SUPPLEMENTAL INFORMATION REPORT

Coral Harbour Airport Community Road Washout Rehabilitaion Project, NU

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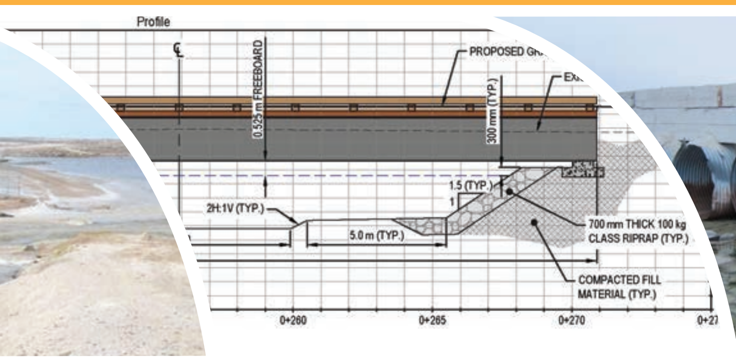
DECEMBER 10, 2015



Prepared by:
TETRA TECH EBA

On behalf of:
Nunavut

FILE NO.: 704-V13203282-01.001

NON-TECHNICAL SUMMARY

The Nunavut Department of Community and Government Services (CGS), has retained an Engineering firm (Tetra Tech EBA Inc.) to provide design and construction administration services for the Coral Harbour Airport Community Road Washout Rehabilitation Project located at Coral Harbour, Nunavut. Upgrades are needed to the watershed road drainage crossing structures, allowing the road to pass a 100-year storm event. Generally, this includes replacement of the 8 – culvert stream crossing with a new bridge, rehabilitation of the abutments of the existing bridge, and replacement of culverts near the community fuel tank farm.

The Airport Road has washed out four times in the past nine years during spring freshet. The last occurrence was in the spring of June 2012, when snowmelt and heavy rain caused the road to washout in two places northwest of the fuel storage facility tank farm. The community was without access to the airport for approximately one week and the flooding also damaged the fuel tank farm's resupply pipeline. The airport and fuel tank farm are the community's lifelines; medevac services, food deliveries, and other basic provisions rely on the airport and heating and power rely on fuel. The residents' health and safety will be at risk if the community becomes isolated from these facilities.

The proposed plan includes:

- Replacement of the existing eight culverts at Crossing #4 with the bridge currently in place at Crossing #7. The bridge will be founded on new bin-wall abutments;
- Construction of a new, 30 m long bridge at Crossing #7, founded on a pre-cast concrete sill and protected by an earth-filled abutment protected by rip-rap;
- Removal of the twin 1.2 m diameter culverts at Crossing #5 and the 1.2 m diameter culvert at Crossing #6, followed by re-installation of these three culvert at Crossings #9 and #9a to improve the hydraulic capacity of the East Basin;
- Removal of the existing culvert crossing at Crossing #10 to protect the existing fuel line to the Hamlet and forcing the flow in the East Basin through Crossings #9 and #9a; and
- Construction of temporary access roads around all crossings involved in the upgrades during construction to maintain 24-hour access between the Hamlet and airport.

The present plan anticipates a 4-6 week construction schedule to be initiated soon after the arrival of the shipment of bridge components, which are tentatively expected to be delivered in late July/August, 2016. Although construction could be extended into the fall, Tetra Tech is still recommending to complete the works before the end of September, while temperatures are above freezing.

This Supplementary Information Report provides additional information on the Project, including available environmental baseline information and an assessment of the potential environmental effects and proposed mitigation measures that will be used to minimize potential effects.

TABLE OF CONTENTS

LIST OF TABLES IN TEXT

LIST OF PHOTOS IN TEXT

LIST OF FIGURES IN TEXT

APPENDIX SECTIONS

APPENDICES

LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Nunavut Department of Community and Government Services and their agents. Tetra Tech EBA Inc. (Tetra Tech EBA) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Nunavut Department of Community and Government Services, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech EBA's Services Agreement. Tetra Tech EBA's General Conditions are provided in Appendix A of this report.

1.0 INTRODUCTION

The Nunavut Department of Community and Government Services (CGS), has retained an Engineering firm (Tetra Tech EBA Inc. [Tetra Tech]) to provide design and construction administration services for the Coral Harbour Airport Community Road Washout Rehabilitation Project, at Coral Harbour, Nunavut. Upgrades are needed to the watershed road drainage crossing structures, allowing the road to pass a 100-year storm event. Generally, this includes replacement of the eight – culvert stream crossing with the bridge structure currently installed 180 m to the east, construction of a new larger bridge at the current bridge crossing location, and replacement of culverts near the community fuel tank farm.

The Airport Road has washed out four times in the past nine years during spring freshet. During the week of June 30, 2012 the Mayor of the Hamlet of Coral Harbour reported to CGS that the water level in the lakes around the Airport Road at the entrance to the Hamlet was rising at an alarming rate. This was due to a fast spring melt and moderate rain for over two weeks which caused the road to washout in two places northwest of the fuel storage facility tank farm. The community was without access to the airport for approximately one week and the flooding also damaged the fuel tank farm's resupply pipeline. The airport and fuel tank farm are the community's lifelines; medevac services, food deliveries and other basic provisions rely on the airport and heating and power rely on fuel. The residents' health and safety will be at risk if the community becomes isolated from these facilities.

The CGS has continued to engage with the community on a regular basis since that time and with the assistance of Tetra Tech has developed the following plan for the rehabilitation of a number of the stream/drainage crossings along the Coral Harbour Airport community road.

The proposed plan includes:

- Replacement of the existing eight culverts at Crossing #4 with the bridge currently in place at Crossing #7. The bridge will be founded on new bin-wall abutments;
- Construction of a new, 30 m long bridge at Crossing #7, founded on a pre-cast concrete sill and protected by an earth-filled abutment protected by rip-rap;
- Removal of the twin 1.2 m diameter culverts at Crossing #5 and the 1.2 m diameter culvert at Crossing #6, followed by re-installation of these three culvert at Crossings #9 and #9a to improve the hydraulic capacity of the East Basin;
- Removal of the existing culvert crossing at Crossing #10 to protect the existing fuel line to the Hamlet and forcing the flow in the East Basin through Crossings #9 and #9a; and
- Construction of temporary access roads around all crossings involved in the upgrades during construction to maintain 24-hour access between the Hamlet and airport.

The present plan anticipates a 4-6 week construction schedule to be initiated soon after the arrival of the shipment of bridge components, which are tentatively expected to be delivered in late July/August, 2016. Although construction could be extended into the fall, Tetra Tech is still recommending to complete the works before the end of September, while temperatures are above freezing.

As the project progresses there will be additional meetings to present the construction schedule and the involvement of the people living in the Hamlet.

This Supplementary Information Report provides additional information on the Project, including available environmental baseline information and an assessment of the potential environmental effects and proposed mitigation measures that will be used to minimize potential effects.

2.0 PROPONENT INFORMATION

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Email: ASharma@gov.nu.ca

3.0 PROJECT DESCRIPTION

3.1 Project Location

The Project involves the rehabilitation/replacement of a number of stream/drainage crossings along the Coral Harbour Airport community road extending from:

- Latitude: 64° 07' 51 59" N; Longitude: 83° 11' 17 08" W to,
- Latitude: 64° 08' 00 98" N; Longitude: 83° 10' 07 54" W

Figure 3-1 shows the locations of the proposed stream/drainage crossings that will be rehabilitated or replaced. It should be noted that all of these proposed undertakings and indeed the entire road is located within the Municipal Boundaries of Coral Harbour as shown in Figure 3-2.

3.2 Project Description

3.2.1 Background of the Problem

The following text, which describes the problem that the community of Coral Harbour was facing in June/July, 2012, was taken directly from a report prepared by CGS (2012) on the Airport Road washout that occurred in 2012.

During the week of June 30, 2012 the Mayor of the Hamlet of Coral Harbour reported to GCS that the water level in the lakes around the Airport Road at the entrance to the Hamlet was rising at an alarming rate. This was due to a fast spring melt and moderate rain for over two weeks.

The Hamlet mobilized equipment belonging to airports and local dump trucks. The Hamlet proceeded to place fill along the Airport Road to help prevent it from washing out.

The water overflowed in to the wetlands area and flowed down stream to the lowest elevation which is near the Fuel Storage Facility. Two 1,000 mm diameter CMP culverts are located across the Airport Road in this area. These culverts could not handle the excessive water run-off and the existing road washed out in two areas on both sides of the existing Fuel Storage Facility tank farm. The washout also caused damage to the Fuel Storage Facility's re-supply Pipeline.

The Hamlet mobilized equipment and installed culverts and gravel fill to repair the areas that washed out. The road to the Airport was closed for about a week while repairs were done.

According to the Mayor this has happened four times in the last six or seven years.

The following are some photos of the damage and the amount of water in the area. The Hamlet has completed temporary repairs and the road to the airport is open. Water levels have receded to normal seasonal levels.

