



MEMO

TO: Scott Cosman. P Eng.
COMPANY: BC MOTI
FROM: Bob Forsyth
DATE: 4 May 2023
CC: Wayne Byczek, P Eng, Johnathan Tillie, Michael Carreira, P Eng.
PROJECT NO.: VG07794.303 Rev.1
SUBJECT: Silver Skagit Road, South of Hope, BC
Road and Culvert Repairs at Several Locations, Geotechnical Review of 100% Design Drawings (Rev 1)

1 INTRODUCTION

As requested, we herein provide geotechnical comment regarding 100% Design Drawings prepared by RF Binnie & Associates Ltd, for the recovery phase of flood repairs to the Silver Skagit Road. We have already reviewed and commented on preliminary drawings provided by Binnie for several sections of the road as noted below. Response phase activities were carried out at most of these sections in 2022.

- Km 10.9
- Km 12.5
- Km 18.3 to 18.6
- Km 20.9
- Km 23.0
- Km 25.3
- Km 27.8
- Km 31.9
- Km 34.5
- Km 36.7

We have been requested to provide some additional comments regarding geotechnical aspects of work at these sections which are included in Section 2.0.

Drawings have also been provided for the following repair sections for which we have recently received drawings. We have visited these locations in the field but have not provided related geotechnical memos. A description of each site and related geotechnical commentary is provided in Sections 3.0 to 3.6

These are:

- Km 32.7
- Km 38.4
- Km 39.2
- Km 43.1
- Km 55.0
- Km 56.7

2 ONGOING CONSTRUCTION SECTIONS - ADDITIONAL COMMENTS

We have been requested to make additional comments that relate to all of the sites. Construction was carried out at the first group of sites in 2022. To date, compacted embankment fill (Type D fill) has consisted of clean sand and gravel removed from creek channel crossings at kms 10.9, 34.5 and 36.7. This fill is comprised of sand and gravel with trace cobbles and less than 5% silt and clay sizes. It is our opinion that such material is suitable for use as Select Granular Subbase (SGSB). Where such material has been placed above the design bottom of SGSB, it should be left in place with cobbles/boulders exceeding 75 mm in diameter selectively removed, prior to placing the overlying SGSB or Well Graded Base (WGB).



As well, the same comment applies to the fill originating from the creek channel at Mile 10 of the Coquihalla Highway. It has been used to raise the grade in the section from about km 21.5 to 22.0. This material is similarly sand and gravel with trace cobbles and less than 5% silt and clay sizes.

With regard to stripping, all organic and existing fill material should be removed down to stiff/dense native mineral soil prior to placing compacted subgrade or subbase material. We understand that the thickness of stripping encountered during 2022 construction has typically been about 150 mm. Thicker organics are possible, especially in low lying, poorly drained areas.

The pavement structure should consist of:

Table 1: Pavement Structure

Course	In Cut	In Fill
HFSA	100	100
25 mm WGB	225	225
SGSB	300*	150**

Notes:

* assumes fine grained subgrade ML/CL/OL/MH/CH/OH. Can be reduced if it is coarse grained.

** assumes coarse grained subgrade GW/GP/GM/GC/SW/SP/SM/SC.

If the embankment and/or natural subgrade meet SGSB specifications, the SGSB layer can be omitted. The geotechnical engineer should observe the embankment fill during construction to confirm the SGSB requirement.

Cut and fill slopes should generally be limited to 1.5H:1V. These slopes assume granular material and should be confirmed during construction by the geotechnical engineer. It is understood that a maximum slope of 2H:1V will be used for the embankment including riprap armouring where applicable.

Site specific comments follow:

2.1 KM 25.3

At km 25.3, the west shoulder of the Silver Skagit Road has been eroded by a creek channel which migrated toward the road during the November 2021 flood event. We are in agreement with the design, which specifies reconstruction of the west shoulder of the road and protection of the embankment with rip rap.

There is a culvert at the north end of the section. The culvert outlet is exposed and the inlet, in a small flat lying area on the east side of the road, is buried. It is recommended that the culvert inlet be exposed and the culvert repaired and maintained going forward.

2.2 KM 27.8

At km 27.8, a 50 m long section of the road was covered with an approximately two meter thick debris fan during the 2021 flood event. Water from the hillside above, which has been logged in the past, flowed down a new debris channel to the road. The repair involves raising the road grade, the construction of a culvert undercrossing at the likely location of the original creek channel, about 200 m south of the debris channel, and construction of a ditch on the east (upslope) side of the road. We are in general agreement with the proposed repairs, however, there is a risk that future floods and debris flows could occur in the new debris channel. The blockage of the original creek channel has not been found and is believed to be on the hillside, far from the road right of way. It may be difficult to remove blockage upslope and restore flow into the original channel.

3 NEW REPAIR SECTIONS

Design Drawings have been recently provided for additional repair locations that have not been addressed previously by geotechnical memos. Our descriptions and opinions regarding these locations are provided in Sections 3.1 to 3.6.

3.1 KM 32.7

At this location, shown in Photo 1 below, a seasonal creek crossed beneath the Silver Skagit Road in a CSP culvert. The inlet became blocked and during the 2021 flood event, a concentrated stream of water flowed for about 300 m down the east roadside ditch, causing erosion of the ditch and east shoulder of the road. As well there were erosional rivulets on the road at about km 33.0 where the flow crossed the road.



