



MEMO

TO: Scott Cosman, P.Eng.
COMPANY: BC MOTI
FROM: Bob Forsyth
DATE: June 26, 2023
CC: Binnie: Zach Crippen, PMP.
PROJECT NO.: VG07796.A04
SUBJECT: Edwards Road, Chilliwack, BC
Flood Recovery Project –Site C Conceptual design of Retaining Wall
Project Number: 14095

1 INTRODUCTION

Further to our design group meeting of February 6, 2023, we were requested to provide a conceptual retaining wall design to support the road embankment on the south side of Edwards Road at Site C. A conceptual design was provided in our draft memo of February 2023. The project civil engineer, Stantec, has provided a preliminary wall layout and sections and requested that we provide our comments from a geotechnical perspective.

A description of the site and proposed wall from our previous memo follows. Also, in subsequent sections we provide some comments regarding the preliminary wall design.

The MoTI design standard requires a factor of safety of 1.54 for static stability and 1.0 for seismic stability considering 2020 National Building Code of Canada 475 year-return period as per Table 6.2b of the BC Supplement to the Canadian Highway Bridge Design Code, CSA S6-19.

1.1 CONCEPTUAL DESIGN PROVIDED IN OUR FEB 23, 2023 MEMO

Site C is located about 150 m east of the junction of Edwards Road and Chilliwack Lake Road in Chilliwack, BC. We visited the site on January 13, 2023 and discussed the site in our memos of January 31 and February 7, 2023.

The subject bank is about 3 m high and presently inclined at about 1.25H: 1V (Horizontal: Vertical) with some steeper and flatter portions. The subject section is about 47 m long with an approximately 10 m long section of active instability. The most desirable and economic option for the site is to buttress the bank with a fill inclined at about 2H: 1V and improve drainage of the road so that water does not collect in and overflow the ditch on the north side of the road and enter the subject section of the south bank. However, such a buttress fill would encroach onto the neighbouring property. To date, BC MOTI representatives have been unable to reach an agreement with the property owner regarding such buttress fill placement.

An alternative to the buttress fill would be to construct a retaining wall entirely on the Edwards Road Right of Way. The conceptual location of the wall is shown in plan on Figure 1. A typical wall section is shown in the inset drawing in Figure 1 and in more detail in Figure 2. The wall design could be as follows:

- We envisage that the wall would be up to about 3 m high and could be an MSE (Mechanically Stabilized Earth) wall constructed with a concrete block facing and reinforced backfill. The wall shown is constructed with a facing of interlocking 1500 X 750 X 750 mm concrete blocks. Many other types of wall facing are possible and are included in BC MOTI's Recognized Products List.
- The lower block is typically fully embedded in the ground.

- The backfill of the wall is reinforced with geogrid. A uniaxial geogrid with a minimum ultimate tensile strength of 70 kN/m is recommended.
- The reinforcement should extend a distance, H, equal to the wall height, back from the wall outer face.
- Backfill in the reinforced zone should consist of free draining granular fill compacted to at least 98% of standard Proctor maximum dry density (SPMDD). 75 mm minus road subbase (SGSB) material would be suitable for this purpose.
- The excavation slope for construction of the wall should be inclined in accordance with Worksafe BC regulations.
- We expect that the excavation cut will extend into the existing roadway which will require reconstruction of a portion of the road. We understand that BC MOTI desires to keep at least one lane of the road open during construction.
- Backfill behind the reinforced zone should consist of compacted subgrade, typically locally derived mineral soil compacted to at least 95% of SPMDD, except the top 300 mm if under the roadway which shall be compacted to 100% SPMDD. A 150 mm minus material, free of organics, would be acceptable for this purpose.
- The wall backfill should be drained. The purpose of the drain is to provide relief of hydrostatic pressure behind the wall. A large volume of groundwater is not expected from behind the wall. Accordingly, the drain can outlet laterally onto the ground adjacent to the west (downslope) end of the wall.
- The wall facing should be constructed with a slight batter; 10V: 1H is typical for this type of wall.
- The slope of the backfill at the wall crest should be inclined at 2H: 1V or flatter.
- We understand that the road in back of the wall will have a 1 m wide flat gravel shoulder. North of the shoulder, the pavement structure of the road will consist of 300 mm of subbase, 225 mm of well graded base and 75 mm of asphalt pavement.

