Appendix B

Supporting Documentation

Stantec

Memo

To:	Alexis Campbell, Environmental Analyst Department of Infrastructure Government of the Northwest Territories Box 1320, 5015 – 49 Street Yellowknife, NT X1A 2L9	From:	Erica Bonhomme, M.Sc., P.Geo. Project Manager Stantec Consulting Ltd. 2nd Floor, 4910 – 53 Street Yellowknife, NT X1A 2P3
File:	144930112	Date:	October 15, 2018

Reference: **Fish Habitat Assessment for Crossing Structure Replacement: NWT Highway 10 at KM 7.5 (Gunghi Creek)**

INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by the Government of the Northwest Territories, Department of Infrastructure (GNWT-INF), to complete a fish habitat assessment at KM 7.5 (Gunghi Creek) of Northwest Territories Highway 10 (Inuvik-Tuktoyaktuk Highway), for crossing structure replacement. The objective of the program was to:

- Complete a field-level assessment of the watercourse and existing crossing location to document the existing conditions of fish habitat potentially affected by the proposed crossing structure replacement.

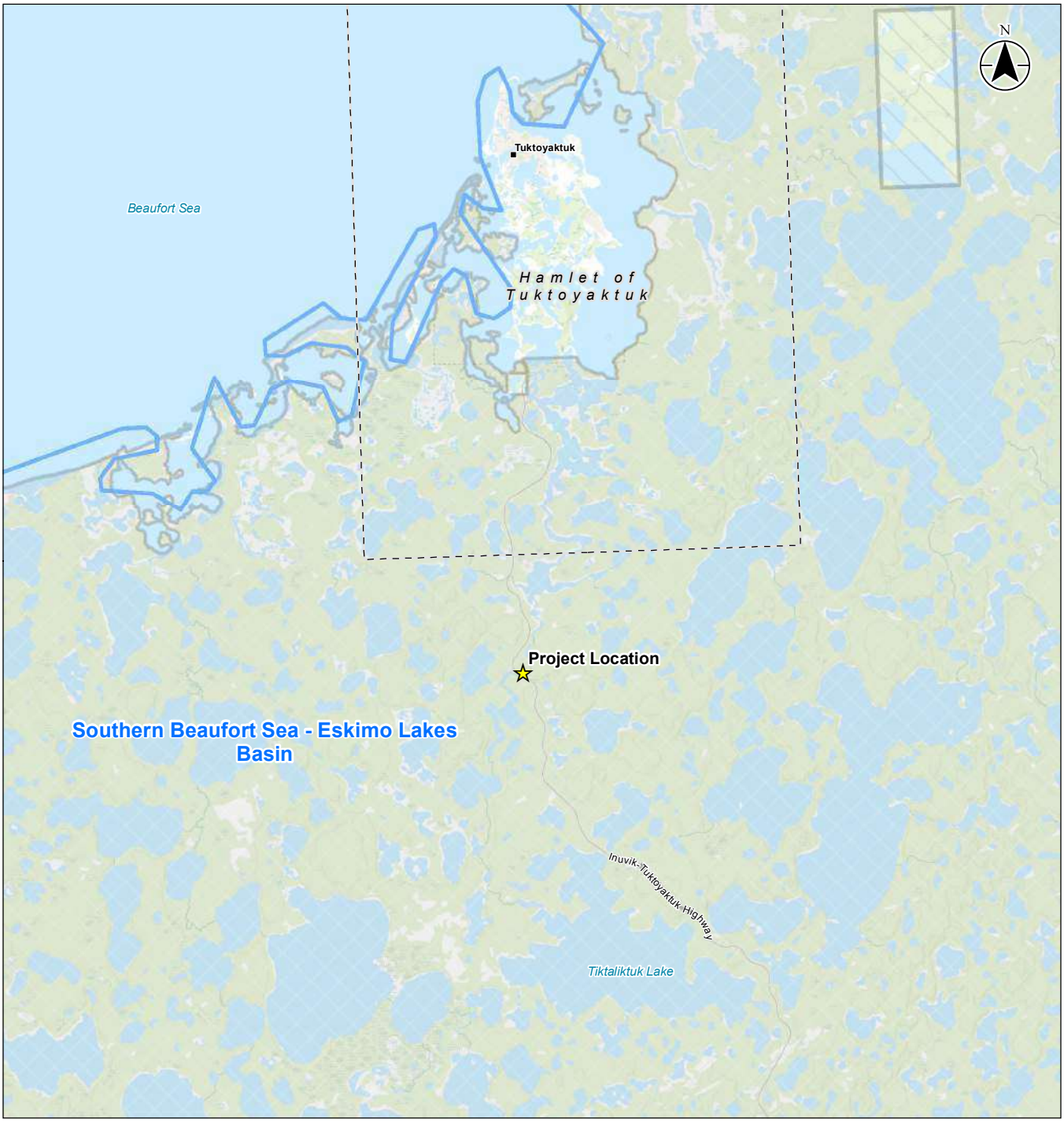
STUDY AREA

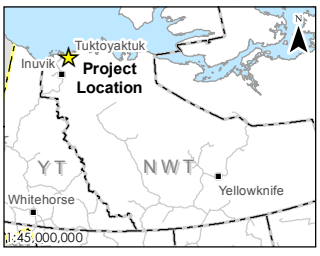
The Gunghi Creek crossing is located at 69° 20’ 38” N, 133° 2’ 19” W (see Figure 1) and is situated within the Southern Beaufort Sea – Eskimo Lakes catchment of the Arctic Ocean watershed. Gunghi Creek ultimately flows from a large lake, named Tiktaliktuk Lake (Big Lake), located approximately 6.0 km upstream (south) of the crossing, and continues to flow north for approximately 4.0 km, downstream of the crossing, to the marine environment of Tuktoyaktuk Harbour at Reindeer Point.

