

17 September 2020

Flood Mitigation: Remediation Options of High Priority Areas

1. Project Understanding

In 2019, McElhanney was contracted by the Regional District of Kitimat-Stikine (RDKS) to provide consulting services in support of forward planning of flood mitigation works along the Skeena River and its tributaries near Terrace, BC. As part of flood mitigation planning, the RDKS intended to submit an application for funding assistance under the Union of BC Municipalities' Flood Risk Assessment, Flood Mapping & Flood Mitigation Planning Funding Program. Funding assistance would support the expansion of the Skeena River Channel Management Program (the Project) to include an additional length of the Skeena River and the lowest reach of the Zymoetz/Copper River. Work completed as part of the flood mitigation planning included LiDAR collection, bathymetric surveys, fish habitat assessments, hydrological analysis, channel modeling, and mapping. The following report provides a summary of the proposed remediation options for the top four highest priority areas including conceptual designs and estimates to assist with planning and budgeting.

2. Methodology

Several sites were identified as potential areas of concern during the process of completing the Inundation and Flood Hazard Mapping for the Skeena River and the lower Kitsumkalum River. These sites were identified based on the potential for erosion, flooding or other issues caused by the river. These sites were reviewed at the final stakeholders meeting and the following four priority sites were chosen to be reviewed:

- RDKS Lagoon Erosion Protection Completion
- Thornhill Frontage Slope Protection
- Queensway Dike Improvements
- Dutch Valley Slope Protection

These four sites were reviewed for issues caused by the river and conceptual designs were created for potential remediation of the issues. Cost estimates have been created based on the conceptual designs for each site to assist with planning and budgeting for these projects.

3. Results/Discussion

3.1. RDKS LAGOON EROSION PROTECTION COMPLETION

The RDKS completed Phase 1 of the Lagoon Erosion Protection in 2018, this included a 600 m section of riprap directly in front of the lagoons to provide immediate protection as deemed the highest priority at the time. Currently there is a 630-meter section of exposed bank with existing riprap upstream and downstream. This section is considered to be a high priority due to the highly erodible nature of the bank material combined with an outside bend of the full Skeena River. This section also poses a risk of the river eroding behind the downstream riprap causing the river to outflank the existing riprap and washing out the RDKS lagoon system. An application for half of this project (Phase 2a) was prepared by McElhanney and submitted to the Community Emergency Preparedness Fund for funding.

The proposed remediation for this section is to install Class 1000 kg riprap with a minimal nominal thickness for the full 630-meter length. Access for construction would utilize the same access as used during Phase 1 construction.

The plan drawing 01515-04-C-01 is attached to this report along with an updated version of the cost estimate.

3.2. THORNHILL FRONTAGE SLOPE PROTECTION

This section is located along Highway 16 through Thornhill, BC behind the Copper River Motel. This section is approximately 600 meters in length. This section was also deemed as a high priority based on the erosion potential along Highway 16 and the potential to damage or destroy highway infrastructure and commercial property. This section consists of a high gravel bank along a relatively straight section of the Skeena River.

The proposed remediation for this section is to install Class 1000 kg riprap with a minimal nominal thickness for the full 600-meter length. This would require the construction of an access road to the base of the slope to allow for transportation of the rock and equipment.

A conceptual plan drawing C-102 and cost estimate are attached to this report.

3.3. QUEENSWAY DIKE IMPROVEMENTS

This section includes the properties immediately adjacent to the Skeena River in the Queensway subdivision between Thornhill Creek and Bobsein Slough. This area was identified to have a moderate flood hazard under current conditions. Projected future conditions including climate change, increase the hazard to extreme due to the current elevation of the dike. The dike follows the Skeena River for approximately 1200 meters in length from Thornhill Creek to Bobsein Slough. During the 2007 flood, the RDKS increased the elevation of this dike to the current Q100 elevation. When the projected increase in flow conditions as a result of climate change is assessed the dike no longer provides adequate flooding protection.



The proposed remediation for this section is to install high fines compacted material to increase the height of the dike to a proposed elevation above the current Q200 including freeboard. To protect the newly placed material, a layer of riprap should be placed along the outside face at a nominal thickness of 1.2 meter to mitigate any erosion potential.

Access for construction is proposed to be from Queensway Dr. at Thornhill Creek and through Mark Ave.

A conceptual plan drawing C-103 and cost estimate are attached to this report.

3.4. DUTCH VALLEY SLOPE PROTECTION

The Dutch Valley section consists of a large slope failure along the Kitsumkalum (Kalum) River, just downstream of the Spring Creek confluence. The site was assessed based on slope erosion and protecting the slope from additional scour, although it is assumed that there are global geotechnical instabilities of the surrounding area.

The proposed remediation for this section is to install Class 500 kg riprap with a minimal nominal thickness for approximately 150 meters in length. This will provide protection for the toe of slope; however, this does leave a 400-meter length of unprotected bank between the new proposed riprap and the riprap placed by the RDKS during the 2009 flooding event. It is recommended that an additional review be completed prior to completing this section to analyze the benefits with connecting with the older section.