Photo 1: June 2012 washout

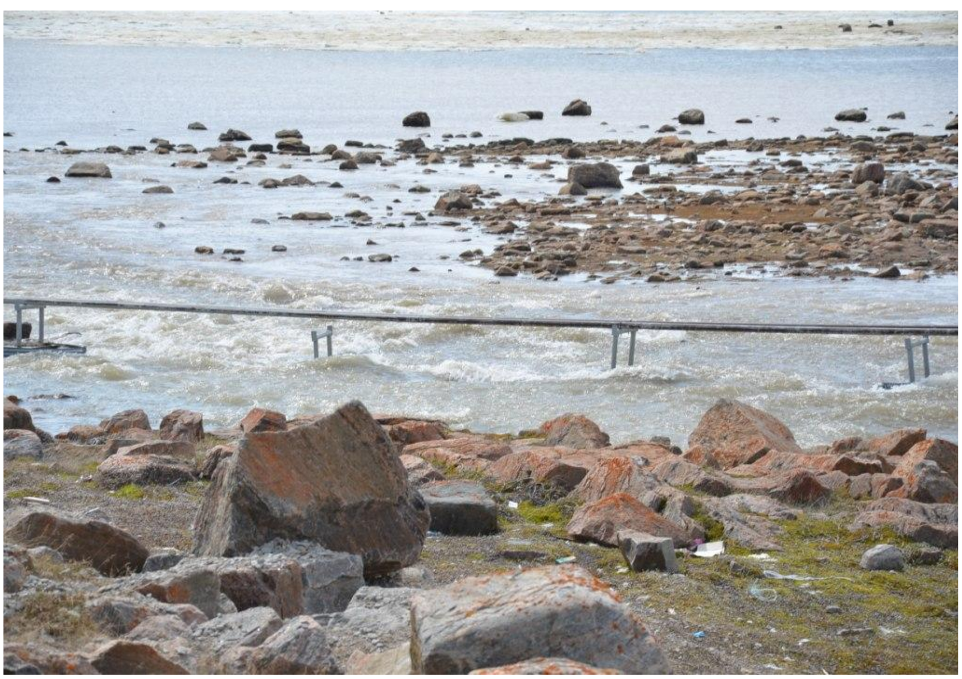
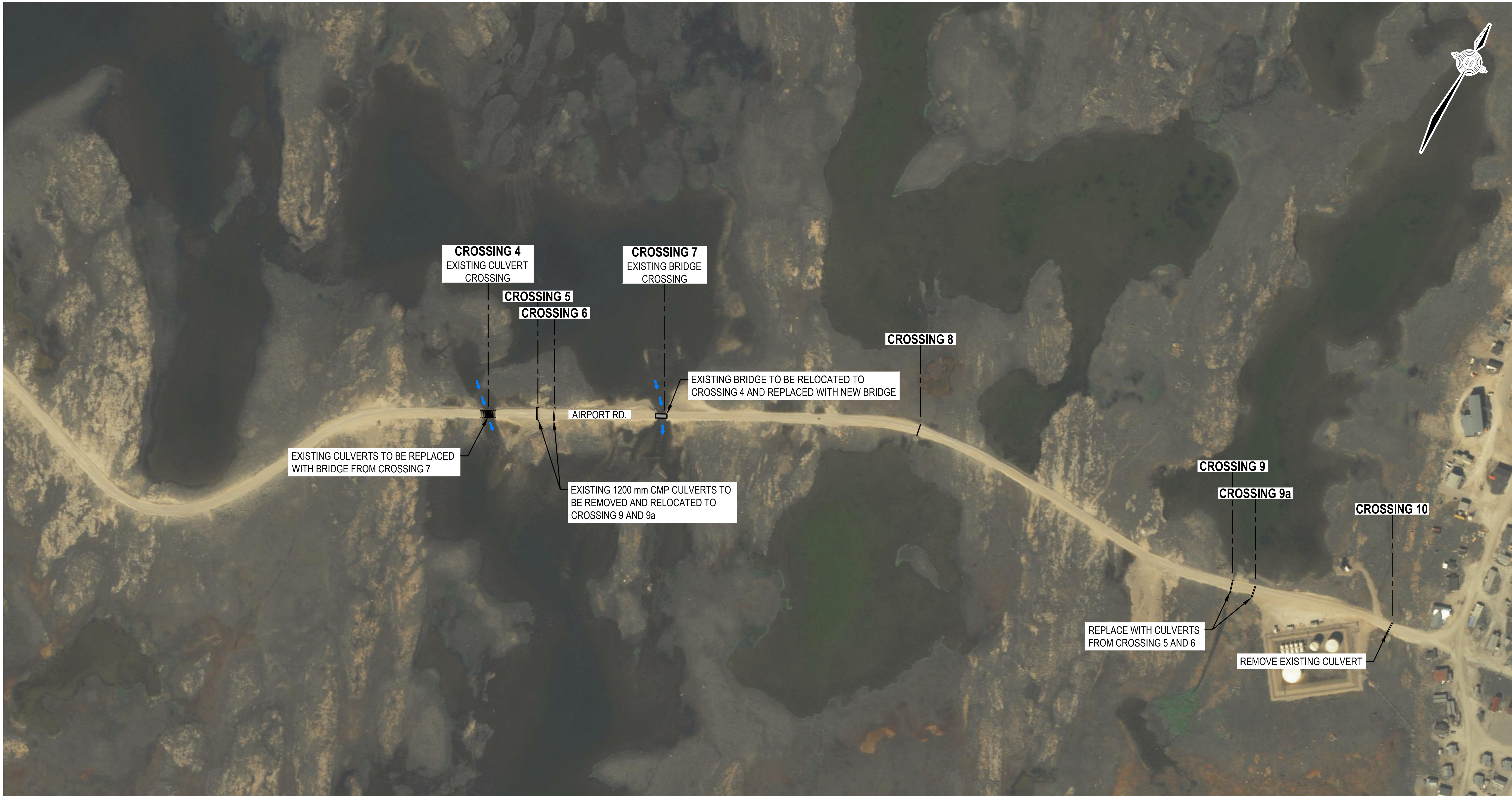


Photo 2: June 2012 impact of washout on Community Fuel Line

Photo 3: Fill placement along the Airport Road to help prevent it from washing out

Photo 4: Fill placement along the Airport Road to help prevent it from washing out



SITE PLAN
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NOTES

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40 0 40 100 160m

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Nunavut

TETRA TECH EBA BUCKLAND & TAYLOR COWI

AIRPORT RD. WASHOUT REHABILITATION CORAL HARBOUR, NU

CORAL HARBOUR AIRPORT COMMUNITY ROAD STREAM/DRAINAGE CROSSING REHABILITATION PROGRAM SITES

PROJECT NO.	OFFICE	DES	CKD	REV	DRAWING
V13203282	VANC	RH	RH	0	Figure 3-1
DATE	SHEET No.	DWN	APP	STATUS	
December 1, 2015	of	JDM	DNM	-	

Q:\Vancouver\Drafting\Engineering\V132\V13203282\V13203282 - Coral Harbour Airport Rd Conceptual Design_R0.dwg [FIGURE 3-1] December 10, 2015 - 10:50:46 am (BY: MANG, JUSTIN)

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CORAL HARBOUR, NU

CORAL HARBOUR MUNICIPAL BOUNDARY MAP

PROJECT NO.	OFFICE	DES	CKD	REV
V13203282	VANC	RH	RH	0
DATE	SHEET No.	DWN	APP	STATUS
December 1, 2015	of	JDM	DNM	-

DRAWING
Figure 3-2

Q:\Vancouver\Drafting\Engineering\V132\V13203282\V13203282 - Coral Harbour Site Plan_R0.dwg [FIGURE 3-2] December 10, 2015 - 10:54:10 am (BY: MANG, JUSTIN)

3.2.2 Feasibility Review of Stream Crossing Alternatives

In 2014, a feasibility review of potential solutions designed to address the washouts caused by the Post River along Airport Road in Coral Harbour, NU was completed. This feasibility review was completed to highlight the possible design alternatives and materials to consider, and develop a cost estimate allowing the CGS to secure the required funding.

Throughout the feasibility review, a number of alternatives were evaluated. These included an array of culvert and bridge options, all of which would resolve the recurring washout issues. A number of weighted criteria were used to evaluate all alternatives, criteria included: constructability, material and construction cost, construction duration, service life, lifecycle costs, and environmental impacts. Minor consideration was given towards aesthetics, but presented to allow the community of Coral Harbour to provide input into the selection process.

Through the evaluation process, all culvert options were deemed to be unfavorable solutions for this particular project. This is largely due to number of culvert barrels which are needed to match the capacity of a single bridge. Ultimately, the addition of a single bridge to the system, supplementing the existing bridge, was deemed to be the most favorable solution. Various bridge abutment designs were evaluated, with bin-wall, lock-block, and rip-rap protected sloped abutments being deemed the most favourable for the project.

3.2.3 Proposed Plan

Based on the work completed to date, we have identified a proposed plan that satisfies the identified design constraints. The proposed plan includes:

- Replacement of the existing eight culverts at Crossing #4 with the bridge currently in place at Crossing #7. The bridge will be founded on new bin-wall abutments;
- Construction of a new, 30 m long bridge at Crossing #7, founded on a pre-cast concrete sill and protected by an earth-filled abutment protected by rip-rap;
- Removal of the twin 1.2 m diameter culverts at Crossing #5 and the 1.2 m diameter culvert at Crossing #6, followed by re-installation of these three culvert at Crossings #9 and #9a to improve the hydraulic capacity of the East Basin;
- Removal of the existing culvert crossing at Crossing #10 to protect the existing fuel line to the Hamlet and forcing the flow in the East Basin through Crossings #9 and #9a; and
- Construction of temporary access roads around all crossings involved in the upgrades during construction to maintain 24-hour access between the Hamlet and airport.

This proposed plan will result in two bridge crossings (one new and one re-used) within the Central Basin at Crossings #4 and #7, as previously shown in Figure 3-1. The main crossing (Crossing #7) will convey the Post River flow on a year-round basis. Crossing #4 will serve as an auxiliary crossing, providing conveyance during spring freshet. Preliminary design drawings of the bridges to be installed at Crossings #4 and #7 are presented in Figures 3-3 and 3-4, respectively.

Under design flow conditions, we estimate that Crossing #7 would convey 69 m^3/s while Crossing #4 would convey the remaining 25 m^3/s. The corresponding upstream water level during this event would be approximately 6.8 masl, reducing the risk of the Post River spilling into the East Basin.

The increase in hydraulic capacity at Crossings #9 and #9a will further reduce the risk of East Basin becoming inundated during freshet or heavy rainfall and the removal of the culvert at Crossing #10 will protect the existing fuel pipeline to the Hamlet.

Bin-wall abutments have been favoured at Crossing #4 as the near vertical configuration helps maximize the hydraulic capacity underneath the shorter bridge structure. Some corrosion is expected as the bin-walls will be in direct contact with water; however, corrosion will be minimal due to the seasonal nature of this auxiliary crossing and the availability of alternate options including aluminum coated steel panels and panels made out of a thicker gage. We have recommended sloped rip-rap abutments at Crossing #7. Sloped abutments were favoured over bin-wall type abutments due to a lower initial installation cost, easier replacement process, and high risk of bin-wall corrosion in this perennial watercourse.

As detailed in this section, Tetra Tech has shifted the main crossing upgrades to Crossing #7 for three reasons. The first is based on the absence of bedrock at a shallow depth at Crossing #4. The second is based on the fact that the Post River never dries up, forcing the contractor to temporarily divert water regardless of the proposed solution. Finally, the proposed improvements were shifted to Crossing #7 in recognition of the fact that the main stem of the river is located at Crossing #7 and the river will continue to naturally favour that route over Crossing #4.

As part of the stream/drainage crossing rehabilitation/replacement program, a range of borrow material will be needed for retrofitting (raising) sections of Airport Road, constructing temporary by-pass roadways, and constructing the bridge abutments. A total of nine existing borrow pits were identified in the project location, including sources of sand, gravel and rip-rap. Each of these aggregate sources are shown in Figure 3-5. Table 3-1 summarizes the type of material observed at each sources and provides field comments made by a geotechnical engineer.