The Gunghi Creek crossing is situated within the Tuktoyaktuk Coastal Plains Level IV ecoregion of the Southern Arctic Tundra Plains Level II ecoregion[1]. Based on information in GNWT (2012), the Tuktoyaktuk Coastal Plains Level IV ecoregion is predominantly a low-elevation till plain, with low relief and numerous lakes (shallow and large) and wetlands. North of Eskimo Lakes, including the Gunghi Creek area, soils are primarily organic cryosols with shallow peat deposits. Permafrost is continuous and has high ice-content. There are no trees in this area of the Tuktoyaktuk Coastal Plains Level IV ecoregion and vegetation is dominated by low- and dwarf-shrub tundra species, primarily dwarf birch (*Betula nana*) and willows, that are generally less than 50 cm tall.

The Gunghi Creek crossing is situated within Inuvialuit-owned 7(1)(A) private lands of the Inuvialuit Settlement Region.

[1] In the Northwest Territories, Level II ecoregions are similar to “ecozones” from the Canadian National Ecosystem Classification Framework (GNWT 2012). On the mainland Northwest Territories, the Southern Arctic ecozone has been split into two Level II ecoregions: Tundra Plains and Tundra Shield (GNWT 2012).





Highway
Road
Local Street
Watercourse
Waterbody
Municipal Boundary

Project Location
Arctic Ocean Sub-Basin

Aboriginal and Inuit Owned Lands-Inuvialuit Settlement Land

Surface
Surface//Subsurface

0 1 2 3 4 5 km

1:125,000 (at original document size of 8.5x11)

Notes
1. Coordinate System: NAD 1983 UTM Zone 8N
2. Data Sources: Base Data; http://www.geomatics.gov.nt.ca, Esri World Topo Map

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Government of Northwest Territories

Project Location
NTS Mapsheet: 107C07

Project Number 144930112
Prepared by DJOZSA on 20181010
Discipline Review by CSIBBALD on 20181011
GIS Review by TCARDINAL on 20181012

Client/Project
Government of Northwest Territories
Fish Habitat Assessments for Crossing Replacement

Figure No.
1

Title
Overview of the Stream Crossing at KM 7.5 (Gunghi Creek) of NWT Highway 10 (Inuvik-Tuktoyaktuk Highway)

METHODS

RESEARCH LICENCING

In advance of obtaining necessary regulatory approvals for the field program, an information letter was sent to the Tuktoyaktuk Hunters and Trappers Committee (HTC) for comment. In response, the HTC provided a letter of support for the field program. Upon submission of a pre-screening application to the Environmental Impact Screening Committee, the program was deemed to be exempt from screening. Finally, a Scientific Research Licence (No. 16392) was obtained from the Aurora Research Institute. No other licences were required as the field program at Gunghi Creek did not require capture or handling of fish.

FISH HABITAT

Fish habitat was assessed by establishing cross-channel transects to document habitat and channel characteristics along a 400 m reach of the crossing site. Six transects were surveyed: 50 and 100 m upstream of the crossing, at the crossing site (immediately upstream and downstream of the existing structure), and 100, 200, and 300 m downstream. Since the Northwest Territories does not have established protocols for fish habitat data collection, methods were based on the British Columbia Resource Inventory Standards Committee standards for fish and fish habitat data collection (BC RIC 2001). These standards were developed to collect stream reach data to interpret habitat sensitivity and capability for fish production (BC RIC 2001) and provide sufficient information to assess potential impacts of linear developments (e.g., road crossings). A fish habitat data card was completed for the watercourse crossing, which included the following field data:

- Location (site and transect coordinates)
- Channel characteristics, including: width of bed and top of bank, bankfull depth and average channel water depth (at time of survey), and dominant habitat unit (e.g., riffle, rapid, pool, run)
- Bank characteristics (height, slope, stability, percent vegetation cover, bank materials)
- Substrate composition (percent substrate size distribution and embeddedness)
- Stream cover (percent total instream cover, overhead, and aquatic)
- Vegetation characteristics (riparian width and crown closure)
- Physical channel characteristics (pattern type, islands, bars, coupling and confinement)

Photographs were taken at each transect (upstream, downstream, left downstream bank, right downstream bank) and of any noted features along the watercourse. In-situ water quality measurements (e.g., temperature, pH, specific conductivity) were planned but were unfortunately not collected due to equipment not arriving in time for the survey.

FISH PRESENCE

Fish usage data exists for Gunghi Creek from previous technical studies completed in support of development of NWT Highway 10 (segment previously known as “Source 177 Road”). Fish use of Gunghi Creek is also expected to be similar to other freshwater coastal drainages on the Tuktoyaktuk Peninsula, including Kukjuktuk Creek (Chang-Kue & Jessop 1992), and Freshwater and Mayogiak Creeks, which also flow into Tuktoyaktuk Harbour (Bond & Erickson 1985). Consequently, no additional fish use information was collected during the August 2018 field program. The following documents were reviewed to obtain information on known and potential fish use of Gunghi Creek:

- *Life history studies of anadromous Coregonid fishes in two freshwater lake systems on the Tuktoyaktuk Peninsula, Northwest Territories* (Bone & Erickson 1985)
- *Coregonid migration studies at Kukjuktuk Creek, a coastal drainage on the Tuktoyaktuk Peninsula, Northwest Territories* (Chang-Kue & Jessop 1992)
- *Distributions of Freshwater and Anadromous Fishes from the Mainland Northwest Territories, Canada* (Sawatzky et al. 2007)
- *Assessment of Fisheries Potential of the Tuktoyaktuk to Source 177 All-Weather Road Impact Area* (IMG-Golder 2009)

RESULTS

FISH HABITAT

The field assessment at Gunghi Creek occurred on August 30, 2018. Fish habitat survey locations at Gunghi Creek are outlined in Figure 2 and habitat data for the creek are summarized in the attached habitat summary sheet. Photographs at each survey transect are also attached.