This protection would require the construction of an access road to the base of the slope from Bohler Road to allow for transportation of the rock and equipment. This access road would require a bridge over Spring Creek.

A conceptual plan drawing C-101 and cost estimate are attached to this report.



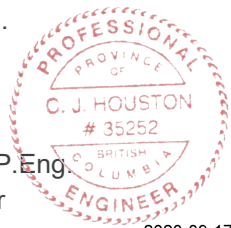
4. Closure

McElhanney has reviewed these four sites for the purposes of the Regional District of Kitimat Stikine or the other stake holders to assist with planning and budgeting or apply for funding to assist with these projects. The conceptual designs and cost estimates were developed using the most recently available data and field conditions, a detailed design of these sites is required prior to construction. Detailed designs, complete assessments, and supporting documents for these sites can be prepared upon the securing of construction funding.

We thank you for the opportunity to work on this project. Please do not hesitate to contact us if you have any questions.

Yours truly,
McElhanney Ltd.

Chris Houston, P.Eng.
Project Manager



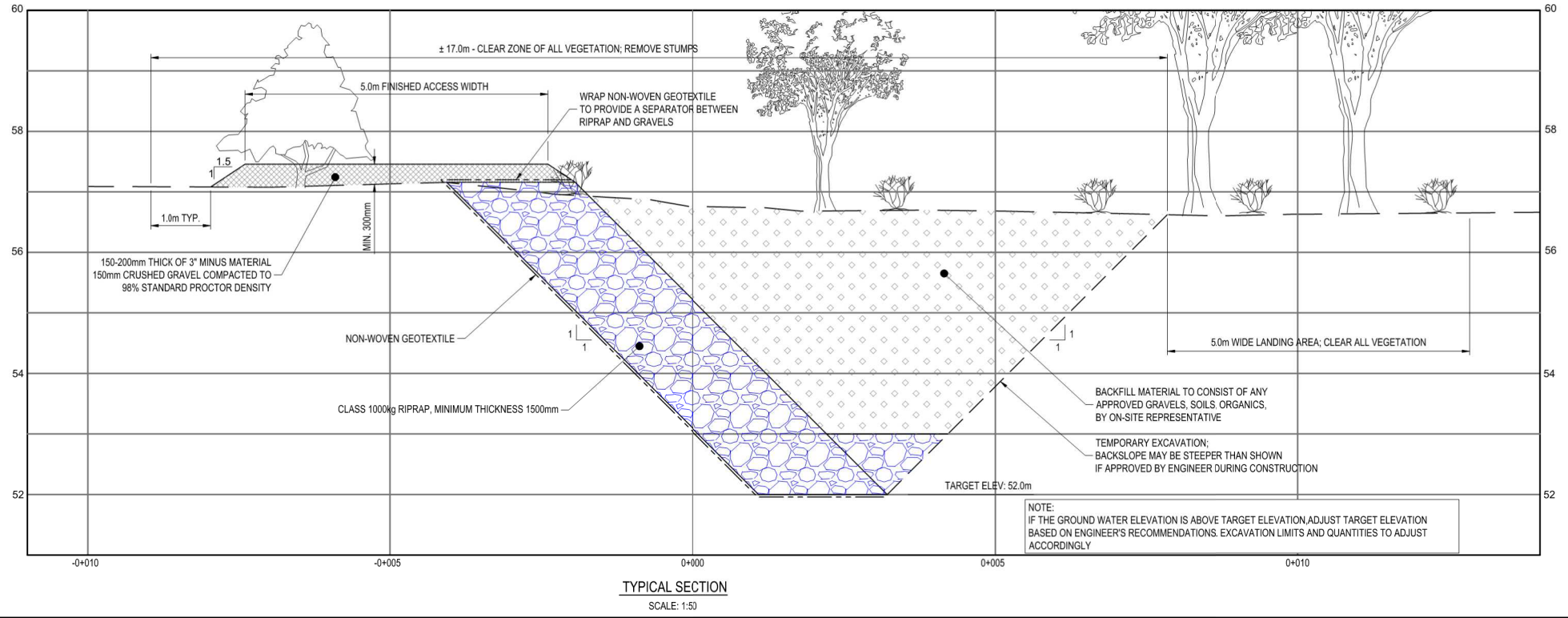
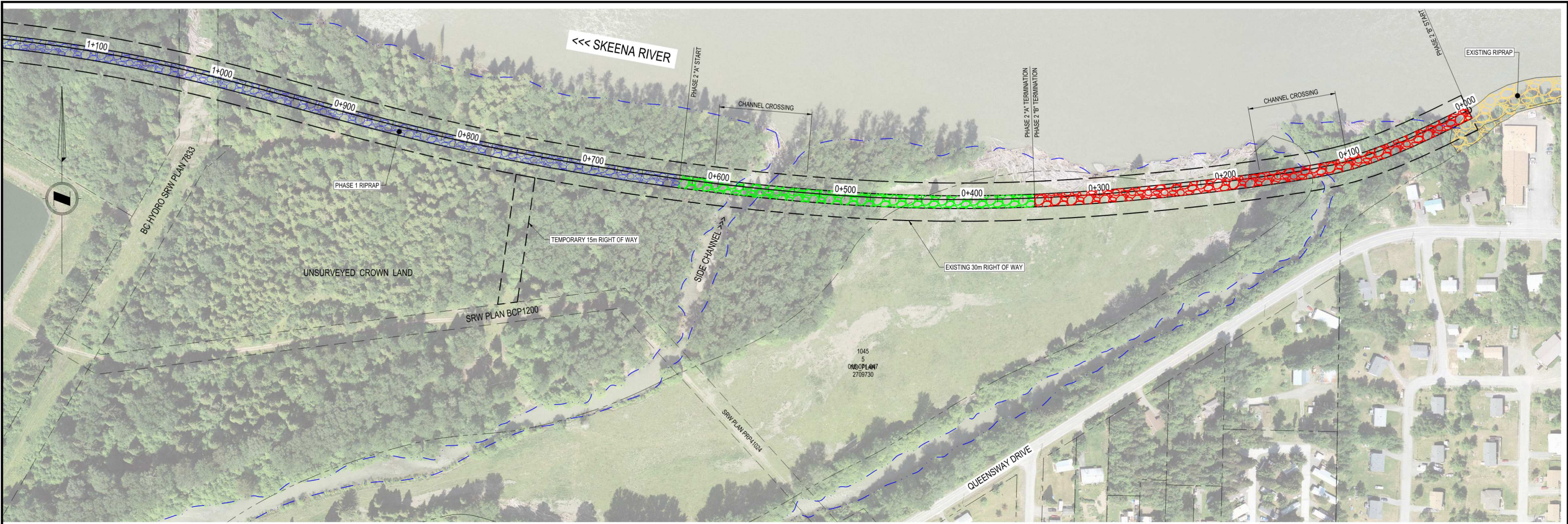
2020-09-17