Photo 1: Looking south from km 32.7 of the Silver Skagit Road, on September 21, 2022. Note the erosion damage to the east ditch and shoulder of the road.

The proposed design specifies replacement of the existing metal culvert with a concrete box culvert and improvement of the channel at the culvert inlet and outlet. The shoulder and ditch on the east side of the road will be reconstructed and the road will be regraded and resurfaced as required. From a geotechnical perspective we are in general agreement with the plan and have no further comment.

3.2 KM 38.4

Similarly at km 38.4, another seasonal creek crossed beneath the Silver Skagit Road in a CSP culvert. The inlet became blocked and during the 2021 flood event, a concentrated stream of water flowed for about 220 m down

the east roadside ditch, causing erosion of the ditch and east shoulder of the road. As well, there was some erosion in the vicinity of the culvert outlet.



Photo 2: Looking east at the culvert outlet at km 38.4, on September 21, 2022. The culvert inlet was buried.



Photo 3: Looking south from km 38.4 on September 21, 2022. Note the erosion on the east side of the road.

The proposed design specifies replacement of the existing metal culvert with two concrete box culverts and improvement of the channel at the culvert inlet and outlet. The shoulder and ditch on the east side of the road will be reconstructed and the road will be regraded and resurfaced as required. From a geotechnical perspective we are in general agreement with the plan and have no further comment.

3.3 KM 39.2

At this location, up to about 0.8 m of granular material was deposited on the roadway during the 2021 flood event. This drainage course may not have been identified previously as no existing culvert has been located at the site. The site is photographed below.



Photo 4: Looking north at the deposit of granular material on the road at km 39.2.

The proposed design specifies the installation of a concrete box culvert at the creek location and improvement of the channel at the culvert inlet and outlet. The road will be graded and surfaced as required. From a geotechnical perspective we are in general agreement with the plan and have no further comment.

3.4 KM 43.1

In the vicinity of km 43.1, the Silver Skagit Road crosses a relatively flat forested area. Drainage is poor in that the area will tend to collect surface water during wet weather. For a distance of about 100 m, erosion occurred along the west shoulder of the road. A metal culvert with a damaged outlet was noted near the south end of the road section.



Photo 5: Looking north at the road at km 43.1, September 21, 2022. Note the erosion of the west shoulder.



Photo 6: Culvert outlet near km 43.1, September 21, 2022

We are in general agreement with the design of the proposed repair which includes re-construction of the shoulder on the west side of the road and grading and surfacing of the road as required.

The base of the embankment will be toed into the native soil. The depth of stripping / thickness of organics at this location could be more than 300 mm.

As well the culvert should be repaired and maintained going forward (maintenance should include removal of the log in front of the culvert outlet).

3.5 KM 55.0

At this location a culvert was partially blocked. In November 2021, flood waters eroded the ditch on the east side of the Silver Skagit Road for a distance of about 50 m then flowed across the road resulting in erosional rivulets on the road surface. Deposition of less than 300 mm of sand occurred on the surface of a nearby trailhead clearing/parking area on the east side of the road.

Photos of the site are shown below:



Photo 7: Culvert inlet at km 55.0 partially blocked with gravel, September 21, 2022.



Photo 8: September 21, 2022. Looking north at erosion of the ditch and shoulder on the east side of the road, km 55.0.

The proposed design includes replacement of the existing corrugated metal culvert with two concrete box culverts, reconstruction of the damaged portion of the embankment on the east side of the road and regrading / resurfacing of the road and trailhead area. From a geotechnical perspective we are in general agreement with the design and have no additional comments.

3.6 KM 56.7

At this location, a seasonal creek crosses beneath the Silver Skagit Road in two metal culverts. These culverts were partially blocked and in 2021, flood waters eroded the ditch and shoulder on the east side of the road for a distance of about 25 m.



Photo 9: September 21, 2022. Looking north at culvert inlets at km 56.7. Note erosion along the east side of the road north of the creek channel.



Photo 10: km 56.7, Spetemebr 21, 2022. Looking west at the culvert outlets and creek channel downstream of the road.

The proposed design includes replacement of the existing corrugated metal culverts with three concrete box culverts, reconstruction of the damaged portion of the embankment on the east side of the road and regrading / resurfacing of the road. From a geotechnical perspective we are in general agreement with the design and have no additional comments.



4 CLOSURE

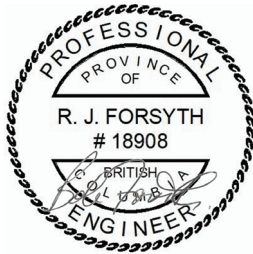
Comments and recommendations presented herein are based on a geotechnical evaluation of the available information as noted. If conditions other than those reported are noted in subsequent phases of the project, WSP E&I Canada Limited should be notified and be given the opportunity to review and revise the current comments and recommendations if necessary. Recommendations presented herein may not be valid if an adequate level of review or inspection is not provided during construction.

This memo has been prepared for the exclusive use of BC MOTI and their appointed agents for specific application to the area covered within this memo. Any use which a third party makes of this memo or any reliance on or decisions made based on it are the responsibility of such third parties. WSP accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this memo. It has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

Effective September 21, 2022, Wood Environment & Infrastructure Solutions Canada Limited is now operating as WSP E&I Canada Limited. No other aspects of our legal entity, contractual terms or capabilities have changed in relation to this memo submission.

Yours sincerely,

WSP E&I Canada Limited



04-May-2023 14:36 PDT

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