The existing crossing at Gunghi Creek is a 2 m wide by approximately 40 m long, round, corrugated steel culvert. At the time of the survey, flow was considered low and water depth in the culvert was approximately 0.08 m at its upstream end, and 0.15 m at its downstream end. Fish passage through the culvert may be impeded at low flows.

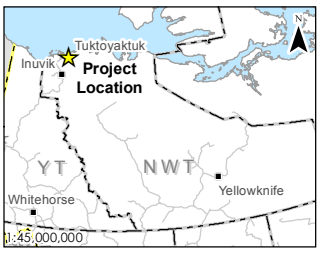
Immediately upstream of the existing culvert (i.e., ↑CL on the attached habitat summary sheet), Gunghi Creek flows from slow and shallow run/glide habitat into a shallow channelized pool section. In this area (↑CL), channel width was 8.4 m, wetted width was 7.6 m, and average pool depth was 0.75 m, with a residual pool depth of 0.67 m. Immediately downstream of the culvert (i.e., ↓CL on the habitat summary sheet), Gunghi Creek flows into a wider and deeper pool, which subsequently flows into slow and shallow run/glide habitat. This downstream pool was present before culvert construction, as indicated in photos from a 2009 field survey (i.e., Crossing #6 from IMG-Golder 2009). Downstream of the culvert (at ↓CL), channel width was approximately 15 m, wetted width was 7.0 m, and average pool depth was estimated around 1.0 m; residual pool depth of the downstream pool is unknown as sediments were soft and prevented safe wading.

Substrates immediately up and downstream of the culvert were dominated by fines with some organics and cobbles (upstream), and gravels, cobbles and boulders (downstream). Larger substrates (e.g., cobbles, boulders) are largely resultant from road and culvert construction and were not present at other survey transects further up or downstream of the culvert.

Stream banks were generally stable, up and downstream of the culvert, and shrubs (willows) were the dominant riparian vegetation, which typically hung over the creek channel. With the exception of banks disturbed during road and culvert construction, stream banks along Gunghi Creek were fully vegetated (100% coverage) and primarily comprised of fines. Where road and culvert construction disturbed stream banks, immediately up and downstream of the culvert, riparian vegetation coverage was less developed (50% coverage), dominated by grasses, and banks were primarily composed of fine-grained sediments and gravels.

Overall, the pool habitats up and downstream of the existing crossing of Gunghi Creek were rated as moderate for spawning for northern pike and small-bodied species (e.g., pond smelt, ninespine stickleback) that may prefer shallower pool areas with fine sediments and dense vegetation. Otherwise, spawning habitat is considered poor for coregonid species and those that prefer gravelly substrates. The pools may provide rearing habitat for migrating juvenile species; however, the pool habitats, and the rest of Gunghi Creek, are

too shallow to provide overwintering habitat for any species. Overall migration habitat of Gunghi Creek is considered good although the culvert may impede passage of fish during low flow conditions.



Gunghi Creek Flow Direction

Survey Transect Location

0 30 60 90 120 m

1:3,000 (at original document size of 8.5x11)

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Government of Northwest Territories

Project Location
NTS Mapsheet: 107C07

Project Number 144930112
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Client/Project
Government of Northwest Territories
Fish Habitat Assessments for Crossing Replacement

Figure No.
2

Title
Fish Habitat Survey Locations at KM 7.5 (Gunghi Creek) of NWT Highway 10 (Inuvik-Tuktoyaktuk Highway)

Notes
1. Coordinate System: NAD 1983 UTM Zone 8N
2. Data Sources: Imagery: Esri Digital Globe

FISH PRESENCE

Table 1 outlines the fish species that are known to occur, or have the potential to occur, within Gunghi Creek. Similar to other freshwater coastal drainages on the Tuktoyaktuk Peninsula, the Gunghi Creek system is likely a migration route for whitefish (coregonid) and other fish species between larger freshwater lakes (e.g., Tiktaliktuk Lake) and the coastal waters of Tuktoyaktuk Harbour (Bond & Erickson 1985, Chang-Kue & Jessop 1992). Fish were observed in Gunghi Creek during the August 2018 field survey, immediately up and downstream of the existing culvert. Fish were not identified to species but appeared to be juvenile coregonid species.

Table 1: Fish species known or expected to occur within Gunghi Creek, NT

Species	Scientific Name	Presence	Sport Fish?	NWT GSRank[5]	SARA Status[6]
Lake whitefish	*Coregonus clupeaformis*	Potential[1]	Yes	Secure	None
Broad whitefish	*Coregonus nasus*	Known[2]	Yes	Secure	None
Least cisco	*Coregonus sadinella*	Potential[1,2]	No	Secure	None
Northern pike	*Esox lucius*	Known[2]	Yes	Secure	None
Pond smelt	*Hypomesus olidus*	Potential[1]	No	Undetermined	None
Burbot	*Lota lota*	Potential[1]	Yes	Secure	None
Ninespine stickleback	*Pungitius pungitius*	Known[2]	No	Secure	None
Lake trout	*Salvelinus namaycush*	Potential[1]	Yes	Secure	None
Inconnu	*Stenodus leucichthys*	Potential[3,4]	Yes	Sensitive	None