Table 3-1: Gravel Source Locations

Source #	Material Description	Field Comments
1	GRAVEL -Trace sand, trace silt	Closest source to Hamlet. Platey/obtate/shale like gravel.
2	GRAVEL – Some sand, trace silt	Typically used for local roads
3	GRAVEL – Some sand, trace silt	Large stockpile.
4	SAND AND GRAVEL, Trace Silt	Large stockpile. Typically used for local roads
5	SAND – some gravel to gravelly, some sand, trace silt	Very large stockpile. Similar material to Source #4 but larger gravel.
6	SAND and GRAVEL – some silt	Frozen. Smallest stockpile
7	Gravel	Clean gravel from riverbed. Well sorted/poorly graded.
8	Rip-Rap	Granite and Gneissic up to 1.0 m diameter. Medium sized source.
9	Sand – trace gravel	Very clean. Typically used for concrete.

Quantities required to be withdrawn from the borrow sources as part of the construction have been estimated to be 3,350 m^3 of granular roadway material and 600 m^3 of rip rap material.

The project will be completed with a phased approach such that disruptions to drainage and traffic on Airport Road are minimized throughout the construction. A description of the tasks related to improvements at the main crossings (#'s 4, 7, 9 and 10) to be completed during each phase is as follows:

3.2.3.1 Phase 1: Construction of Temporary Bypass Road around Crossing #7

A temporary road, approximately 120 m in length, will be constructed north (upstream) of Crossing #7 to allow for the continual flow of traffic throughout construction. This roadway will be constructed of crushed granular material placed onto filter fabric. No culverts or other openings will permit the passage of water through this temporary roadway during construction; instead, all water in the Post River will cross Airport Road via Crossing #4. Expected equipment to be utilized during this phase includes one excavator at the borrow pit, three dump/rock trucks, and one loader at Crossing #7 distributing the material.

3.2.3.2 Phase 2: Removal of Existing Bridge and Construction of New Bridge at Crossing #7

This phase involves the removal of the existing 13.6 metre long bridge at Crossing #7, and the installation of a new 30 metre long bridge. The superstructure of the old bridge will be removed with a single excavator and set aside. The existing gabion basket abutments and concrete wing walls will be removed with an excavator and disposed of. Excavation of the existing roadway material will then occur at both abutments to widen the channel crossings. Two new abutments will be constructed consisting of a simple concrete slab sill and sloped-earth abutments protected by riprap. A temporary earth berm will be constructed within the crossing parallel to water flow to support the bridge superstructure as it is assembled. Once assembled, this temporary berm will be removed leaving the bridge free-standing in its final position.

3.2.3.3 Phase 3: Relocation of Temporary Bypass Road Material from Crossing #7 to Crossing #4

The material used for the construction of the temporary road around Crossing #7 in Phase 1, will be relocated north (upstream) of Crossing #4 to allow for continual flow of traffic throughout construction. This roadway will be constructed of crushed granular material placed onto filter fabric. No culverts or other openings will permit the passage of water through this temporary roadway during construction; instead, all water in the Post River will cross Airport Road via the new bridge at Crossing #7. Expected equipment to be utilized during this phase includes one excavator at Crossing #7, two/three dump/rock trucks, and one loader at Crossing #4 distributing the material.

3.2.3.4 Phase 4: Culvert Removal and Bridge Reinstallation

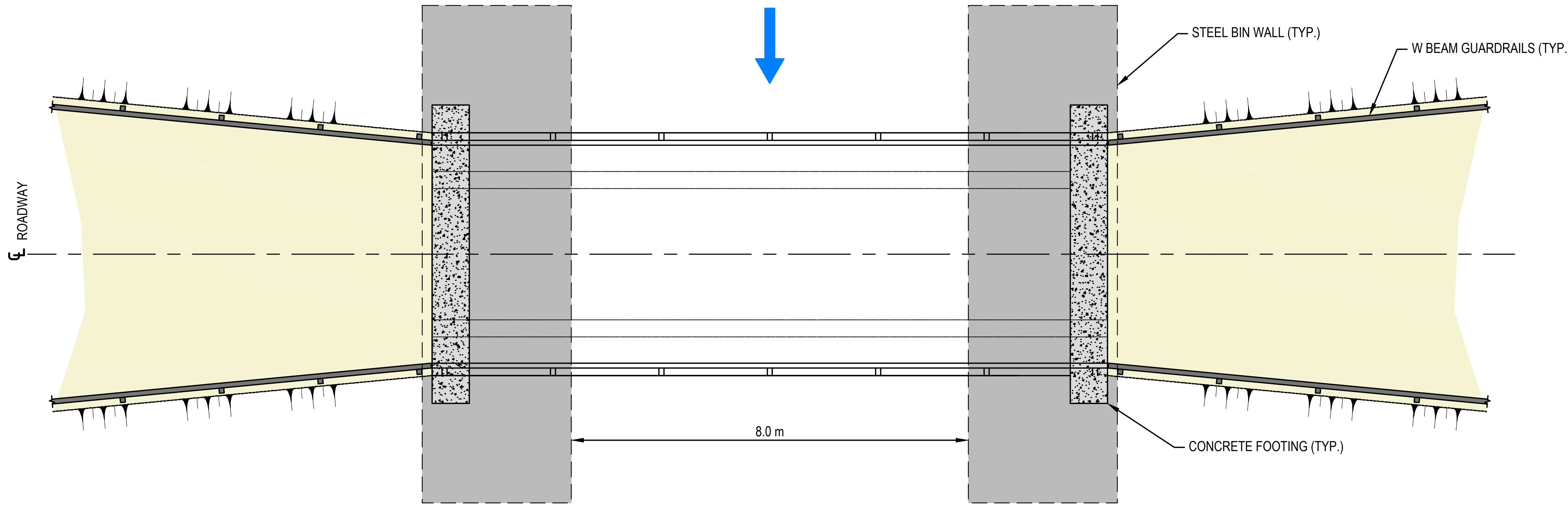
The eight existing 1.2 m diameter corrugated metal culverts at Crossing #4 will be removed from under Airport Road. Two binwall abutments will be constructed, complete with concrete sills, approximately nine metres apart. An excavator will be used to install the bridge recently removed from Crossing #7. A small amount of riprap will be placed at both abutments, both upstream and downstream of the bridge, to complete the installations.

3.2.3.5 Phase 5: Other Culvert Installations/Removals

Minor work will be completed with an excavator for two small drainage courses (Crossings # 9 and #10) immediately west of the Hamlet. The work completed will involve excavating to remove existing culverts at Crossings 9 and 9a that are in poor condition, and replacing them with larger culverts in better condition. The single culvert at Crossing 10 will be completely removed as its outflow goes directly underneath an elevated gas pipeline. Existing flow through this culvert will be diverted to flow through Crossing #9.

3.2.4 Project Schedule

The present plan anticipates a 4-6 week construction schedule to be initiated soon after the arrival of the shipment of bridge components, which are tentatively expected to be delivered in late July/August, 2016. Although construction could be extended into the fall, Tetra Tech is still recommending to complete the works before the end of September, while temperatures are above freezing.



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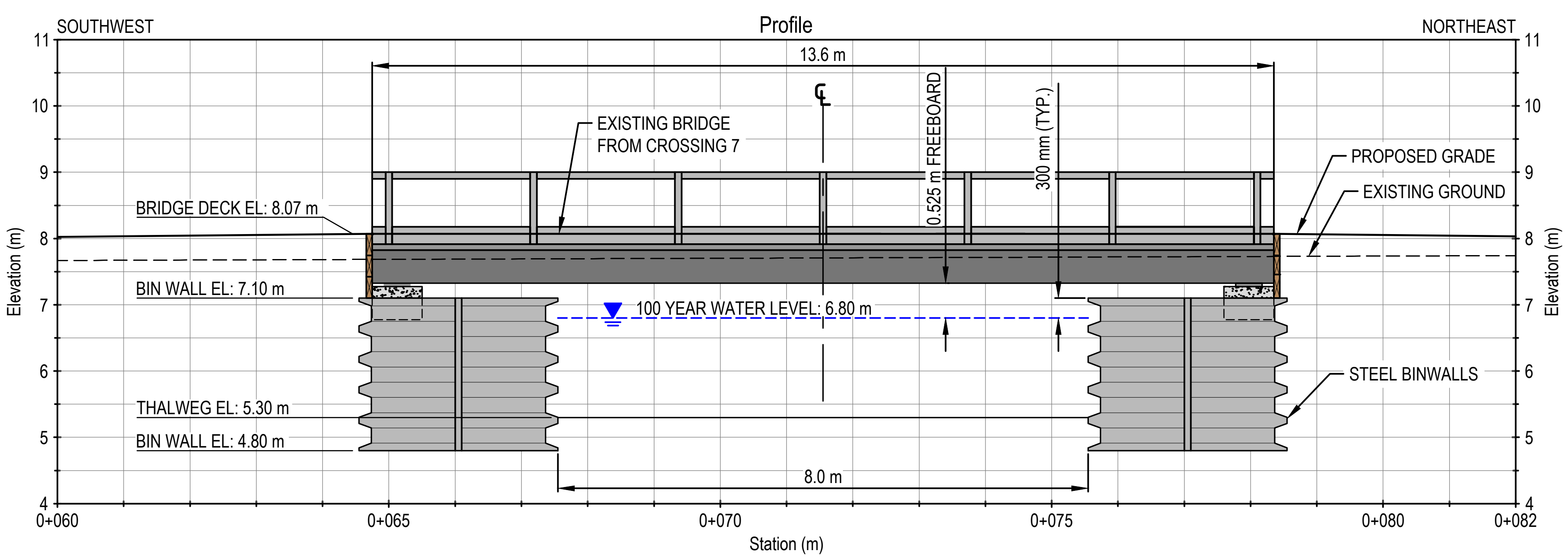

ELEVATION
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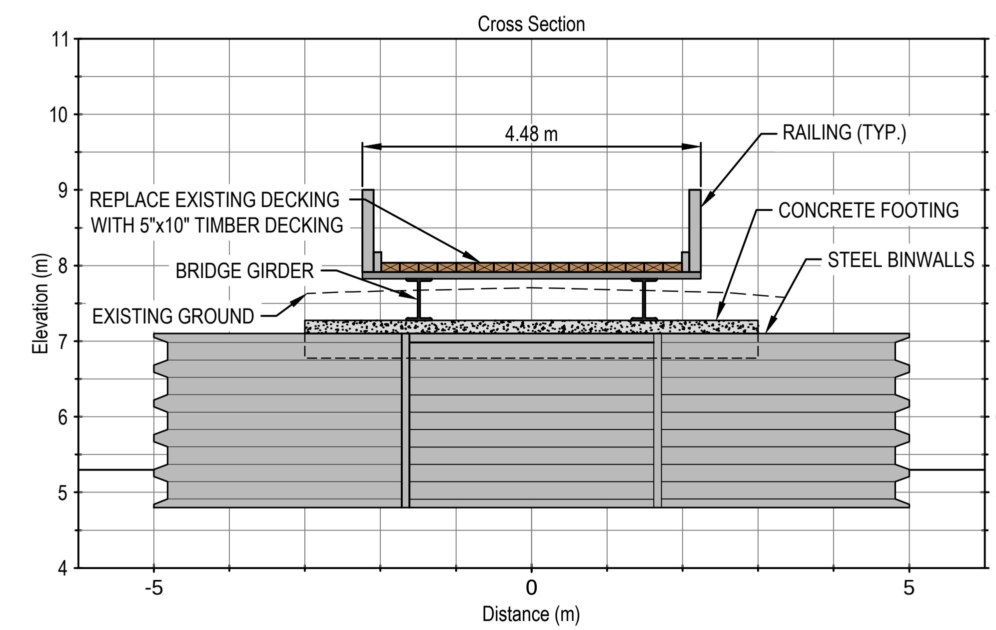

