



## TECHNICAL MEMORANDUM

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TO

Ministry of Transportation and Infrastructure

CC

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FROM

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### SILVER-SKAGIT ROAD FLOOD MITIGATION – 10.9 KM SITE ENVIRONMENTAL OFFSETTING HYDROTECHNICAL DESIGN BASIS

## 1.0 INTRODUCTION

WSP has been retained by the Ministry of Transportation and Infrastructure (MOTI) to provide hydrotechnical engineering and design services for flood response mitigation and recovery works on the Silver-Skagit Road near Hope, BC. The project has been divided into multiple sites depending on their location along the corridor. This memorandum describes the hydrotechnical considerations and assessment carried out to provide an environmental offsetting design for the 10.9 km site.

The 10.9 km site environmental offsetting measures consist of a series of inter-connected ponds and open channels to provide fish habitat downstream of the 10.9 km culverts. The ponds will receive flows exiting the culvert and flowing towards Silverhope Creek. Pond geometry, channel alignment, fill materials and geotechnical design were provided by the Highway Design Engineer (R.F. Binnie & Associates Ltd.) and geotechnical consultant (WSP Canada Inc.), and are outside of the hydrotechnical scope of work.

## 2.0 SITE CLIMATE AND HYDROLOGY

### 2.1 General Climate and Precipitation

Hope has an oceanic climate with warm summers and moderately cold winters based on the Köppen climate classification. Temperatures in Hope over the course of the year typically range from -2 °C to 25 °C and are rarely below -10 °C or above 31 °C with a distinct warm season between June and September, and a cold season between November and February. The hottest month of the year is typically August with an average high temperature of 24 °C, and the coldest month is typically December with an average low of -2 °C.

The chance of wet days in Hope varies significantly throughout the year. The wetter season is typically between October and April with the wettest month generally being November with an average rainfall of 199 mm; the driest month is generally August with an average rainfall of 34 mm. Wet days are comprised of rain only, snow only, and rain and snow events. The month with the most snow is January, with an average snowfall of 276 mm.

## 2.2 Watershed Hydrology and Peak Flows

The Silverhope Creek drains approximately 350 km<sup>2</sup> of the Cascade Range entering the Fraser River in Hope, BC; the creek is approximately 40 km long from the upper reaches in the Cascade Range to Hope. The portion of the watershed draining to Silverhope Creek at the 10.9 km site is approximately 4.14 km<sup>2</sup> and consists of steep mountain terrain draining towards Silverhope Creek across the Silver-Skagit road. Similar to other tributary catchments, the area draining to Silverhope Creek at the 10.9 km site is subject to debris floods. The 10.9 km watershed exhibits elevations ranging from approximately 1841 masl near Wells Peak, to 360 masl at the Silver-Skagit Road crossing.

WSP carried out an analysis of nearby hydrometric stations within 30 km of the site for unregulated streams to establish a relationship between catchment area and peak flows based on historical flow measurements. The stations included in the analysis are Chilliwack River above Slesse Creek (08MH103), Coquihalla River above Alexander Creek (08MF068), Coquihalla River below Needle Creek (08MF062), Slesse Creek near Vedder crossing (08MH056), and Tulameen River below Vuich Creek (08MH056). For a contributing catchment of 4.14 km<sup>2</sup>, the resulting 5-yr and 10-yr return period peak flows (Q5 and Q10) are approximately 3.2 m<sup>3</sup>/s and 4.0 m<sup>3</sup>/s, respectively; not accounting for climate change. Climate Change impact has not been incorporated in the design of the environmental offset ponds.

The location of the stations included in this analysis are shown in Figure 1. Although these gauges are for larger drainage areas, they have been selected to best represent potential runoff at this site and are considered to be adequate for the purposes of this report.



Figure 1 Hydrometric Stations near Hope, BC



### 3.0 HYDRAULIC ANALYSIS

WSP carried out a hydraulic analysis for the 10.9 km ponds to evaluate minimum outlet channel dimensions and erosion protection during a Q10 event. Results of the analysis are summarized in the following sections.

#### 3.1 Outlet Channel Design

The resulting peak flow at the 10.9 km site during the Q10, as described in Section 2.2, was used to estimate the minimum channel base width and depth as well as the maximum longitudinal channel gradient assuming no flow attenuation within the ponds, and an equal distribution of the total flow on each branch of the pond layout.

The resulting dimensions, based on a trapezoidal open channel and a minimum freeboard of 0.30 m, consist of a minimum bottom width of 5.0 m and 0.8 m channel depth including freeboard; and maximum 1.5H:1V side slopes and 5% longitudinal slope.

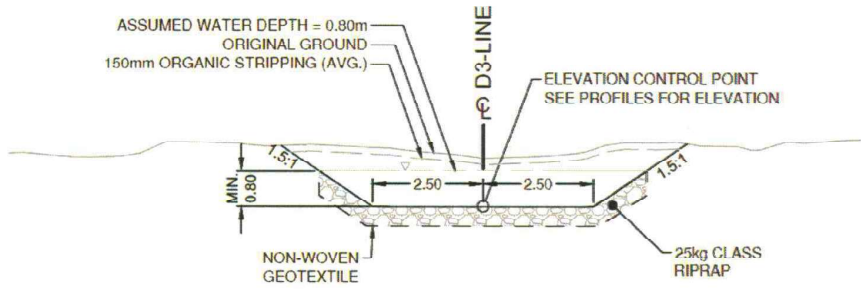
#### 3.2 Erosion Protection

Erosion protection to the drainage channel has been provided via a riprap layer. Sizing for the riprap has been obtained following recommendations from the Transportation Association of Canada (TAC) guidelines using the US Army Corps of Engineers procedure (USACE 1991) for the Q10 design flow and channel configuration described above. The resulting riprap consists of Class 25 kg riprap at a minimum 450 mm thickness. A non-woven geotextile will be placed as a filter between the riprap and subgrade. Approximate rock particle weights and sizes for Class 25 kg riprap, based on spherical rock particles with a specific gravity of 2.50, are provided in Table 1.

**Table 1 – Class 25 kg Riprap Weight and Gradation**

Percent Smaller (by Mass)	Mass (kg)	Intermediate Dimension (mm)
100	125	450
85	75	385
50	25	270
15	2.5	125

Typical channel geometry and erosion protection are shown in Figure 2.



**TYPICAL SECTION  
D3-LINE CHANNEL WITH RIPRAP  
INTERCONNECTING CHANNEL**

Figure 2 10.9 km Pond Outlet Ditch Typical Cross Section

**4.0 CLOSURE**

We trust that this information is sufficient for your requirements. Should you have any questions regarding the above, or if you require further information, please do not hesitate to contact our office.

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