Notes:
1. Bond and Erickson (1985), Chang-Kue and Jessop (1992)
2. IMG-Golder (2009)
3. Sawatsky et al. (2007)
4. The use of Gunghi Creek by inconnu ("coney") was suggested by the local wildlife monitor
5. NWT GSRank = species General Status Rank in the Northwest Territories (GNWT 2016)
6. SARA Status = species status under the federal *Species at Risk Act* (ECCC 2018)

Ninespine stickleback and pond smelt have been caught in coastal drainages of the Tuktoyaktuk Peninsula and resident populations of these species are known in tundra lakes of the peninsula (Chang-Kue & Jessop 1992). Burbot and lake trout may infrequently use these freshwater creek systems; they were caught in only small numbers in nearby Freshwater and Mayogiak Creeks, which also flow into the Tuktoyaktuk Harbour, similar to Gunghi Creek (Bond & Erickson 1985). Tiktaliktuk Lake, upstream of the Gunghi Creek crossing, is known by the authors to be a lake trout fishery for residents of Tuktoyaktuk. Finally, as noted in Table 1, inconnu (known locally as "coney") may also use Gunghi Creek, as suggested by the field crew's local wildlife monitor. Though inconnu have not been captured in Gunghi Creek, or reported in coastal drainages of the Tuktoyaktuk Peninsula (Bond & Erickson 1985, Chang-Kue & Jessop 1992), Tuktoyaktuk Harbour is an important overwintering area for the species (Sawatsky et al. 2007, and references therein).

Based on previous studies, anadromous coregonid species tend to dominate catches in these coastal freshwater drainage systems of the Tuktoyaktuk Peninsula. Seasonal migrations of broad whitefish, lake whitefish and least cisco have been documented in Freshwater and Mayogiak Creeks (Bond & Erickson 1985), and in Kukjuktuk Creek, which flows into the Mackenzie River estuary on the north side of the Tuktoyaktuk Peninsula. In the Freshwater and Mayogiak Creeks, upstream movement of these species

(particularly broad whitefish), from Tuktoyaktuk Harbour, generally occurred throughout the summer but was most intense in early summer (late June to early July), immediately after ice-out (Bond & Erickson 1985). Downstream movements, to Tuktoyaktuk Harbour, typically occurred later in summer (July to August) until freeze-up. Juvenile/young-of-year fish were the primary migrants observed in Freshwater and Mayogiak Creeks though some larger, mature spawning fish were also observed, particularly in downstream runs. Similar movements were observed in Kukjuktuk Creek for the same species (Chang-Kue & Jessop 1992).

Based on these results for coastal drainages in the Tuktoyaktuk area, it is believed that juvenile fish, particularly broad whitefish, use these freshwater streams (likely including Gunghi Creek) to migrate into feeding, rearing, and overwintering habitats in upstream freshwater lakes (Bond & Erickson 1985, Chang-Kue & Jessop 1992). Juveniles may remain in these lakes for a few years before returning to coastal habitats as immature fish. Immature fish may forage seasonally in these freshwater lakes and migrate down to coastal habitats and the Mackenzie River and Delta to overwinter, or they may remain in the freshwater lakes for the winter period. Mature broad whitefish primarily spawn in the Mackenzie River and these seasonal stream migrations may stop once sexual maturity is reached as few mature fish were captured in stream runs by Bond and Erickson (1985) or Chang-Kue and Jessop (1992). Conversely, immature and mature lake whitefish and least cisco may use these coastal habitats and freshwater streams and lakes for foraging during the open-water season and then primarily return to spawning and overwintering grounds in the Mackenzie River and Delta.

METHODS TO AVOID OR MITIGATE DISTURBANCE TO FISH HABITAT

Design of a replacement structure for the Gunghi Creek crossing has not been finalized at the date of this report however an arch bridge structure has been determined the most suitable for the crossing by GNWT-INF[2]. It is assumed construction activities will involve site preparation, trenching for culvert removal and new structure placement, and stream damming and pump-around if water is present. A winter construction period is anticipated given previous construction activities on NWT Highway 10 and expected low or no flow winter conditions in Gunghi Creek. Potential effects to fish and fish habitat of Gunghi Creek, resulting from crossing structure replacement, may include:

- Changes in channel morphology, including flow disruption and blockage of fish passage (if a closed-bottom structure used)
- Alteration or removal of fish habitat, including riparian vegetation during installation
- Increased erosion and sediment loading
- Introduction of deleterious substances (e.g., from hydrocarbon spills, sediments)

Winter construction will help to mitigate potential effects to fish and fish habitat given the expected seasonal (open-water) fish use of Gunghi Creek. To avoid or mitigate further disturbance to fish and fish habitat from crossing structure replacement, the following measures should be implemented, as outlined by Fisheries and Oceans Canada (2016):

- Erosion and sediment control:
  - Preparation and implementation of an Erosion and Sediment Control Plan to minimize erosion and sedimentation risk to Gunghi Creek throughout all project phases (i.e., site preparation to post-construction).

[2] The GNWT-INF's Design-Build Request for Proposals, titled *Gunghi Creek Culvert Replacement* (Event ID EV2618), dated August 21, 2018, identifies a "Buried Precast Concrete Arch Bridge Structure with an ad-freeze pile foundation" (p. 13) as the most suitable option for the crossing location.