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NOTES

1. These drawings represent a conceptual design. Actual dimensions, elevations and materials may vary.

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AIRPORT RD. WASHOUT REHABILITATION
CORAL HARBOUR, NU

CROSSING 4
BRIDGE DESIGN (RE-PURPOSED BRIDGE)

PROJECT NO.	OFFICE	DES	CKD	REV	DRAWING
V13203282	VANC	MAN	DNM	0	Figure 3-3
DATE	SHEET No.	DWN	APP	STATUS	
December 1, 2015	of	JDM	DNM	-	

SCALE AS SHOWN

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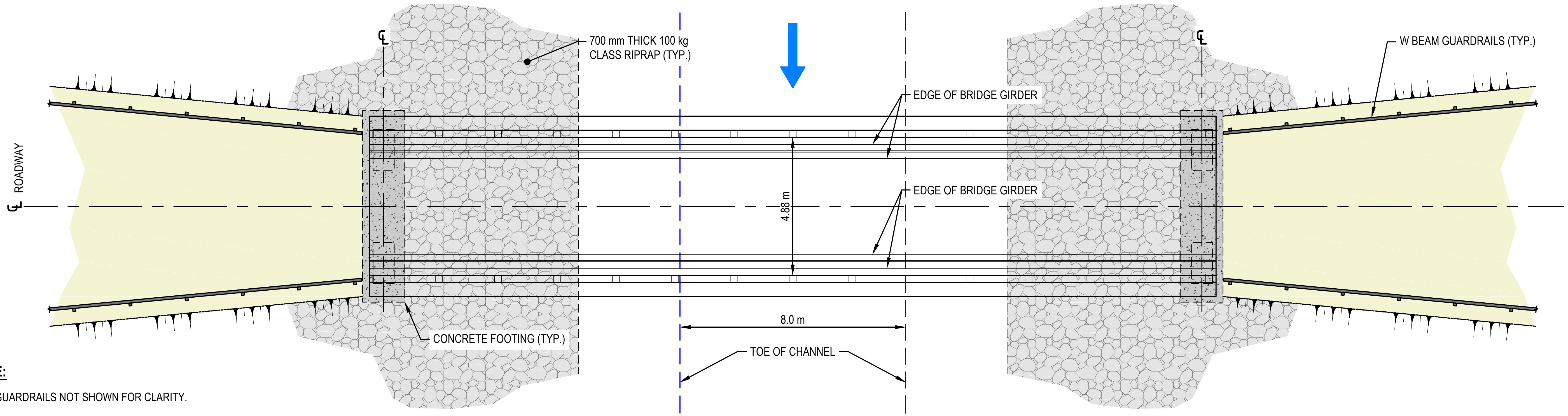
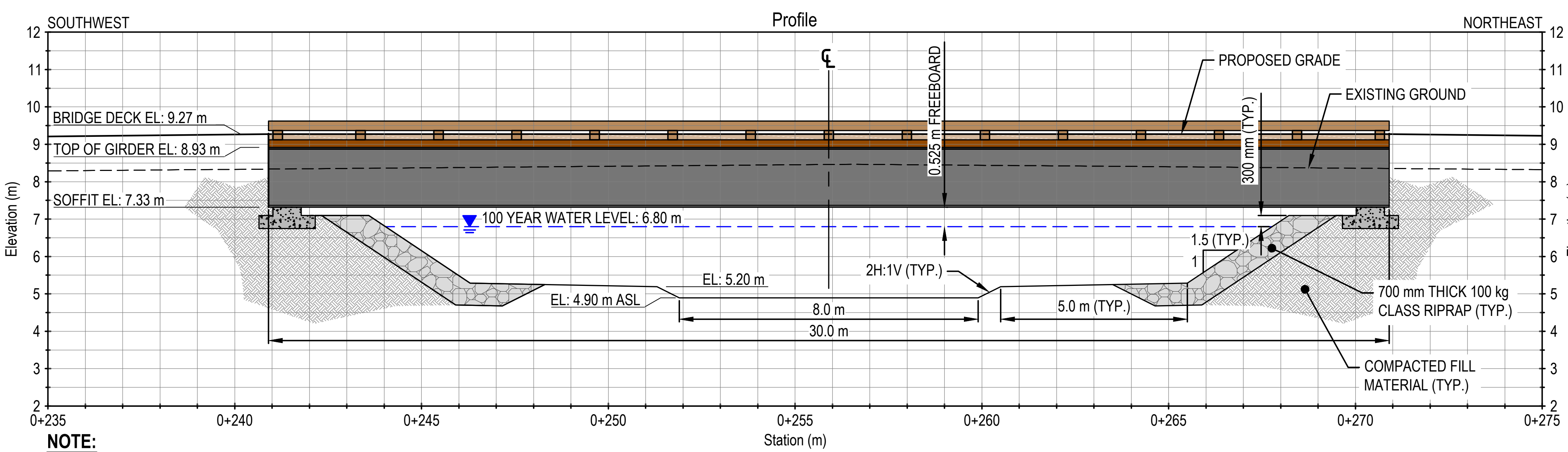


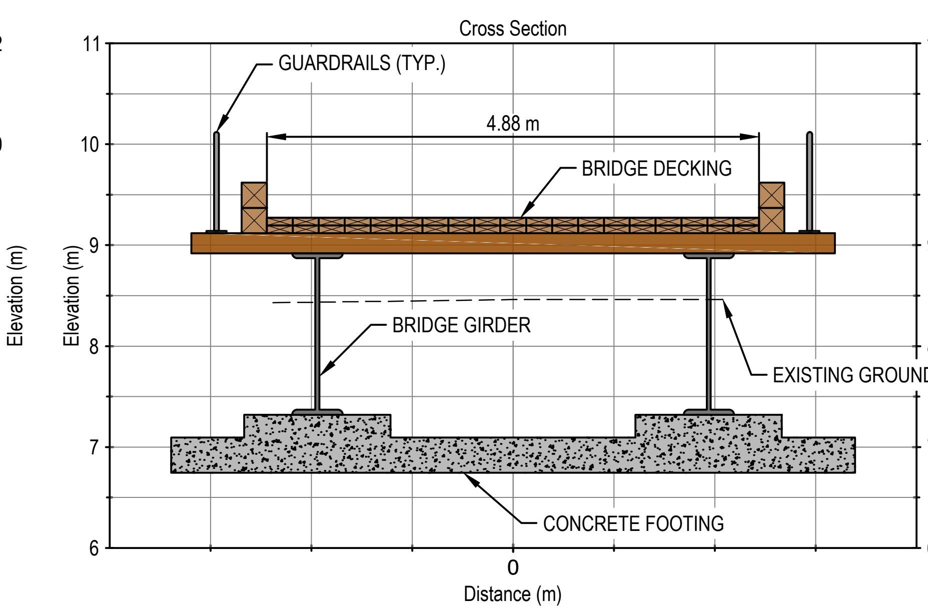
NOTE:

1. GUARDRAILS NOT SHOWN FOR CLARITY.

PLAN

SCALE: 1:150





NOTE:

1. GUARDRAILS NOT SHOWN FOR CLARITY.

ELEVATION

SCALE: 1:150

SECTION

SCALE: 1:75

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CORAL HARBOUR, NU

CROSSING 7
BRIDGE DESIGN (NEW BRIDGE)

PROJECT NO.	OFFICE	DES	CKD	REV	DRAWING
V13203282	VANC	MAN	DNM	0	Figure 3-4
DATE	SHEET No.	DWN	APP	STATUS	
December 1, 2015	of	JDM	DNM	-	

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SITE PLAN
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SAMPLE TAKEN:

- YES
- NO

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0.5 0 0.5 1.0 2.0km

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GRAVEL SOURCE AND SAMPLE LOCATIONS
SITE PLAN

PROJECT NO.	OFFICE	DES	CKD	REV	DRAWING
V13203282	VANC	MAN	DNM	0	Figure 3-5
DATE	SHEET No.	DWN	APP	STATUS	
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4.0 DESCRIPTION OF EXISTING ENVIRONMENT

The existing environment of the Coral Harbour area has been previously described in a number of historical and more recent reports. The following description of the existing environment is based on these previous reports as appropriate.

4.1 Climate

This report describes the typical climate conditions for the Coral Harbour area based on the Environment Canada climate records for Coral Harbour Airport (1981-2010) as summarized in Table 4-1.

Coral Harbour, Nunavut has a polar tundra climate. Over the course of a year, the temperature typically varies from -33.3°C (-28°F) to 14.4°C (58°F) and is rarely below -41.1°C (-42°F) or above 20.5°C (69°F).

4.1.1 Temperature

The snow-free season typically lasts from about mid-June June to mid-September, with an average daily high temperature above 6.1°C (43°F). The warmest days of the year typically occur in July and early August, with an average high of 14.4°C (58°F) and low of 6.1°C (43°F), as shown in Figure 4-1.

The winter season typically extends from early December to the end of March. The coldest days of the year typically occur in January and February, with an average low of -33.3°C (-28°F) and high of -26°C (-15°F).