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The preparation of this study was carried out with assistance from the Government of Canada and the Federation of Canadian Municipalities. Notwithstanding this support, views expressed are the personal views of the authors, and the Federation of Municipalities and the Government of Canada accept no responsibility for them.



McElhanney ANS D - 2017-01-17
 McElhanney Consulting Services Ltd. - Skeena Channel Management (0.0 Drawings) (0.3 Engineering) (0.3.1 Sheets) (0.15-04-C01 PLAN - .dwg)
 DATE: 2018-04-13, 13:31 FILE: C:\2227-01500-01515-00 Regional District\Task 2004 - Skeena Channel Management\0.0 Drawings\0.3.1 Sheets\01515-04-C01 PLAN - .dwg



LEGEND	
LEGAL LINES	---
EASEMENT LINE	- - - -
EDGE OF WATER (FROM MAPPING)	- . - . - .
EXISTING RIPRAP (COMPLETED 2009)	
PHASE 1 RIPRAP (COMPLETED 2018)	
PHASE 2 "A" RIPRAP	
PHASE 2 "B" RIPRAP	

DRAWING REDUCED TO HALF ORIGINAL SCALE

PA	Date	Description	Drawn	Design	App'd
PA	2018-04-13	ISSUED FOR APPROVALS	RJH	CJH	CJH

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ORIGINAL DWG SIZE: ANSI D (22" x 34")



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 Tel 250 635 7163

Approved Sealed
KITIMAT STIKINE REGIONAL DISTRICT
QUEENSWAY EROSION PROTECTION
PLAN
 Drawing No. **C-01**
 Project Number 2321-01515-00 T2004
 Rev. PA