  - The Erosion and Sediment Control Plan should include: installation of erosion and sediment control structures, measures for managing site water and isolating the site, measures for containing and stabilizing waste materials, inspection and maintenance procedures, and repair procedures.
  - Erosion and sediment control structures should be left in place until disturbed ground has stabilized, suspended sediments have resettled to the streambed, and runoff water is clear.
- Shoreline/bank re-vegetation and stabilization:
  - Minimize clearing of riparian vegetation (where possible, prune or top vegetation rather than uprooting/grubbing), minimize removal of any instream natural structures (e.g., woody debris, boulders; if removed, return to its original location), and use existing roads and trails to minimize further disturbance in the riparian area.
  - Stabilize stream shoreline or banks to prevent erosion and/or sedimentation: revegetate with native species to stabilize disturbed area; or, if using rock reinforcement/armouring, confirm rock is clean, appropriately-sized for flow conditions, and installed to maintain similar bank-shoreline slope and stream-shoreline alignments.
- Fish protection:
  - Confirm that in-water activities, and associated structures, will not interfere with fish passage, constrict channel width, reduce flows, or result in fish stranding or death
  - Adhere to restricted activity timing windows for the Northwest Territories. For Gunghi Creek, this is NWT Zone 1 and in-water work should be avoided during April 1 to July 15 given expected seasonal (open-water) fish use of the creek (i.e., winter construction).
- Operation of machinery:
  - Use machinery that is clean and in good working condition, maintained free of leaks or invasive weed species; operate machinery above the stream high-water mark wherever possible to minimize disturbance to the stream bed or banks
  - If machinery needs to cross/ford the stream, construct a snow bridge over the watercourse. The snow bridge should be V-notched once construction is completed.
  - Washing and refueling of machinery, as well as storage of fuels and materials, must occur well above the stream high-water mark, in a designated area, and in a way to prevent the introduction of any deleterious substances. A Spill Contingency Plan should be prepared and implemented throughout all project phases.

CONCLUSIONS

Gunghi Creek is a known fish-bearing stream that provides habitat to coregonid species (likely migratory), as well as northern pike and ninespine stickleback, and may provide habitat to other species given fish use observed in nearby coastal freshwater drainages of the Tuktoyaktuk Peninsula. The existing culvert at the NWT Highway 10 crossing may be impeding fish passage, particularly during low flow conditions and for larger fish.

Structure replacement and instream activities have the potential to impact fish and fish habitat of Gunghi Creek. Overall, fish passage is expected to improve with structure replacement, particularly if the current closed-bottom culvert is replaced with an arch structure or similar bottomless crossing type. The anticipated winter construction period for crossing structure replacement will help to mitigate potential effects to fish and fish habitat given the expected seasonal (open-water) fish use of Gunghi Creek; however, additional mitigation measures should also be implemented during all project phases, as appropriate, to further avoid or mitigate disturbance.

Reference: **Fish Habitat Assessment for Crossing Structure Replacement: NWT Highway 10 at Gunghi Creek**

CLOSURE

Stantec has prepared this technical memorandum for the GNWT-INF to document fish habitat conditions encountered during the August 2018 field survey of Gunghi Creek, known or expected fish use of the creek, and measures to avoid or mitigate disturbance to fish and fish habitat during crossing structure replacement activities. We trust the information contained within meets your immediate needs. Should you have questions or require additional information, please contact the undersigned at your convenience.

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Attachment: Gunghi Creek Habitat Summary Sheet
Gunghi Creek Field Photographs

REFERENCES

Bond, W.A., & Erickson, R.N. (1985). *Life history studies of anadromous coregonid fishes in two freshwater systems on the Tuktoyaktuk Peninsula, Northwest Territories*. Canadian Technical Report of Fisheries and Aquatic Sciences, 1336. Winnipeg, MB: Fisheries and Oceans Canada, 71 pp.

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GNWT-INF Fish Habitat Assessment for Crossing Structure Replacement

Gunghi Creek (NWT Highway 10 km 7.5)

UTM Location:	8W 577226 E, 7693941 W	**Survey Date:**	August 30, 2018
Legal Location:	n/a	**Channel Flow:**	Permanent
Crew Initials:	CS	**Restricted Activity Period:**	April 1 to July 15

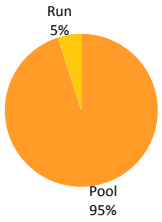
Physical Channel Transect Data

Transect # (Location)	1 (↑100)	2 (↑50)	3 (↑CL)	4 (↓CL)	5 (↓100)	6 (↓200)	7 (↓300)
Channel Width (m)	12	16	8.4	15	4.6	7.4	11
Wetted Width (m)	10	15	7.6	7.0	3.9	5.4	7.5
Residual Pool Depth (m)	unk.	unk.	0.67	unk.	0.15	0.18	unk.
Bankfull Depth (m)	2.0	2.0	1.0	1.7	1.0	1.1	1.5
Avg. Depth (m)	0.45	0.50	0.75	1.00	0.65	0.49	0.50
Gradient (%)	< 0.5	< 0.5	< 1	< 1	1	< 1	< 1
Pool / Riffle / Run (%)	20 / 0 / 80	30 / 0 / 70	90 / 0 / 10	100 / 0 / 0	45 / 10 / 45	0 / 0 / 100	0 / 0 / 100
Stream Bed							
Substrate (% of Transect Area) Organics	40	40	10	35	20	20	5
Fines	60	60	85	35	50	50	95
Gravel	0	0	0	10	30	30	0
Cobble	0	0	5	10	0	0	0
Boulder	0	0	0	10	0	0	0
Bedrock	0	0	0	0	0	0	0
D95 (cm)	< 1	< 1	30	45	10	5	< 1
D (cm)	< 1	< 1	10	10	2	2	< 1
Embeddedness (%)	0	0	10	20	50	50	0