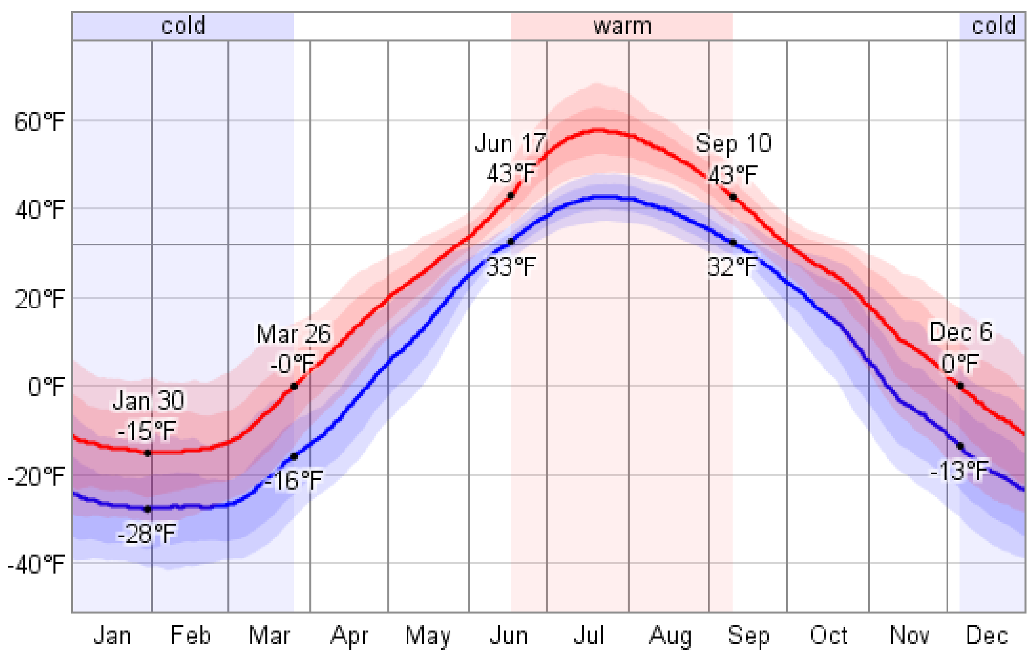

Figure 4-1: Daily High and Low Temperature at Coral Harbour Airport, NU

Notes: The daily average low (blue) and high (red) temperature with percentile bands (inner band from 25th to 75th percentile, outer band from 10th to 90th percentile).
Source: https://weatherspark.com/averages/28456/Coral-Harbour-Nunavut-Canada

4.1.2 Precipitation

The average precipitation at Coral Harbour over the period of record is 302.9 mm/year, with 163.0 mm falling as rain and 141.6 mm falling as snow (water equivalent) (Table 4-1). August and September typically experience the most precipitation, with monthly average values of 59.4 mm and 45.4 mm, respectively. Precipitation is typically lowest during the coldest months of winter (January/February) with monthly average values of 9.5 mm and 7.0 mm, respectively.

4.1.3 Wind

Over the course of the year typical wind speeds in the Coral Harbour area vary from 0 km/h to 32.2 km/h, rarely exceeding 54.7 km/h. Winds occur most frequently from the north (26% of the time), followed by winds from the north west (19% of the time), east (12% of the time), and north east (10% of the time). Winds occur least often from the south west (3% of the time) and south east (5% of the time) (Figure 4-2).

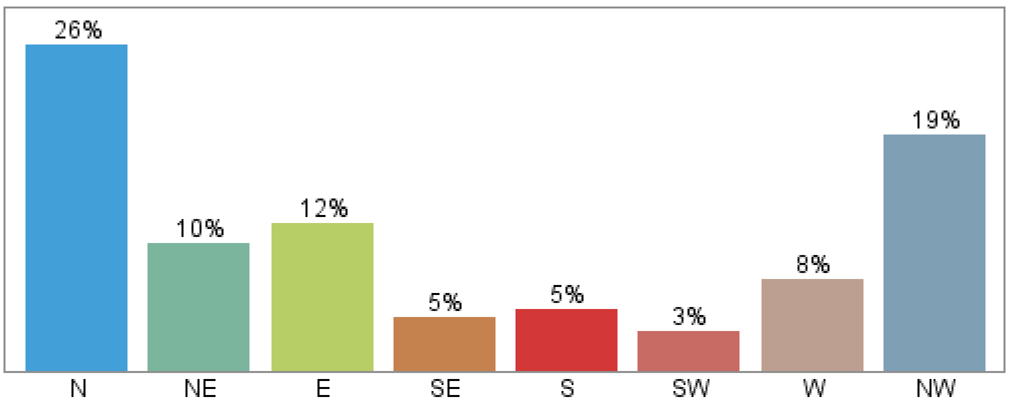

Figure 4-2: Annual Average Wind Directions at Coral Harbour Airport, NU

Notes: The fraction of time spent with the wind blowing from the various directions over the entire year. Values do not sum to 100% because the wind direction is undefined when the wind speed is zero.
Source: https://weatherspark.com/averages/28456/Coral-Harbour-Nunavut-Canada

Table 4-1: Summary of Environment Canada Climate Data for Coral Harbour Airport (1981-2010)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high	−0.6	−1.9	−0.5	4.4	8.9	22.8	32.8	30.1	19.9	7.6	3.7	3.2	32.8
Record high °C (°F)	−0.6 (30.9)	−1.1 (30)	0.0 (32)	5.0 (41)	9.4 (48.9)	23.3 (73.9)	28.0 (82.4)	26.1 (79)	18.5 (65.3)	7.6 (45.7)	4.0 (39.2)	3.4 (38.1)	28.0 (82.4)
Average high °C (°F)	−25.5 (−13.9)	−25.5 (−13.9)	−20.4 (−4.7)	−10.9 (12.4)	−2.9 (26.8)	6.4 (43.5)	14.7 (58.5)	11.7 (53.1)	4.6 (40.3)	−3.0 (26.6)	−11.9 (10.6)	−20.1 (−4.2)	−6.9 (19.6)
Daily mean °C (°F)	−29.6 (−21.3)	−29.7 (−21.5)	−25.2 (−13.4)	−16.1 (3)	−6.7 (19.9)	3.1 (37.6)	10.0 (50)	7.7 (45.9)	1.7 (35.1)	−6.1 (21)	−16.1 (3)	−24.4 (−11.9)	−11.0 (12.2)
Average low °C (°F)	−33.7 (−28.7)	−33.9 (−29)	−29.9 (−21.8)	−21.1 (−6)	−10.5 (13.1)	−0.3 (31.5)	5.3 (41.5)	3.6 (38.5)	−1.2 (29.8)	−9.1 (15.6)	−20.3 (−4.5)	−28.6 (−19.5)	−15.0 (5)
Record low °C (°F)	−52.8 (−63)	−51.4 (−60.5)	−49.4 (−56.9)	−39.4 (−38.9)	−31.1 (−24)	−15.6 (3.9)	−1.1 (30)	−3.3 (26.1)	−17.2 (1)	−34.4 (−29.9)	−40.6 (−41.1)	−48.9 (−56)	−52.8 (−63)
Record low (windchill)	−69.5	−69.3	−64.3	−55.1	−39.7	−23.2	−8.2	−11.8	−23.7	*−43.7*	*−54.8*	−64.2	−69.5
Average precipitation mm (inches)	9.5 (0.374)	7.0 (0.276)	11.2 (0.441)	18.2 (0.717)	19.0 (0.748)	27.6 (1.087)	34.1 (1.343)	59.4 (2.339)	45.4 (1.787)	33.8 (1.331)	22.9 (0.902)	14.8 (0.583)	302.9 (11.925)
Average rainfall mm (inches)	0.0 (0)	0.0 (0)	0.0 (0)	0.4 (0.016)	4.3 (0.169)	20.8 (0.819)	34.1 (1.343)	58.9 (2.319)	36.7 (1.445)	7.2 (0.283)	0.5 (0.02)	0.0 (0)	163.0 (6.417)
Average snowfall cm (inches)	9.6 (3.78)	7.1 (2.8)	11.3 (4.45)	18.2 (7.17)	14.9 (5.87)	6.9 (2.72)	0.0 (0)	0.6 (0.24)	8.6 (3.39)	26.7 (10.51)	22.9 (9.02)	14.8 (5.83)	141.6 (55.75)
Average precipitation days (≥ 0.2 mm)	8.5	6.7	9.0	9.5	10.4	9.6	9.6	12.6	11.2	14.6	13.0	10.4	125.1
Average rainy days (≥ 0.2 mm)	0.0	0.0	0.0	0.2	1.8	7.2	9.6	12.5	8.2	3.6	0.6	0.1	43.8
Average snowy days (≥ 0.2 cm)	8.6	6.6	9.0	9.5	9.4	3.3	0.0	0.3	4.3	13.1	12.9	10.4	87.3
Average relative humidity (%)	64.9	64.2	67.5	73.8	80.3	73.9	63.1	68.9	75.6	84.8	77.6	69.7	72.0
Mean monthly sunshine hours	37.9	112.1	187.4	240.2	239.9	262.2	312.3	220.4	109.8	70.8	47.9	18.8	1,859.7
Percent possible sunshine	22.4	47.0	51.6	53.2	42.0	41.9	51.2	43.3	27.9	23.3	24.3	13.9	36.8

Source: Environment Canada Canadian Climate Normals 1981–2010[18]

4.2 Terrain

4.2.1 Geology

Southampton Island, Nunavut, is situated between the Archean-dominated western Churchill Province and the Paleoproterozoic Baffin-Ungava segment of the Trans-Hudson Orogen (Sanborn-Barrie et al. 2014). The island exposes a highland of Precambrian basement across much of its eastern half and flat-lying Paleozoic carbonate strata across its western half. The Precambrian basement complex consists predominantly of 3,000-2,700 Ma tonalitegranodiorite-granite gneiss, containing enclaves and inclusions of ca. 3 Ga maficultramafic-anorthositic plutonic rocks and lesser metasedimentary rocks. A smaller proportion of Paleoproterozoic gabbroic and granitic plutons also occurs. These rocks experienced profound amphibolite- to granulite-facies tectono-metamorphic reworking at 1880-1820 Ma, during the Trans-Hudson Orogen collision between the Rae and Superior cratons, resulting in their strongly foliated to gneissic character, followed by exhumation and cooling at 1790-1780 Ma.

The areas north and west of the Hamlet are characterized by linear bedrock ridges aligned in an approximate north-south direction, and Coral Harbour is situated mainly on Precambrian granite gneiss. In the trough areas, where rock is not exposed, it is usually filled with fine grained sediments and brown fibrous peat up to 0.46 m deep. Local depressions in these troughs have shallow ponds throughout most of the year. Since surface drainage drains south towards the Coral Harbour Inlet, some of the channels between the bedrock ridges are covered with a slow moving water during snowmelt.

Thurber Consultants Ltd (1985), who conducted geotechnical evaluations for the design of the ice arena at Coral Harbour and five areas just west and north of the community reported that following the retreat of the glaciers during the last ice age, fine-grained marine sediments ranging from sand to clay between rock ridges and cobbles and boulders ranging from 0.5 m to 2.0 m between the fine marine sediments and the bedrock surface were deposited over the general area. As a result, ample sources of granular material exist in the Coral Harbour area.

Coral Harbour is within the zone of continuous permafrost, and the maximum active layer was estimated to be 1 m to 2 m.