QUESTIONS ALL PRINTS BEARING PREVIOUS REVISION

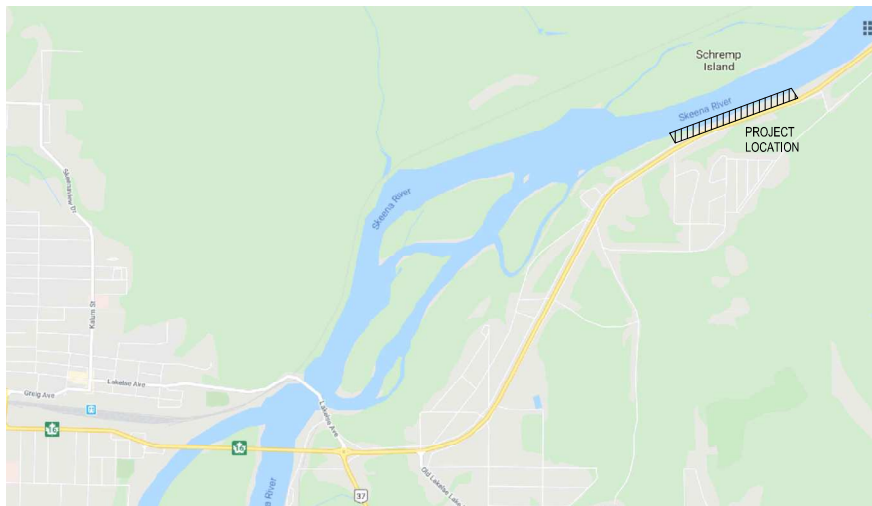
Construction Estimate

RDKS Lagoon Protection Phase 2



Task Description		Units	Quantity	Unit Price	Payable Amount
Construction					
1.1	Access Construction	l.m	200	\$ 170	\$ 34,000.00
1.2	Site Preperation	sq.m.	24500	\$ 6	\$ 147,000.00
1.3	Riprap Installation	cu.m.	10500	\$ 105	\$ 1,102,500.00
1.4	Crossing	l.m	60	\$ 1,200	\$ 72,000.00
Subtotal				Total Bid Price	\$ 1,355,500.00
Support Services					
1.1	Engineering	%	12	\$ 1,355,500.00	\$ 162,660.00
1.2	Construction Support	%	15	\$ 1,355,500.00	\$ 203,325.00
1.3	Project Administration	%	8	\$ 1,355,500.00	\$ 108,440.00
Subtotal				Total Revised	\$ 474,425.00
Project Subtotal					\$ 1,829,925
GST					\$ 91,496
Project Total					\$ 1,921,421

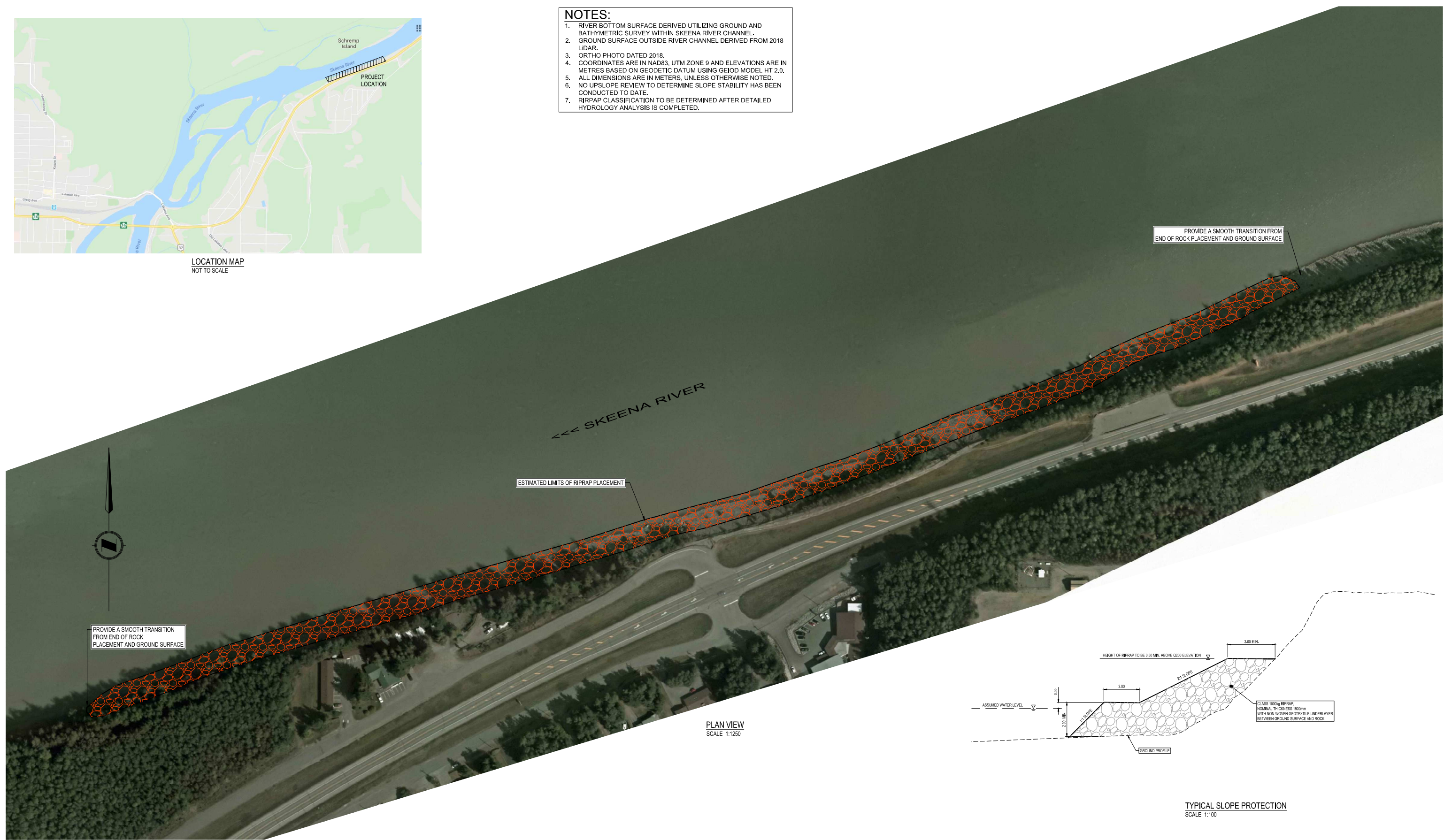
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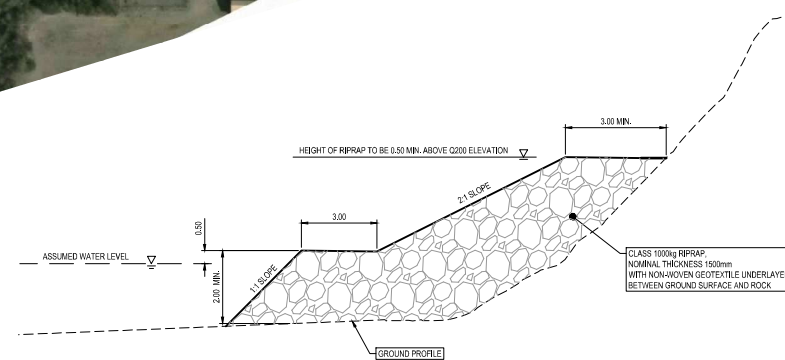
LOCATION MAP
NOT TO SCALE