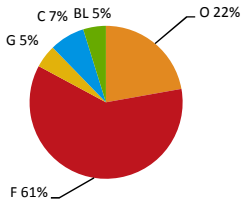
Bank Measurements	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Bank Height (m)	1	2	1	2	3	1	2	3	1	1	1.25	2	2	1.5
Bank Shape	S	V	S	S	V	S	S	S	S	S	S	S	S	S
Bank Slope (°)	30	45	30	20	45	10	20	25	35	30	17	17	35	10
Bank Stability	S	S	S	S	MS	S	S	MS	S	S	S	S	S	S
Vegetation Cover (%)	100	95	100	100	50	100	100	50	100	100	98	98	95	100
Riparian Width (m)	6	6	20	30	1.5	4	40	5	10	20	10	30	10	10
Riparian Veg. Type	S	S	S	S	G	S	S	G	S	S	S	S	S	S
Riparian Veg. Stage	SHR	SHR	SHR	SHR	INIT	SHR	SHR	INIT	SHR	SHR	SHR	SHR	SHR	SHR
Dom. Bank Texture	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Subdom. Bank Texture	NA	NA	NA	NA	G	O	NA	G	NA	NA	NA	NA	NA	NA

Habitat Inventory / Reach Data (CL)

Habitat Distribution



Substrate Composition



Cover Characteristics (CL)

%:	Total	LWD	SWD	DP	B	U	OV	IV
3 (↑CL)	80	0	10	20	1	5	40	25
4 (↓CL)	80	0	5	40	5	0	10	40

Instream Veg. Total (%):	50	LWD Function:	None
Instream Veg. Type:	Vascular	LWD Distribution:	None
Crown Closure (%):	< 1	Features:	CV

Water Quality Data (CL)

Time of Day (HH:MM):	12:00
Water Temperature (°C):	~ 5
Dissolved Oxygen (mg/L):	n/a
Sp. Conductivity (µs/cm):	n/a
pH:	n/a
Turbidity (NTU):	n/a

Channel Characteristic (CL)

Pattern:	IM
Islands:	I
Bars:	SD
Coupling:	DC
Confinement:	UN
Flow Stage:	Low

Fish Habitat Assessment Ratings (CL)

	Quality	Comments
Spawning:	Moderate	Pools @ CL may provide habitat (NRPK)
Overwintering:	Poor	Pools @ CL likely too shallow
Rearing:	Moderate	Pools @ CL may provide habitat
Passage:	Poor-Moderate	CV impede passage at low flow

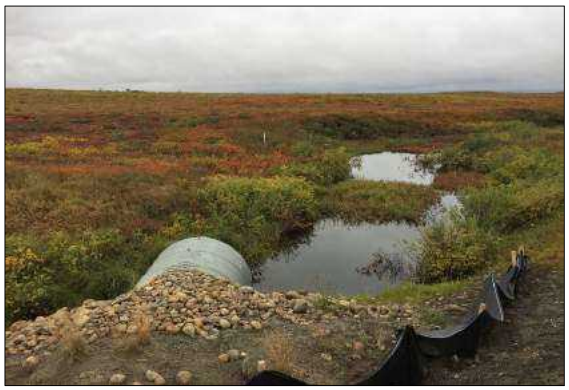


Photo 1: Facing upstream at centerline (↑CL).

Photo 2: Facing downstream at centerline (↓CL).

Fish Sampling Data

Method	Effort	
No Electrofishing	-	(s)
No Trapping	-	(hr)

Electrofisher Settings

Volts	Freq. (Hz)	Duty Cycle (%)	Dist. (m)
-	-	-	-

Species	Efish Catch (n)	Trap Catch (n)	Efish CPUE (#fish/100s)	Trap CPUE (#fish/hr)	Rel. Abundance (% of total)
-	-	-	-	-	

General Comments

- Culvert at CL approx. 2.0 m by 40 m, upstream end appears perched, not sufficiently buried & likely impedes passage of large-bodied fish at low flow conditions
- Small fish (unidentified, possible juvenile Coregonid species) observed in creek at CL - upstream & downstream of culvert
- DFO restricted activity timing window based on spring/summer spawning use of Gunghi Creek (in Zone 1)

Stantec

GNWT-INF Fish Habitat Assessment for Crossing Structure Replacement

Gunghi Creek (NWT Highway 10 km 7.5)

UTM Location:	8W 577226 E, 7693941 W	**Survey Date:**	August 30, 2018
Legal Location:	n/a	**Channel Flow:**	Permanent
Crew Initials:	CS	**Restricted Activity Period:**	April 1 to July 15

Abbreviations & Acronyms

Bank Measurements

Bank Shape

U	Undercut banks, protrude over wetted portion
V	Vertical, steep (45 - 90°)
S	Sloping, gradual (<45°)
O	Overhanging, protude over wetted & non-wetted portion

Bank Stability

S	Stable
MS	Moderately stable
US	Unstable

Bank Texture/Substrate Composition

O	Organics	BL	Boulder
F	Fines	BD	Bedrock
G	Gravel	NA	Not Applicable/none
C	Cobble		

Riparian Veg. Type

N	None
G	Grass
S	Shrub
C	Coniferous
D	Deciduous forest
M	Mixed coniferous and deciduous forest
W	Wetland

Riparian Veg. Stage

INIT	Initial, non-vegtated or initial stage following a disturbance (<5% cover)
SHR	Shrub/herb stage, <10% tree cover
PS	Pole-sapling stage, with trees overtopping shrubs. Stand age <20 yrs
YF	Young forest, self-thinning evident & forest canopy has distinct layers; stand age <80 yrs
MF	Mature forest with canopy gaps and well-developed understory
NA	Not applicable, when riparian vegetation is absent, grass or wetland (specify)