4.3 Permafrost

Permafrost is ground (soil or rock) remaining at or below 0°C for long periods (at least two years) (TAC 2010). About 50% of Canada is underlain by permafrost, mainly in the Arctic Archipelago, Yukon, Northwest Territories, and Nunavut. Permafrost can form in bedrock, gravel, or sand, but it is the ice-rich permafrost found in silt and clay soils that geotechnical engineers are typically most concerned about. Coral Harbour is located within the continuous permafrost zone of Canada (Figure 4-3).

The upper layer of the ground that thaws each summer and freezes again the following winter constitutes the active layer. In the Coral Harbour, the active layer is typically in the order of 1 m to 2 m deep.

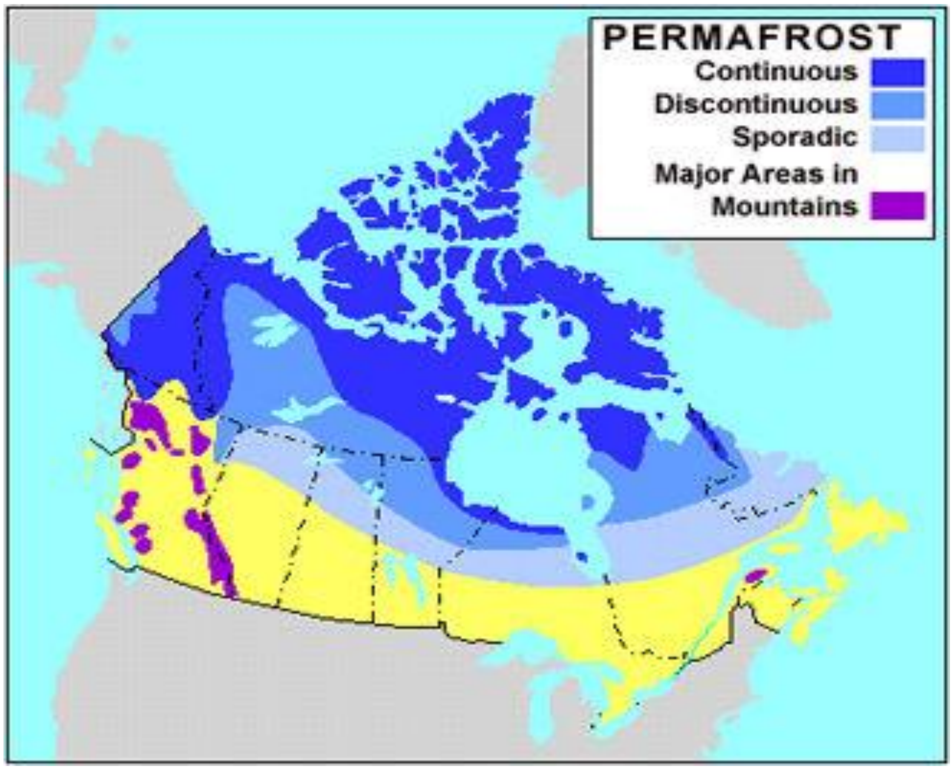

Figure 4-3: Permafrost Areas of Canada

Source: http://www.thecanadianencyclopedia.ca/en/article/permafrost/

4.4 Hydrology

The Coral Harbour Airport Community Road Washout Rehabilitation Project is located within the Post River drainage area. The Post River is located on the eastern side of Southampton Island and has an approximate watershed area of 281 km^2 (Figure 4-4). The upper reach of the watershed originates approximately 48 km north of Coral Harbour and drains south into Hudson's Bay. The project site is defined as Airport Road, which provides access to Coral Harbour Airport.

Figure 4-4: Post River Watershed

As detailed in the report, "Airport Community Road Washout Coral Harbour, Nunavut – EBA 2013", drainage across Airport Road is routed through a series of culvert crossings and one clear-span bridge. Aerial photographs of the site show numerous lakes and wetlands within the Post River watershed, especially at the lower reach of the watershed near the town of Coral Harbour.

As there was no hydrometric station or flow data available for the Post River, a regional statistical approach was used to estimate peak flows. Water Survey of Canada (WSC) hydrometric stations installed across Nunavut were reviewed to find gauged watercourses with similar watershed characteristics and sufficient data for a meaningful statistical regional analysis. Selection of the comparable watersheds was limited to regions of similar climate, topography, and watershed size. Table 4-2 summarizes key hydrological parameters for the available WSC hydrometric stations.

Table 4-2: WSC Stations Comparison Summary

Station ID	Station Name	Distance from Post River	Number of Years of Peak Daily Flow Data	Number of Years of Peak Instantaneous Flows	Watershed Area
06PA001	Kirchoffer River near Coral Harbour	13 km West	3	2	3,160 km^2
06MA002	Qinguq Creek near Baker Lake	635 km West	15	6	432 km^2
10UH001	Sylvia Grinnell River near Iqaluit	715 km East	13	13	2,980 km^2
10UH002	Apex River at Apex	722 km East	9	11	58.5 km^2
06OA001	Lorillard River above Daly Bay	353 km West	8	9	11,000 km^2

WSC Station 06PA001, Kirchoffer River near Coral Harbour, is located approximately 13 km to the west of the Post River with a watershed area of 3,160 km^2 (Figure 4-5). Although the close proximity of the Kirchoffer River station to the Project site is ideal for a watershed comparison, the data record for this WSC station consisted of less than five years of flow data. This is insufficient for statistical extrapolation purposes. However, several important conclusions were drawn from this data set:

- Peak flows on the Kirchoffer River occur in late June, shortly after average daily temperatures begin to exceed 0° Celsius. This coincides with the snowpack melt within the watershed.
- Peak river flows are governed almost entirely by snowmelt. Precipitation events seem to produce only minor responses in the Kirchoffer River (see Figure 4-6).
- The shape and duration of the river flow freshet hydrograph was found to be consistent for all four years of available data (see Figure 4-7).

Due to the consistency of the freshet flow responses and the proximity of the Kirchoffer River station to the project site, the shape of the freshet hydrograph was used to scale the hydrograph for the Post River.

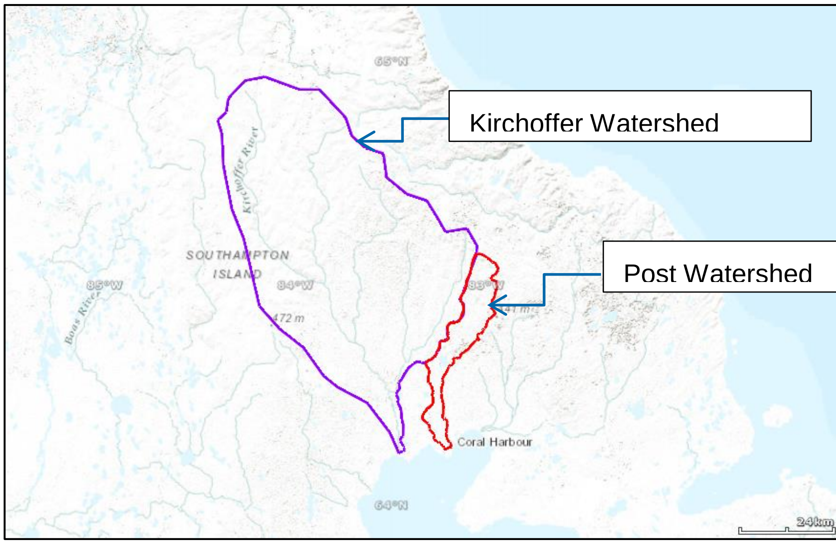

Figure 4-5: Post River and Kirchoffer River Watersheds

The remaining four WSC stations outlined in Table 4-2 with nine or more years of available peak instantaneous flow data were used in a regional statistical flow evaluation to determine peak flows on the Post River for a range of return periods.

As summarized in Table 4-2, the selected hydrometric stations with sufficient data to conduct a frequency analysis are not in close proximity to the project site. However, it should be mentioned that the selected WSC hydrometric stations are located at the same latitude of the Post River watershed. Figure 4-6 presents the relationship between peak instantaneous flow and watershed area for the four WSC stations in a year where all four stations had recorded data, 1991. It was found that the stations exhibit similar hydrologic behaviour and provides confidence that the behavior of Nunavut watersheds are relatively constant at this latitude.

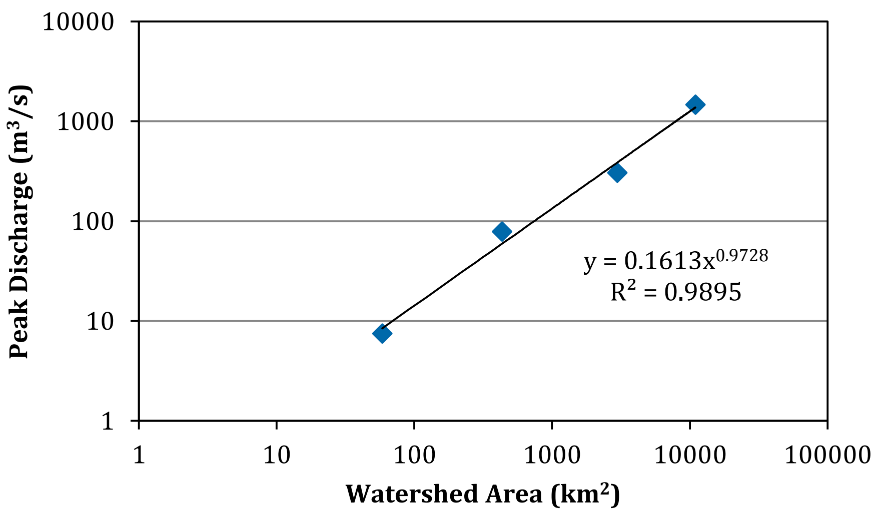

Figure 4-6: Comparison of Peak Flow to Watershed Area in 1991 for WSC Stations Used in Regional Analysis

A flood frequency analysis was conducted using peak instantaneous flows for each of the four stations. In years where a peak instantaneous measurement is missing but a daily maximum flow is reported, peak instantaneous flows were synthesized by prorating the maximum daily value. Prorating factors were determined as the average ratio between the maximum instantaneous flow and the maximum daily flow in all years where both were available.

The flood frequency statistical analysis software HYFRAN was used to fit peak flow data to a number of statistical distributions. While several probability distributions were tested, the Three-Parameter Log Pearson distribution was selected as it is found to visually best fit the data. Calculated peak instantaneous watershed flows for each of the WSC stations are presented in Table 4-3.

Table 4-3: Return Period Summary

Return Period (years)	06MA002	10UH001	10UH002	06OA001
	432 km²	2,980 km²	58.5 km²	11,000 km²
1000	149	832	28.4	5,450
200	138	742	25.0	4,360
100	132	701	23.4	3,900
50	125	658	21.6	3,440
20	113	598	19.1	2,840
10	102	549	16.9	2,380
5	88.5	494	14.4	1,920
3	75.7	447	12.4	1,560
2	62.7	401	10.4	1,250

Figure 4-7 depicts a log-log plot of flow compared to watershed area for each of the WSC stations for each return period. Each set of data was fitted with a power trend line which can be used to determine design floods for a given watershed area.