NOTES:

1. RIVER BOTTOM SURFACE DERIVED UTILIZING GROUND AND BATHYMETRIC SURVEY WITHIN SKEENA RIVER CHANNEL.
2. GROUND SURFACE OUTSIDE RIVER CHANNEL DERIVED FROM 2018 LIDAR.
3. ORTHO PHOTO DATED 2018.
4. COORDINATES ARE IN NAD83, UTM ZONE 9 AND ELEVATIONS ARE IN METRES BASED ON GEODETIC DATUM USING GEIOD MODEL HT 2.0.
5. ALL DIMENSIONS ARE IN METERS, UNLESS OTHERWISE NOTED.
6. NO UPSLOPE REVIEW TO DETERMINE SLOPE STABILITY HAS BEEN CONDUCTED TO DATE.
7. RIRPAP CLASSIFICATION TO BE DETERMINED AFTER DETAILED HYDROLOGY ANALYSIS IS COMPLETED.



PLAN VIEW
SCALE 1:1250



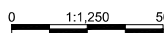
TYPICAL SLOPE PROTECTION
SCALE 1:100

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REGIONAL DISTRICT OF KITIMAT STIKINE
**THORNHILL SLOPE PROTECTION
CONCEPTUAL DESIGN
GENERAL ARRANGEMENT**

Drawing No.

C-102

Project Number
2321-01515-01

Rev.
PA

COPY ALL PRINTS BEARING PREVIOUS REVISIO

Construction Estimate

Thornhill Frontage Protection

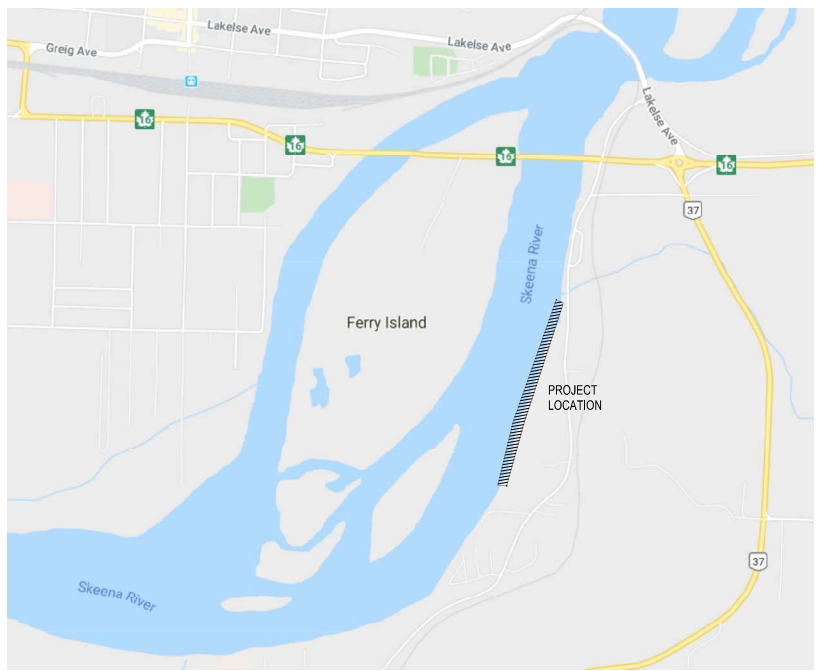


Task Description		Units	Quantity	Unit Price	Payable Amount
Construction					
1.1	Access Construction	l.m	100	\$ 250	\$ 25,000.00
1.2	Site Preperation	sq.m.	86683	\$ 6	\$ 520,098.00
1.3	Riprap Installation	cu.m.	37150	\$ 105	\$ 3,900,750.00
Subtotal				Total Bid Price	\$ 4,445,848.00
Support Services					
1.1	Engineering	%	6	\$ 4,445,848.00	\$ 266,750.88
1.2	Construction Support	%	15	\$ 4,445,848.00	\$ 666,877.20
1.3	Project Administration	%	4	\$ 4,445,848.00	\$ 177,833.92
Subtotal				Total Revised	\$ 1,111,462.00
Project Subtotal					\$ 5,557,310
GST					\$ 277,866
Project Total					\$ 5,835,176