Cover Characteristics

Cover Types

LWD	Large woody debris
SWD	Small woody debris
DP	Deep pools
B	Boulder
U	Undercut banks
OV	Overhanding banks
IV	Instream vegetation

Features

BD	Beaver dam	HCE	Erosion/Sedimentation	D	Dam, general
BG	Crossing, general	FLD	Falls (> 2 m)	FSB	Subsurface flow
BR	Bridge	FD	Ford	TRB	Tributary
C	Cascade or chute	GE	Groundwater, field evidence	VB	Velocity barrier
CN	Canyon	HD	Hydro dam		
CV	Culvert	LS	Landslide or bank sloughing		
FLD	Dewatering	X	LWD jam		

Channel Characteristics

Pattern		Islands		Bars		Coupling		Confinement	
ST	Straight	N	None	N	None	DC	Decoupled	EN	Entrenched
SI	Sinuous	O	Occasional	SD	Side bar/point bar	PC	Partially coupled	CO	Confined
IR	Irregular, wandering	I	Irregular	DG	Diagonal bar	CO	Coupled	FC	Frequently Confined
IM	Irregular, meandering	F	Frequent	MD	Mid-channel bar			OC	Occasionally Confined
ME	Regular meanders	S	Split	SP	Span			UN	Unconfined
TM	Torturous meander	AN	Anastomizing	BR	Braided			NA	Not Applicable

Stantec

Photographic Log

Client:	**GNWT-INF**	**Project:**	**144930112**
Site Name:	**Gunghi Creek (KM 7.5)**	**Site Location:**	**NWT Highway 10**

Photograph ID: 1

Photo Location:
Gunghi Creek, 100 m upstream of existing culvert (facing upstream)

Direction:
Northwest

Survey Date:
8/30/2018

Comments:

Photograph ID: 2

Photo Location:
Gunghi Creek, 100 m upstream of existing culvert (facing downstream)

Direction:
Southeast

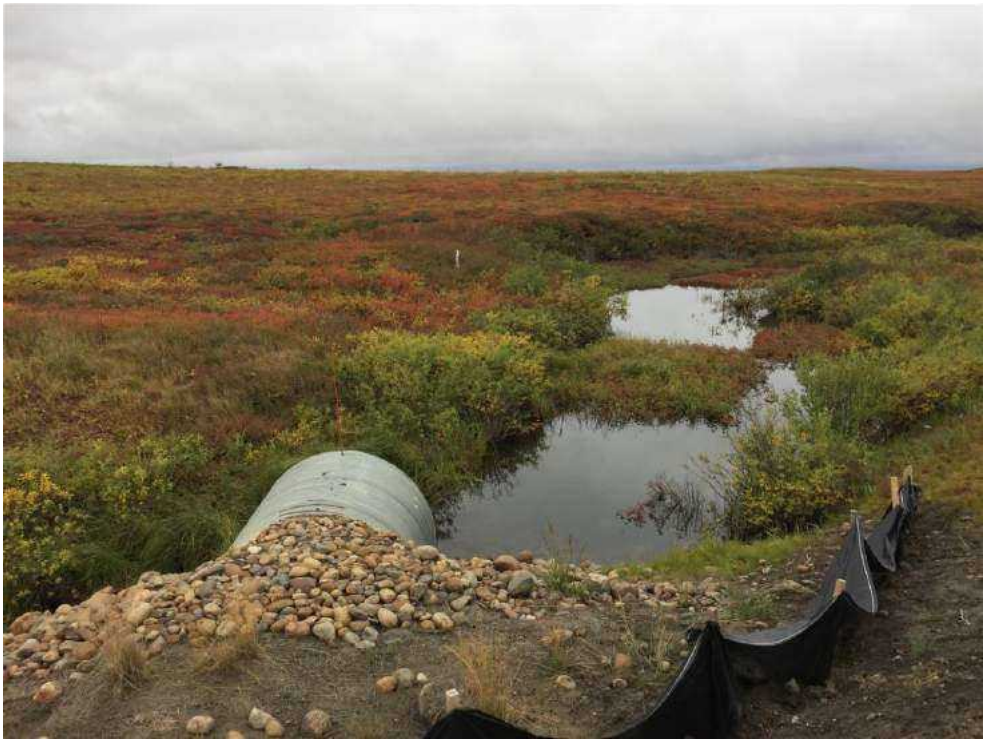
Survey Date:
8/30/2018

Comments:

Client:	**GNWT-INF**	**Project:**	**144930112**
Site Name:	**Gunghi Creek (KM 7.5)**	**Site Location:**	**NWT Highway 10**

Photograph ID: 3 **Photo Location:** Gunghi Creek, 50 m upstream of existing culvert (facing upstream) **Direction:** Northwest **Survey Date:** 8/30/2018 **Comments:**	
Photograph ID: 4 **Photo Location:** Gunghi Creek, 50 m upstream of existing culvert (facing downstream) **Direction:** East **Survey Date:** 8/30/2018 **Comments:**	

Client:	**GNWT-INF**	**Project:**	**144930112**
Site Name:	**Gunghi Creek (KM 7.5)**	**Site Location:**	**NWT Highway 10**

Photograph ID: 5	
Photo Location: Gunghi Creek, upstream end of existing culvert (facing upstream)	
Direction: West	
Survey Date: 8/30/2018	
Comments:	

Photograph ID: 6	
Photo Location: Gunghi Creek, upstream end of existing culvert (facing right bank)	
Direction: South	
Survey Date: 8/30/2018	
Comments:	

Client:	**GNWT-INF**	**Project:**	**144930112**
Site Name:	**Gunghi Creek (KM 7.5)**	**Site Location:**	**NWT Highway 10**