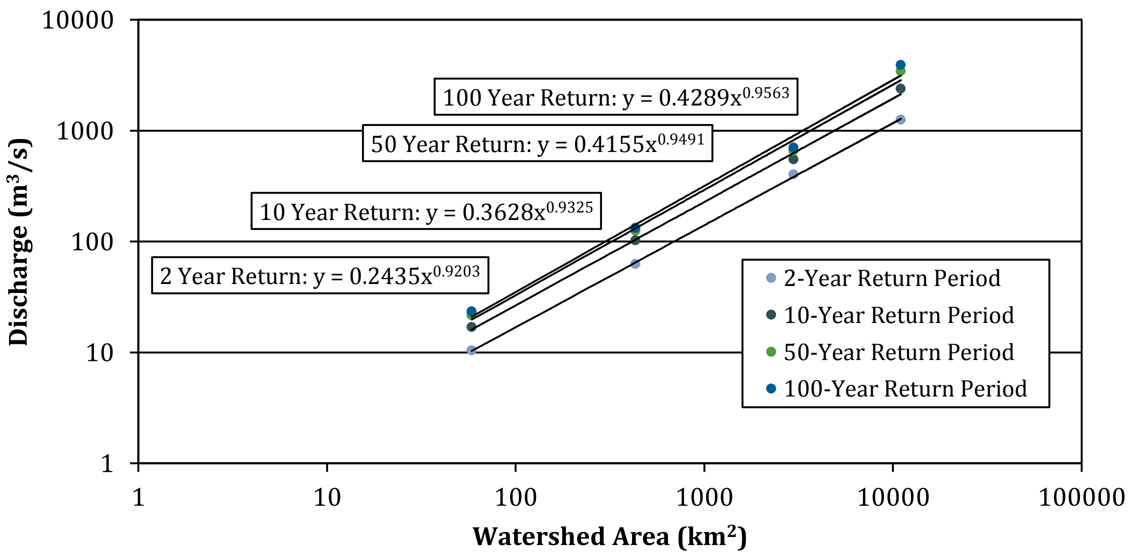

Figure 4-7: Post River at Airport Road: K Value Determination

Using the above trend line equations, estimated flows for the Post River watershed (281 km^2) were calculated for a range of return periods. Table 4-4summarizes the results of the frequency analysis for the Post River watershed.

Table 4-4: Flood Projection Analysis

Return Period (years)	Post River Flow (m^3/s)
1000	117.2
200	100.1
100	94.2
50	87.6
20	78.0
10	69.7
5	60.0
3	51.8
2	43.7

To give a hydrograph shape to estimated Post River peak flows, hydrographs from the nearby Kirchoffer River hydrometric stations were reviewed. Historical records demonstrate that the Kirchoffer River freshet period typically span over multiple days, often lasting more than three weeks (Figure 4-8). The four years of available Kirchoffer River freshet flow data were graphed and the most critical hydrograph was selected for the synthesis of the 100-year Post River freshet hydrograph (Figure 4-9). This synthetic Post River freshet hydrograph was later used in the hydraulic analysis of the Airport Road culvert system.

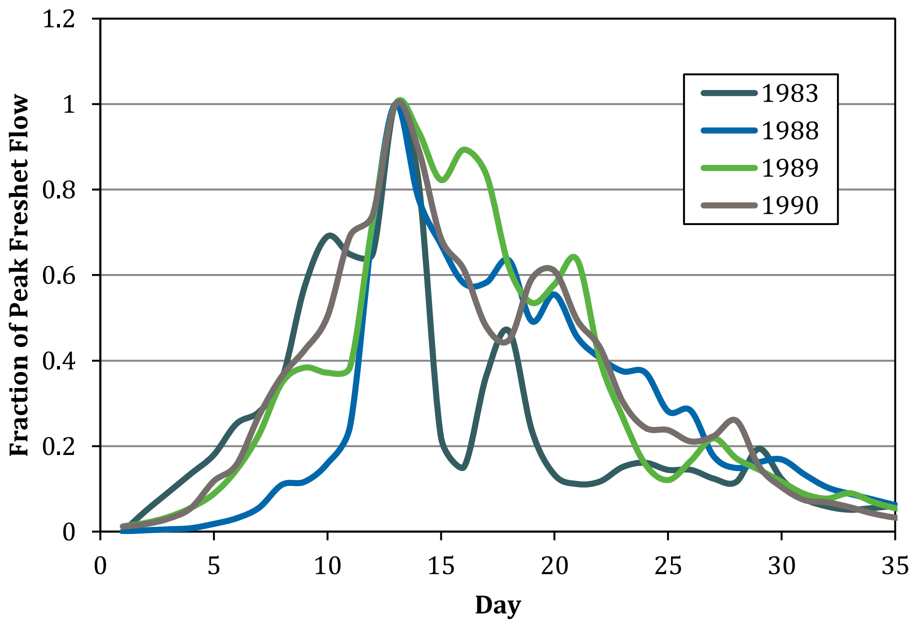

Figure 4-8: Typical Freshet Hydrograph

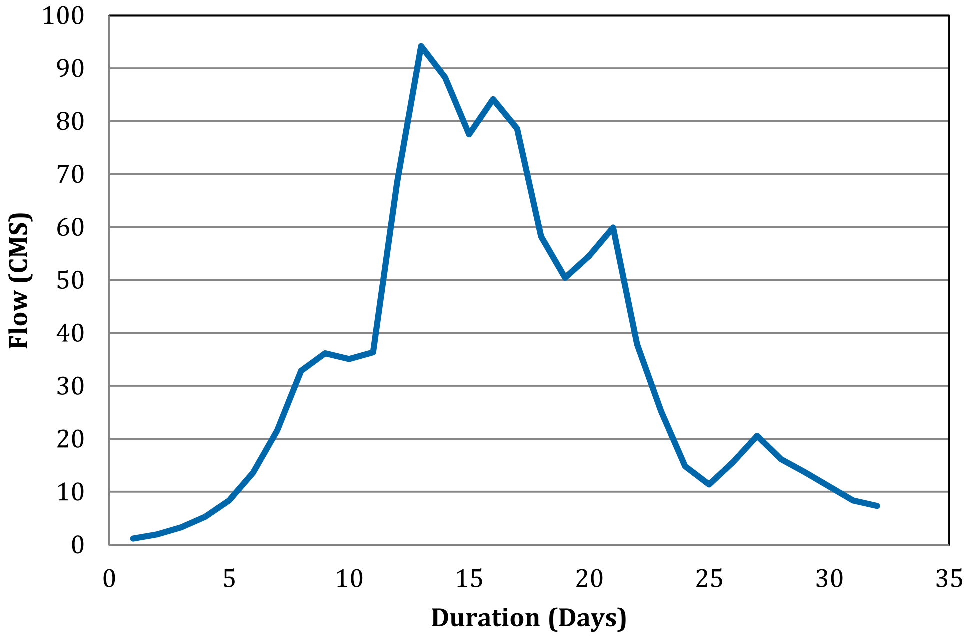

Figure 4-9: Synthesized Post River 100-Year Hydrograph

4.5 Water Quality

Mallory et al. (2006) investigated the water chemistry of 32 small lakes and ponds on Southampton Island, including 4 small waterbodies in the South Bay area in July 2001 and 2002. The ponds were generally small and shallow and at low elevation, within 5 km of the coast. All of the ponds were alkaline (pH range 7.2-8.1), and shared similar major ion chemistries dominated by Calcium (Ca) and Sodium (Na) for cations and Chlorine (Cl) anions although there were some differences observed among habitats. This was expected given that the surficial geology of this region is dominated by sedimentary limestone or other alkaline, calcareous rock.

Nutrients were relatively high compared to other Arctic islands, which was generally attributed to waterfowl (geese, ducks) concentrations using many of these ponds. Only two metals, Aluminum (Al) and Iron (Fe) were examined in this study. For their study ponds, the metals values measures were in the low range, compared to other sites across the Canadian Arctic, but within the range expected for Canadian freshwaters (McNeely et al. 1979).

4.6 Aquatic Resources

A desktop review for the Coral Harbour area and for Southampton Island resulted in only limited fisheries information regarding inland fisheries resources. Fishing for Arctic Char (*Salvelinus alpinus*) in coastal waters occurs in summer and under the ice in winter. Internet searches also indicate the presence of Arctic Char and recreational fishing in a number of streams and lakes along the south end of the island (e.g. Ivitaarulik Lake, Qiqqaq River, Sixteen Mile Brook, Rocky Brook, Kirchoffer River) as well as in the Canyon River Lakes and Cape Donovan Areas[1] that drain

[1] Submission to the Nunavut Wildlife Management Board http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CB4QFjAAahUKEwii4fGWu4bJAhXIVYgKHZtSAeE&url=http%3A%2F%2Fwww.nwmb.com%2Fiku%2Flist-all-site-files%2Fnwmb-meetings%2Fregular-meetings%2F2011%2Fregular-meeting-004-2011-december-7-iqaluit%2F2084-tab-4-dfo-coral-harbour-emerging-char-fishery-application-eng%2Ffile&usg=AFQjCNGMVOEFRqdFLw5h-hNgLhUm___G5qg&sig2=L7XmBGnAwgy1R1K0_r52uA.

to the north and east ends of the island, respectively. However, no references were found for fish presence or fishing in the Post River.

Mr. Troy Netser, the Wildlife Guardian based in Coral Harbour, indicated in a phone interview that to his knowledge, there are no fish runs into the Post River and he is not aware of any fishing taking place in the Post River watershed. Similarly, Ms. Louisa Kudluk, Manager at Aiviit Hunters & Trappers Organization in Coral Harbour indicated that she did not know of any fishing or fish presence in the Post River.

Based on the above information, it is likely that the Post River does not support a fisheries resource. Notwithstanding that conclusion, the proposed rehabilitation of the existing crossing structures would improve fish passage and fish habitat conditions in the Post River system by eliminating possible obstructions at the existing culverts, reducing excessive velocities due to flow constriction, and eliminating erosion and sediment discharges caused by periodic road washouts.

It is recommended that a Construction Environmental Management Plan (CEMP) be developed and implemented to mitigate potential adverse effects during bridge and culvert replacement. In particular, the CEMP would highlight DFO best practices (http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html), including erosion and sediment control measures and preferred scheduling to minimize potential adverse downstream effects on aquatic resources.