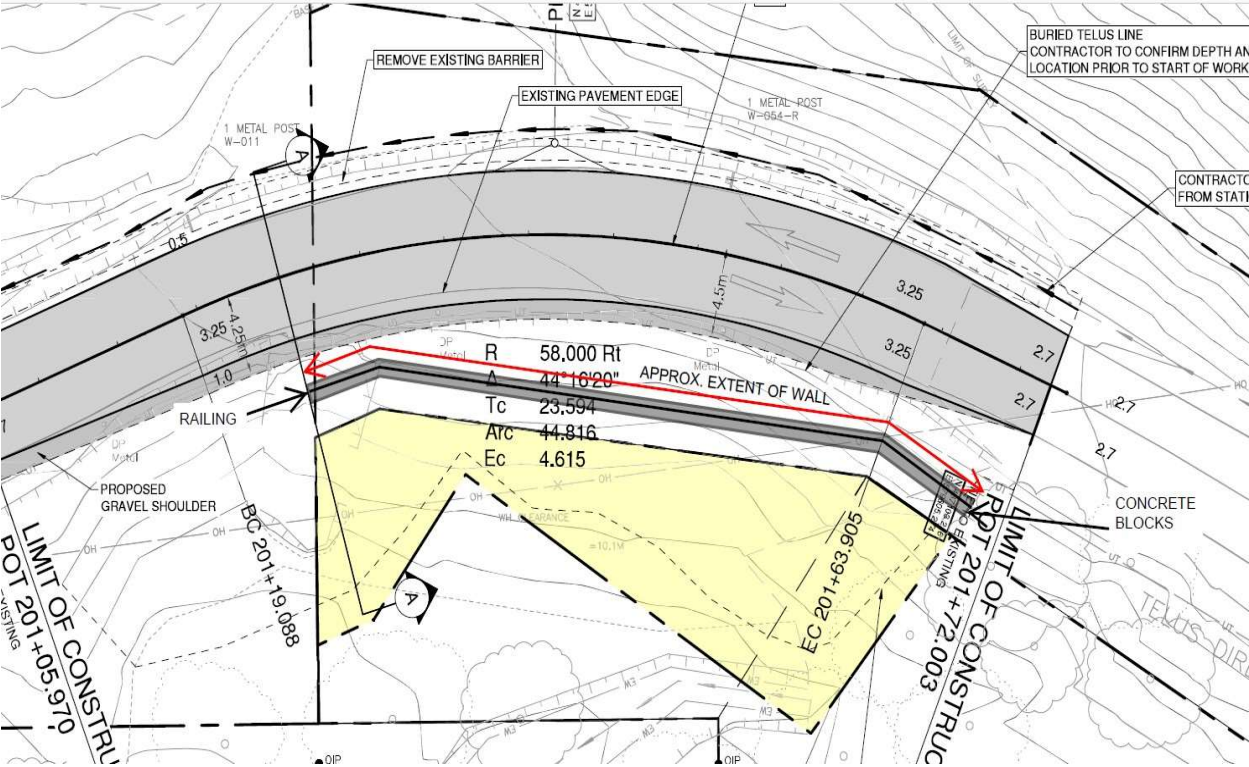
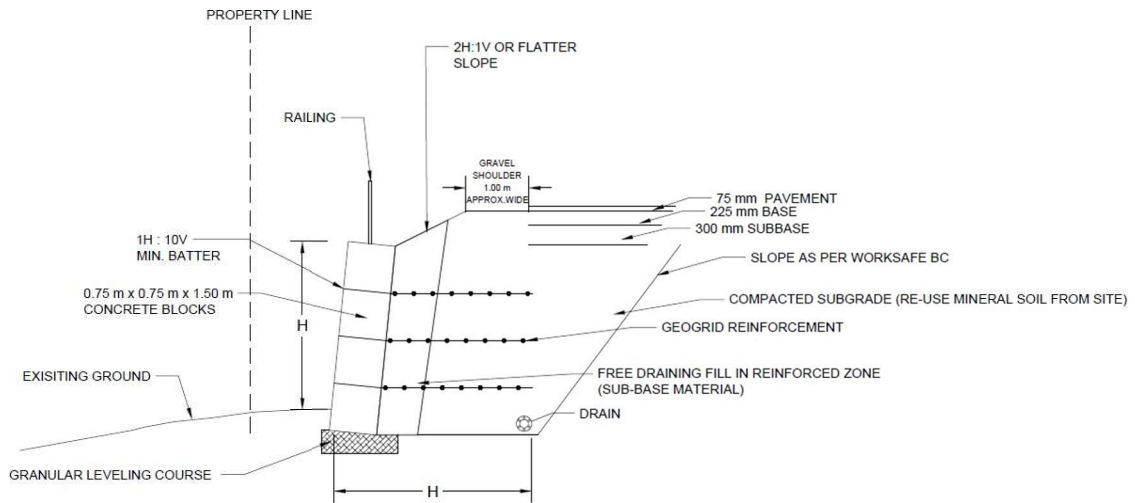


Figure 1: Plan View of Site C



CONCEPTUAL DRAWING OF RETAINING WALL

PROJECT : EDWARDS ROAD - SITE C
PROJECT NUMBER : VG07796.A04



Figure 2: Typical MSE Retaining Wall Section



Photo 1: Looking west at the bank repair area (marked with the stakes and ribbon)



Photo 2: Looking southeast at the area of instability within the subject section

1.2 COMMENTS ON PRELIMINARY WALL DESIGN

We have reviewed the preliminary wall design provided by the project civil engineer. In general, the preliminary design agrees with our conceptual design. We make the following comments.