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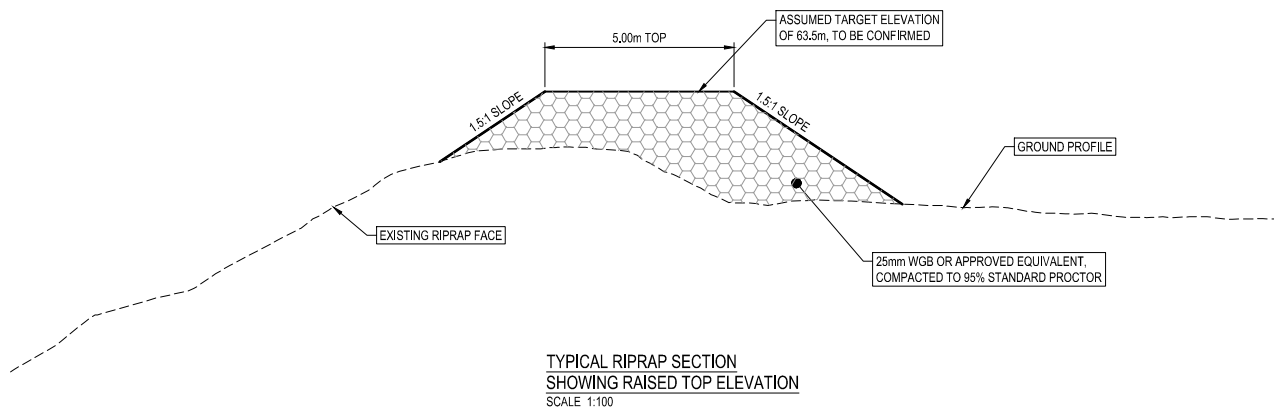


PLAN VIEW
SCALE 1:2500



LOCATION MAP
NOT TO SCALE

- NOTES:**
1. RIVER BOTTOM SURFACE DERIVED UTILIZING GROUND AND BATHYMETRIC SURVEY WITHIN SKEENA RIVER CHANNEL.
 2. GROUND SURFACE OUTSIDE RIVER CHANNEL DERIVED FROM 2018 LIDAR.
 3. ORTHO PHOTO DATED 2018.
 4. COORDINATES ARE IN NAD83, UTM ZONE 9 AND ELEVATIONS ARE IN METRES BASED ON GEODETIC DATUM USING GEIOD MODEL HT 2.0.
 5. CONTOUR INTERVAL: MAJOR 2.0m MINOR 1.0m
 6. ALL DIMENSIONS ARE IN METERS, UNLESS OTHERWISE NOTED.
 7. GRAVEL ELEVATION TO BE CONFIRMED AFTER DETAILED HYDROLOGY ANALYSIS IS COMPLETED.



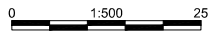
TYPICAL RIPRAP SECTION
SHOWING RAISED TOP ELEVATION
SCALE 1:100

Rev	Date	Description	Drawn	Design	App'd
PA	2020-09-16	ISSUED FOR REPORT	RJH	RJH	CJH

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REGIONAL DISTRICT OF KITIMAT STIKINE