4.7 Vegetation

The Coral Harbour area is located within the Southern Arctic ecozone and the Southampton Island Plain ecoregion, which is characteristic of low elevation, generally flat terrain with exposed bedrock areas. Within this ecoregion, an expanse of low arctic shrubs and a diverse cover of vascular plants, mosses, and lichens cover much of the well-drained upland tundra (Fontaine and Mallory 2011). Common arctic shrubs include birch, willow, northern Labrador tea, aven (Dryas) species, and Vaccinium species (Government of Canada 2013; Fontaine and Mallory 2011). Willows, sedges, and mosses dominate the wet areas (Government of Canada 2013), and crustose lichens, mosses, and heather (Cassiope) species dominate dry boulder ridges and exposed rock areas (Fontaine and Mallory 2011).

4.8 Wildlife

Southampton Island is home to many species of wildlife including caribou, Arctic fox and numerous species of geese, ducks and other waterfowl. Marine mammals living in the ocean around the island includes beluga whale, ring and bearded seals, walruses and polar bears.

4.8.1 Southampton Island Barren-ground Caribou

The Southampton Island barren-ground caribou population range extends to all of Southampton and White Island and includes small coastal islands along the eastern shores of Southampton Island (www.nwmb.com).

Historically, barren-ground caribou were abundant on Southampton Island. During the early to mid-1900s the population declined dramatically as a result of over harvesting, and was extirpated from the island by 1955. In 1968, 48 caribou from Coats Island were successfully reintroduced onto Southampton Island. Between 1968 and 1997 the population increased rapidly from 48 individuals to 30,381 ±3,982 individuals. An aerial survey in 2003 detected the first decline since their reintroduction with a population estimate of 17,981 ± 2,127 individuals. Between 2003 and 2011 the population continued to decline and was estimated at 7,762 ± 1,858 individuals in 2011. Explanations for this downward trend in abundance include: the reproductive disease Brucellosis suis, which was first identified in the population in February 2000 and had infected over 50% of the population by 2006, reduction in pregnancy rates from approximately 80% in 1997 to 37% in 2011 and extensive icing events in 2011 resulting in inaccessibility to food and decline in condition.

More recent survey results indicate that the caribou population is not yet recovering, despite interim management decisions, including hunting quotas, which have significantly reduced harvesting (DOE 2013). The Nunavut Wildlife Management Board (NWMB) is the main instrument for wildlife management in the Nunavut Settlement Area and has sole decision making responsibilities in relation to the establishment of a TAH and the imposition of Non-Quota Limitations (NQL) on Inuit harvesting. Such restrictions can only be imposed on Inuit when there are conservation concerns in relation to a population of wildlife.

4.8.2 Polar Bear

The Polar Bear (*Ursus maritimus*) was added to the Northwest Territories (NWT) *Species at Risk Act* List of Species at Risk as a Species of Special Concern in February, 2014 by the NWT Minister Environment and Natural Resources. Polar bears are also listed as a species of Special Concern under the Federal *Species at Risk Act* and have been assessed similarly by COSEWIC.

Coral Harbour is located within the boundaries of the Foxe Basin (FB) subpopulation of polar bears, which encompasses the northern part of Hudson Bay, the western end of Hudson Strait and Foxe Basin proper (Government of Nunavut 2013). This region is seasonally ice-free, spanning some 1.1 million km^2 across Nunavut and Nunavik in northern Quebec. Seven communities in Nunavut (Cape Dorset, Chesterfield Inlet, Coral Harbour, Hall Beach, Igloolik, Kimmirut, and Repulse Bay) and four communities in Quebec (Akulivik, Ivujivik, Puvirnituq, and Salluit) lie within the FB bounds.

A subpopulation estimate of 2,197 ± 260 (S.E.) bears was completed in 1996 from analysis of mark-recapture data collected between 1989 and 1994 (Taylor et al. 2006). In response to the findings of this study which suggested that the harvest was unsustainable, the permitted harvest from FB underwent a phased reduction (in Nunavut) between 1993 and 1996 to permit slow recovery of the subpopulation. During this period, Total Allowable Harvest went from 137 to 961 bears/year.

Local knowledge suggested that the abundance of polar bears in FB had increased since 1996 (McDonald et al. 1997; Government of Nunavut community consultations 2004-2009). Community consultations in 2005, resulted in a new Memorandum of Understanding (MOU) for management of FB, which increased the Total Allowable Harvest to a level consistent with a subpopulation size of approximately 2,300 bears (106 bears/year). Harvesting from FB by residents of Nunavik is unregulated and has averaged approximately 2.5 bears per year over the last 10 years. Note however that the 2005 MOU allocates 7 bears for Quebec for a total potential combined FB harvest of 113 bears.

More recently, in 2009 and 2010, the Government of Nunavut conducted comprehensive aerial surveys of FB. The surveys estimated overall abundance at about 2,580 bears, with a 95% confidence interval of 2,093 to 3,180 (CV: 10.7%). Observed litter sizes were comparable to those documented in other subpopulations with robust annual growth rates, suggesting that recruitment is currently indicative of a healthy subpopulation. Anecdotally, polar bears observed during the aerial surveys generally appeared to be in good body condition further supporting the notion that FB is a healthy subpopulation (Government of Nunavut 2013).

4.8.3 Birds

Southampton Island has two bird sanctuaries, both located relatively close to Coral Harbour. The East Bay Migratory Bird Sanctuary is located in East Bay in southeast Southampton Island, about 71 km east of Coral Harbour. It is 1,138 km^2 in size and it protects habitat for dozens of bird species including Arctic terns, Atlantic brants, black-bellied and golden plovers, black guillemots, herring and Sabine's gulls, jaegers, ruddy turnstones, king eider ducks, red knots and red phalaropes, white-rumped sandpipers, oldsquaws, Canada geese and red-throated loons (www.ec.gc.ca/ap-pa/default.asp?lang=en&n=74BC888B-1).

The Harry Gibbons Migratory Bird Sanctuary is located in western Southampton Island near the Boas River and Bay of Gods Mercy, about 103 km southwest of Coral Harbour. It protects 1,224 km^2 of tundra and tidal habitat for many arctic birds. Along with its wetlands, the Boas River is a Canadian Important Bird Area (Site #NU022). The Harry Gibbons MBS takes up the western portion of the IBA. (www.ec.gc.ca/appa/default.asp?lang=en&n=74BC888B-1)

5.0 POTENTIAL ENVIRONMENTAL EFFECTS AND MITIGATION MEASURES

The proposed Coral Harbour airport road stream/drainage crossing rehabilitation/replacement program is a mitigation project intended to prevent future flooding and road washouts. Potential environmental effects associated with this project are expected to be limited because most of the proposed construction work will be undertaken directly within the existing airport road footprint. To mitigate potential adverse environmental effects, a Construction Environmental Management Plan (CEMP) will be developed and implemented by the construction contractor. In particular, the CEMP would highlight DFO best practices (http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html), including erosion and sediment control measures and preferred scheduling to minimize potential adverse downstream effects on aquatic resources.

Table 5-1: Summary of Potential Environmental Effects and Mitigation Measures

Potential Environmental Effect	Construction	Operation & Maintenance	Summary of Mitigation Measures
Air Quality			
Temporary degradation of air quality due to dust and exhaust emissions during construction of the new bridges/culverts	M	M	Water will be applied as needed to minimize dust and fuel conservation methods will be employed
Surface Water Quality			
Temporary changes in surface water quality due to release of sediments during stream crossing construction activities and construction dust	M	M	Stream crossings will be designed to minimize erosion (slopes, placement of rip rap cover, etc.)
Surface Water Quantity			
The road washout rehabilitation project is being implemented to prevent future flooding and road washouts and to enhance public safety	P	P	The properly engineered and implemented road washout rehabilitation project is a mitigation project intended to prevent future flooding and road washouts
Hydrocarbon Spills			
Potential environmental contamination related to accidental spills of gasoline, diesel, anti-freeze from construction equipment	M	M	The possibility of accidental spills will be eliminated or minimized by effective implementation of the contractors operations management procedures and their spill contingency plan
Aquatic Resources			
Potential effects on aquatic resources	M	P	The effective application of the mitigation measures described for Air Quality, Surface Water Quality, Surface Water Quantity and Hydrocarbon Spills will all assist in minimizing

Potential Environmental Effect	Construction	Operation & Maintenance	Summary of Mitigation Measures
			potential effects on the aquatic resources of the area. In addition, the Construction Environmental Management Plan (CEMP) for the project will highlight DFO best practices (http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html) including erosion and sediment control measures and preferred scheduling to minimize potential adverse downstream effects on aquatic resources.
Vegetation			
No effects on vegetation are expected to occur because all construction activities will take place within the existing footprint of the road	-	-	No mitigation measures needed
Terrestrial & Marine Wildlife (Mammals and Birds)			
Potential effects on terrestrial & marine wildlife (mammals and birds)	M	M	As the road washout rehabilitation project is taking place within the existing community road footprint and in close proximity to the Hamlet, no effects on wildlife are expected to occur. However, construction activities can be paused if concentrations of wildlife (e.g. caribou, polar bear) were to be in the vicinity

Notes: P = Positive; M = Negative and mitigatable; N = Negative and non-mitigatable; U = Unknown; - = No effect

6.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Nunavut Department of Community and Government Services and its agents. Tetra Tech EBA Inc. (operating as Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than the Nunavut Department of Community and Government Services or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech EBA Inc.'s Services Agreement. Tetra Tech's General Conditions are attached to this Supplementary Information Report.

7.0 CLOSURE

We trust this Supplementary Information Report will meet the needs of the Nunavut Department of Community and Government Services and the Nunavut Water Board. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech EBA Inc.

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APPENDIX A
TETRA TECH'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOENVIRONMENTAL REPORT

This report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT AND OWNERSHIP

This report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment.

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Both electronic file and hard copy versions of Tetra Tech EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. The Client warrants that Tetra Tech EBA's instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

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In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by Tetra Tech EBA in its reasonably exercised discretion.

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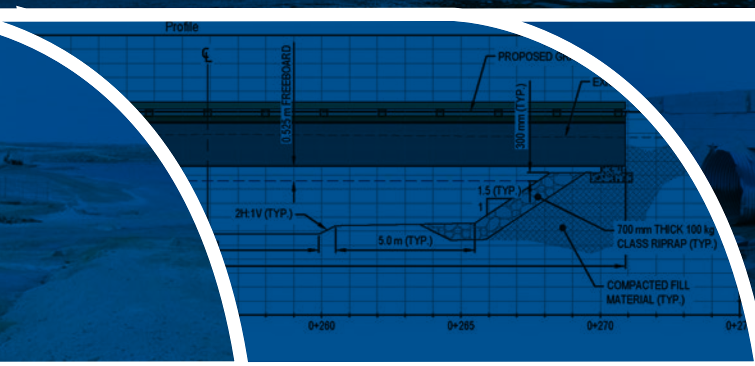

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