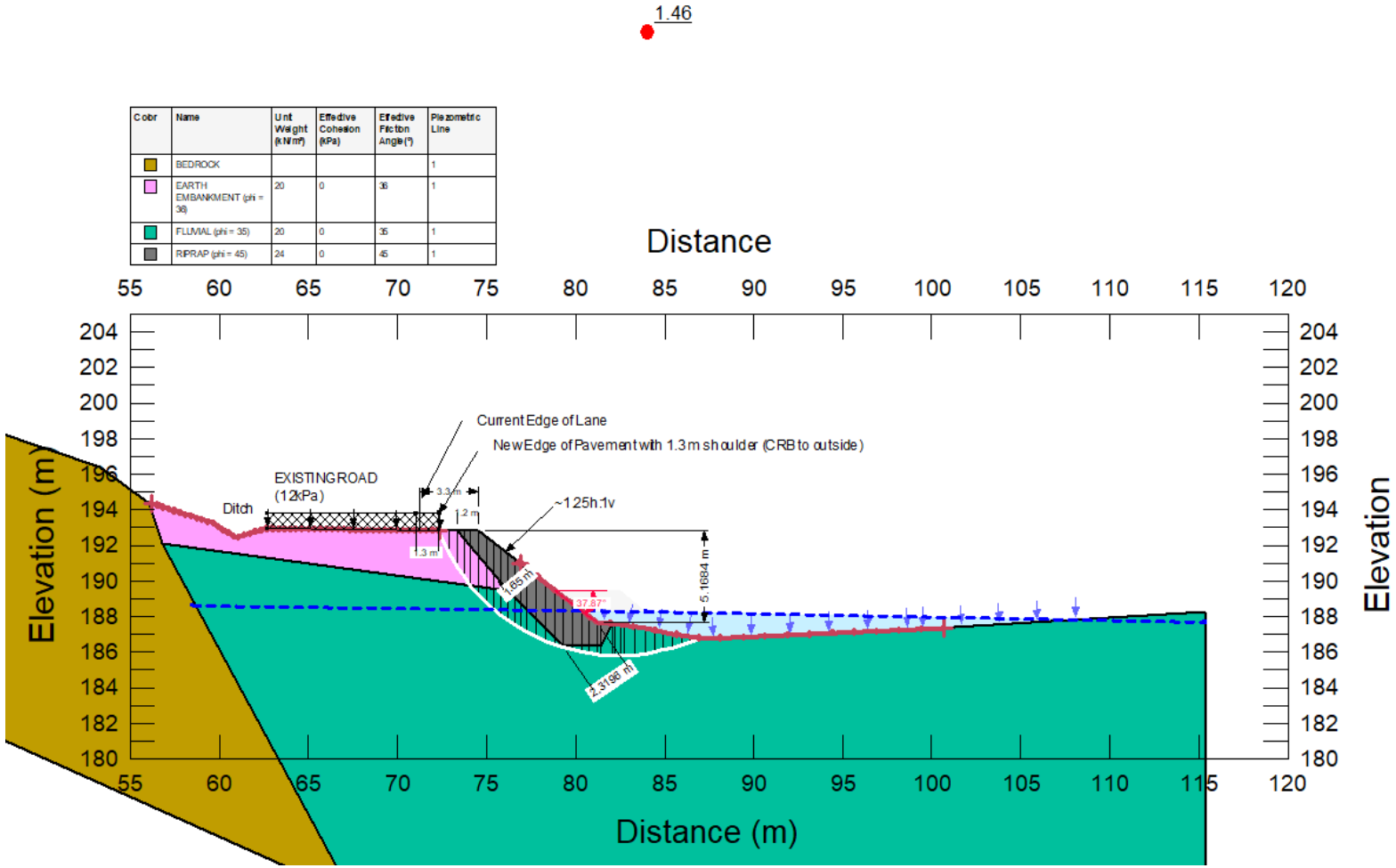
NOTES:

1. THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH BGC'S LETTER REPORT TITLED "OTHELLO ROAD SITE C GEOTECHNICAL ASSESSMENT – FINAL (REV.0)" AND DATED OCTOBER 2023.
2. THE ROAD AND EMBANKMENT ARE DESIGNED BY MCELHANNEY LTD. AND SHOWN IN DRAWINGS TITLED "OTHELLO ROAD SITE C WASHOUT RECOVERY – 50% DESIGN" AND DATED JULY 25, 2023.
3. THE SECTION SHOWS THE CONCEPTUAL GEOLOGICAL INTERPRETATION BASED ON SITE OBSERVATIONS AND BOUNDARIES BETWEEN MATERIAL UNITS SHOULD BE CONSIDERED APPROXIMATE.

PREPARED BY:	FIGURE TITLE:		
PN	OTHELLO C - CASE 6 (TYPICAL SECTION) - STATIC STEADY STATE		
CHECKED BY:	CLIENT:		
MD	BRITISH COLUMBIA MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE		
APPROVED BY:	SCALE:	PROJECT NO:	FIGURE NO:
ES	NTS	0272101	A-6

0 5 10 mm in ANSI A sized paper

BGC ENGINEERING INC.



NOTES:

1. THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH BGC'S LETTER REPORT TITLED "OTHELLO ROAD SITE C GEOTECHNICAL ASSESSMENT – FINAL (REV.0)" AND DATED OCTOBER 2023.
2. THE ROAD AND EMBANKMENT ARE DESIGNED BY MCELHANNEY LTD. AND SHOWN IN DRAWINGS TITLED "OTHELLO ROAD SITE C WASHOUT RECOVERY – 50% DESIGN" AND DATED JULY 25, 2023.
3. THE SECTION SHOWS THE CONCEPTUAL GEOLOGICAL INTERPRETATION BASED ON SITE OBSERVATIONS AND BOUNDARIES BETWEEN MATERIAL UNITS SHOULD BE CONSIDERED APPROXIMATE.

PREPARED BY:	FIGURE TITLE:		
PN	OTHELLO C - CASE 7 (CRITICAL SECTION) - STATIC STEADY STATE WITH ADDITIONAL PAVED SHOULDER		
CHECKED BY:	CLIENT:		
MD	BRITISH COLUMBIA MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE		
APPROVED BY:	SCALE:	PROJECT NO:	FIGURE NO:
ES	NTS	0272101	A-7

0 5 10 mm in ANSI A sized paper

BGC ENGINEERING INC.