QUEENSWAY DIKE IMPROVEMENTS
CONCEPTUAL DESIGN
GENERAL ARRANGEMENT

Drawing No. **C-103**

Project Number 2321-01515-01

Rev. PA

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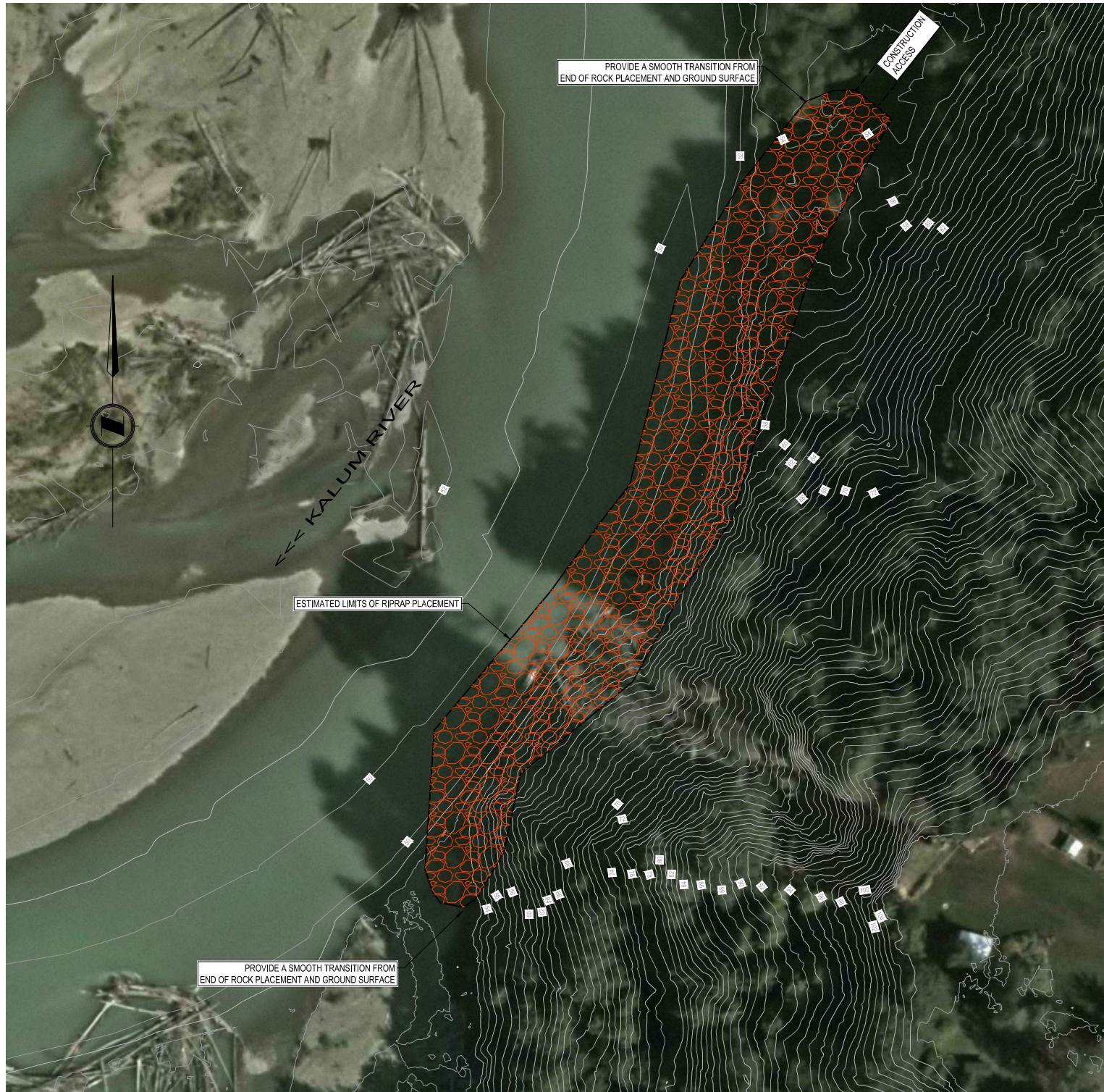
Construction Estimate

Queensway Dike Improvements

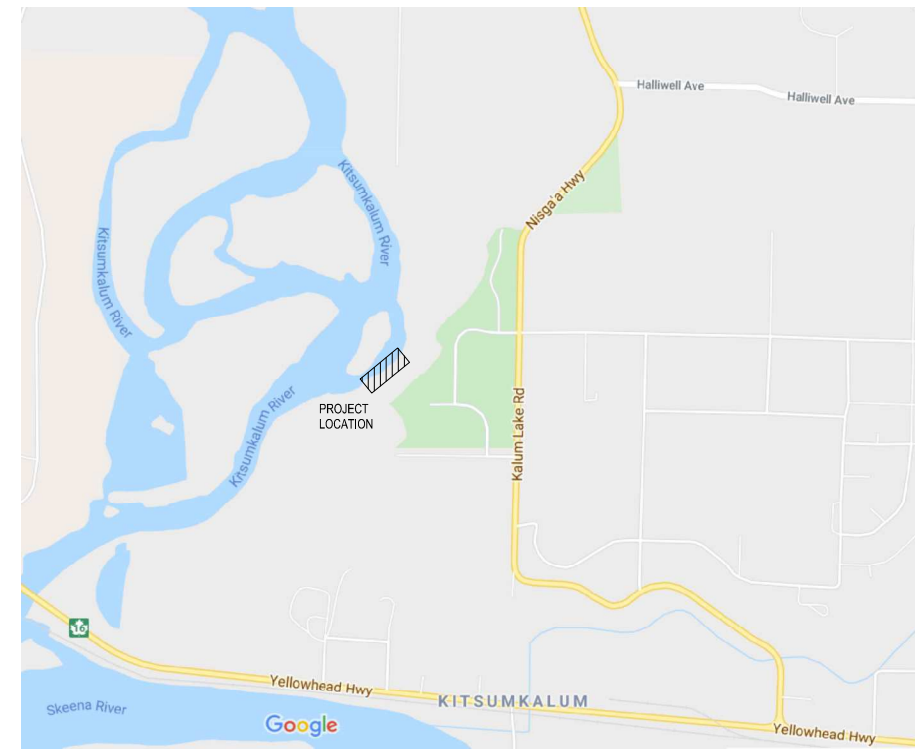


Task Description		Units	Quantity	Unit Price	Payable Amount
Construction					
1.1	Access Construction	l.m	50	\$ 150	\$ 7,500.00
1.2	Site Preperation	sq.m.	9600	\$ 10	\$ 96,000.00
1.3	Gravel Installation	cu.m.	210	\$ 550	\$ 115,500.00
1.4	Riprap Installation	cu.m.	60	\$ 1,200	\$ 72,000.00
Subtotal				Total Bid Price	\$ 291,000.00
Support Services					
1.1	Engineering	%	15	\$ 291,000.00	\$ 43,650.00
1.2	Construction Support	%	15	\$ 291,000.00	\$ 43,650.00
1.3	Project Administration	%	8	\$ 291,000.00	\$ 23,280.00
Subtotal				Total Revised	\$ 110,580.00
Project Subtotal					\$ 401,580
GST					\$ 20,079
Project Total					\$ 421,659