- 1** The wall is 3 m high, as per our conceptual section, in its western 11 m. Further to the east the wall height decreases to 1.5 to 2.25 m.
- 2** Drainage of the wall backfill is very important. The drain should consist of 150 mm diameter perforated PVC pipe covered with about 150 mm of drain rock all wrapped in non woven geotextile. The drain outlet should be toward the relatively flat ground at the west end of the wall.
- 3** The lower block should be embedded in the ground and based on stiff/dense native mineral soil. All existing fill and/or organic material should be removed from beneath the lower block and replaced with engineered fill material, typically consisting of road subbase or base. If deemed appropriate by the geotechnical engineer, the replacement fill could be reinforced with geogrid for additional strength.
- 4** The reinforced zone of wall backfill should extend back from the wall face a distance equal to the wall height. (ie: for a 3 m high wall, the geogrid should extend back a distance of 3 m from the face. The width of reinforcement can be decreased with decreased wall height).
- 5** Temporary slopes are typically the responsibility of the contractor. The excavation slope for the wall should follow Worksafe BC regulations. Those regulations state that un-shored slopes higher than 1.2 m and steeper than 3/4H: 1V are possible subject to on site written assessment by an experienced professional engineer. It may be possible to reduce the width of excavation relative to the roadway above if the excavation slopes, especially slopes in stiff/dense native soils, can be steepened.
- 6** Our analysis of the 3 m high wall section indicate that the static and seismic factors of safety of global slope stability for the wall exceeds 2.0. In this case the wall backfill is drained and the wall is based on stiff or dense native soil or engineered fill placed on top of such.

4 CLOSURE

This memo report was prepared for the exclusive use of the BC Ministry of Transportation and Infrastructure. Additional limitations are attached. If you have any questions concerning our geotechnical comments or require additional information, please do not hesitate to contact the undersigned.

Yours sincerely,

WSP E&I Canada Limited

Reviewed by:

Bob Forsyth, P Eng.,
Associate Geotechnical Engineer

John Laxdal, P Eng.
Senior Principal Geotechnical Engineer

Attachment: Limitations

Attachment:

Limitations





Limitations

1. The work performed in the preparation of this report and the conclusions presented are subject to the following:
 - a. The Standard Terms and Conditions which form a part of our Professional Services Contract;
 - b. The Scope of Services;
 - c. Time and Budgetary limitations as described in our Contract; and
 - d. The Limitations stated herein.
2. No other warranties or representations, either expressed or implied, are made as to the professional services provided under the terms of our Contract, or the conclusions presented.
3. The conclusions presented in this report were based, in part, on visual observations of the Site and attendant structures. Our conclusions cannot and are not extended to include those portions of the Site or structures, which are not reasonably available, in WSP's opinion, for direct observation.
4. The environmental conditions at the Site were assessed, within the limitations set out above, having due regard for applicable environmental regulations as of the date of the inspection. A review of compliance by past owners or occupants of the Site with any applicable local, provincial or federal bylaws, orders-in-council, legislative enactments and regulations was not performed.
5. The Site history research included obtaining information from third parties and employees or agents of the owner. No attempt has been made to verify the accuracy of any information provided, unless specifically noted in our report.
6. Where testing was performed, it was carried out in accordance with the terms of our contract providing for testing. Other substances, or different quantities of substances testing for, may be present on-site and may be revealed by different or other testing not provided for in our contract.
7. Because of the limitations referred to above, different environmental conditions from those stated in our report may exist. Should such different conditions be encountered, WSP must be notified in order that it may determine if modifications to the conclusions in the report are necessary.
8. The utilization of WSP's services during the implementation of any remedial measures will allow WSP to observe compliance with the conclusions and recommendations contained in the report. WSP's involvement will also allow for changes to be made as necessary to suit field conditions as they are encountered.
9. This report is for the sole use of the party to whom it is addressed unless expressly stated otherwise in the report or contract. Any use which any third party makes of the report, in whole or the part, or any reliance thereon or decisions made based on any information or conclusions in the report is the sole responsibility of such third party. WSP accepts no responsibility whatsoever for damages or loss of any nature or kind suffered by any such third party as a result of actions taken or not taken or decisions made in reliance on the report or anything set out therein.
10. This report is not to be given over to any third party for any purpose whatsoever without the written permission of WSP.
11. Provided that the report is still reliable, and less than 12 months old, WSP will issue a third-party reliance letter to parties that the client identifies in writing, upon payment of the then current fee for such letters. All third parties relying on WSP's report, by such reliance agree to be bound by our proposal and WSP's standard reliance letter. WSP's standard reliance letter indicates that in no event shall WSP be liable for any damages, howsoever arising, relating to third-party reliance on WSP's report. No reliance by any

party is permitted without such agreement.

BC MOTI
Project No. VG07796.A04

WSP E&I Canada Limited
27 March 2023
Limitations