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 MCElhanney ANS/D - 2015-08-11
 MCElhanney ANS/D - 2015-08-11



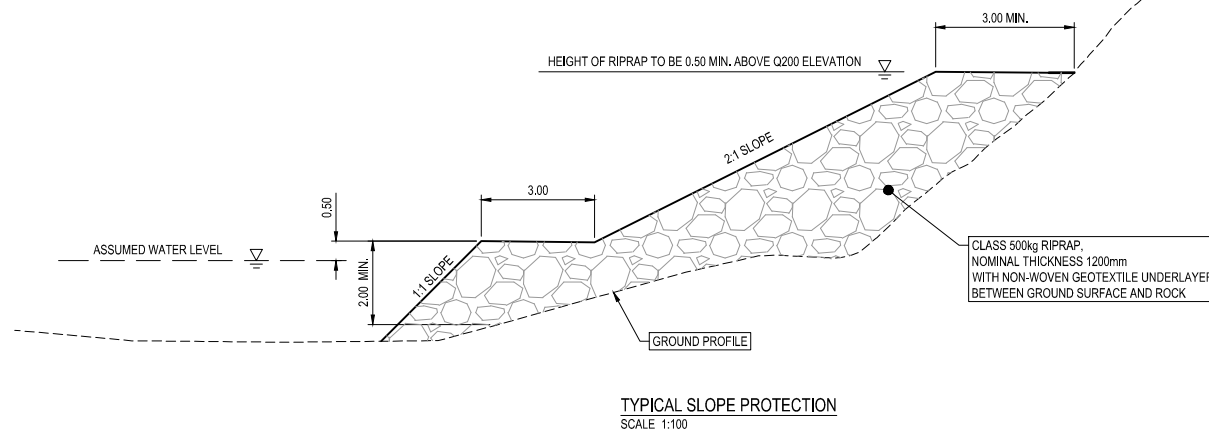
PLAN VIEW
SCALE 1:500



LOCATION MAP
NOT TO SCALE

NOTES:

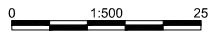
1. RIVER BOTTOM SURFACE DERIVED UTILIZING GROUND AND BATHYMETRIC SURVEY WITHIN KALUM RIVER CHANNEL.
2. GROUND SURFACE OUTSIDE RIVER CHANNEL DERIVED FROM 2018 LIDAR.
3. ORTHO PHOTO DATED 2018.
4. COORDINATES ARE IN NAD83, UTM ZONE 9 AND ELEVATIONS ARE IN METRES BASED ON GEODETIC DATUM USING GEOD MODEL HT 2.0.
5. CONTOUR INTERVAL: MAJOR 2.0m MINOR 1.0m
6. ALL DIMENSIONS ARE IN METERS, UNLESS OTHERWISE NOTED.
7. NO UPSLOPE REVIEW TO DETERMINE SLOPE STABILITY HAS BEEN CONDUCTED TO DATE.
8. RIPRAP CLASSIFICATION TO BE DETERMINED AFTER DETAILED HYDROLOGY ANALYSIS IS COMPLETED.



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REGIONAL DISTRICT OF KITIMAT STIKINE

**DUTCH VALLEY SLOPE PROTECTION
CONCEPTUAL DESIGN
GENERAL ARRANGEMENT**

Drawing No.	C-101
Project Number	2321-01515-01
Rev.	PA

COPY ALL PRINTS BEARING PREVIOUS REVIS

Construction Estimate

Dutch Valley Slope Protection



Task Description		Units	Quantity	Unit Price	Payable Amount
Construction					
1.1	Access Construction	l.m	425	\$ 250	\$ 106,250.00
1.2	Site Preperation	sq.m.	25182	\$ 6	\$ 151,092.00
1.3	Riprap Installation	cu.m.	10073	\$ 105	\$ 1,057,612.50
1.4	Crossing	LS	1	\$ 200,000	\$ 200,000.00
Subtotal				Total Bid Price	\$ 1,514,954.50
Support Services					
1.1	Engineering	%	12	\$ 1,514,954.50	\$ 181,794.54
1.2	Construction Support	%	15	\$ 1,514,954.50	\$ 227,243.18
1.3	Project Administration	%	8	\$ 1,514,954.50	\$ 121,196.36
Subtotal				Total Revised	\$ 530,234.08
Project Subtotal					\$ 2,045,189
GST					\$ 102,259
Project Total					\$ 2,147,448