Photograph ID: 7 **Photo Location:** Gunghi Creek, upstream end of existing culvert (facing left bank) **Direction:** North **Survey Date:** 8/30/2018 **Comments:**	
Photograph ID: 8 **Photo Location:** Gunghi Creek, upstream end of existing culvert (facing downstream) **Direction:** East **Survey Date:** 8/30/2018 **Comments:**	

Client:	**GNWT-INF**	**Project:**	**144930112**
Site Name:	**Gunghi Creek (KM 7.5)**	**Site Location:**	**NWT Highway 10**

Photograph ID: 9

Photo Location:
Gunghi Creek, downtream end of existing culvert (facing downstream)

Direction:
East

Survey Date:
8/30/2018

Comments:

Photograph ID: 10

Photo Location:
Gunghi Creek, downstream end of existing culvert (facing right bank)

Direction:
South

Survey Date:
8/30/2018

Comments:

Client:	**GNWT-INF**	**Project:**	**144930112**
Site Name:	**Gunghi Creek (KM 7.5)**	**Site Location:**	**NWT Highway 10**

Photograph ID: 11

Photo Location:
Gunghi Creek, downstream end of existing culvert (facing left bank)

Direction:
North

Survey Date:
8/30/2018

Comments:

Photograph ID: 12

Photo Location:
Gunghi Creek, downstream end of existing culvert (facing upstream)

Direction:
West

Survey Date:
8/30/2018

Comments:

Client:	**GNWT-INF**	**Project:**	**144930112**
Site Name:	**Gunghi Creek (KM 7.5)**	**Site Location:**	**NWT Highway 10**

Photograph ID: 13

Photo Location: Gunghi Creek, 100 m downstream of existing culvert (facing upstream)

Direction: Northwest

Survey Date: 8/30/2018

Comments:

Photograph ID: 14

Photo Location: Gunghi Creek, 100 m downstream of existing culvert (facing downstream)

Direction: Southeast

Survey Date: 8/30/2018

Comments:

Client:	**GNWT-INF**	**Project:**	**144930112**
Site Name:	**Gunghi Creek (KM 7.5)**	**Site Location:**	**NWT Highway 10**

Photograph ID: 15

Photo Location: Gunghi Creek, 200 m downstream of existing culvert (facing upstream)

Direction: Northeast

Survey Date: 8/30/2018

Comments:

Photograph ID: 16

Photo Location: Gunghi Creek, 200 m downstream of existing culvert (facing downstream)

Direction: Southwest

Survey Date: 8/30/2018

Comments:

Client:	**GNWT-INF**	**Project:**	**144930112**
Site Name:	**Gunghi Creek (KM 7.5)**	**Site Location:**	**NWT Highway 10**

Photograph ID: 17

Photo Location:
Gunghi Creek, 300 m downstream of existing culvert (facing upstream)

Direction:
South

Survey Date:
8/30/2018

Comments:

Photograph ID: 18

Photo Location:
Gunghi Creek, 300 m downstream of existing culvert (facing downstream)

Direction:
North

Survey Date:
8/30/2018

Comments:

Detailed Hydrotechnical Report

Gunghi Creek Culvert Replacement
Km 131.2 Inuvik Tuktoyaktuk Highway (No. 10)
Project # EB193003

Prepared for:

Department of Infrastructure
Government of the Northwest Territories
Stuart M. Hodgson Building, 1st Floor, 5009 49th Street, Yellowknife, NT X1A 2L9

29 August 2019

Wood Environment & Infrastructure Solutions
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29 August 2019

Mr. Amir Khatibi, P.Eng.
Senior Project Officer
Government of the Northwest Territories
Department of Infrastructure
Stuart M. Hodgson Building, 1st floor
5009 49th Street
Yellowknife, NT X1A 2L9

Dear Mr. Khatibi,

Please find attached a copy of the Detailed Hydrotechnical Engineering Report for the Gunghi Creek culvert replacement.

If you have any questions, please contact the undersigned.

Sincerely,

Wood Environment & Infrastructure Solutions
a Division of Wood Canada Limited

Riaz Abbas, M.Eng., P.Eng.
Bridge Manager
T: (780) 377-3613
E: riaz.abbas@woodplc.com

Detailed Hydrotechnical Report

Gunghi Creek Culvert Replacement
Project # EB193003

Prepared for:

Department of Infrastructure
Government of the Northwest Territories
Stuart M. Hodgson Building, 1st Floor, 5009 49th Street, Yellowknife, NT X1A 2L9

Prepared by:

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29 August 2019

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Third-party disclaimer

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1.0 Introduction

Wood Environment & Infrastructure Solutions (Wood) was retained by Allen Services & Contracting Ltd. to complete an hydrotechnical assessment for the Gunghi Creek culvert replacement. This crossing is located at the north end of the Inuvik to Tuktoyaktuk Highway (ITH) at approximately km 131.2. It is south of Tuktoyaktuk and north of the Source 177 access road. In April 2010, the Gunghi Creek culvert consisting of a 2000 mm in diameter CSP with an invert length of 38 m was constructed. In June 2011, excessive jacking of the pipe required rehabilitation measures to be taken. Repairs were done. Nonetheless, the current state of the culvert requires replacement due to major sagging in the center. Gunghi Creek is located in a permafrost rich area prone to major icinig that contributes to culvert ice plugging which additionally undermines and endangers the embankments.

This report provides the detailed hydrotechnical information for the Gunghi Creek culvert replacement.

2.0 Hydrology

Gunghi Creek flows from west to east within ITH crossing area. The drainage area upstream of the Gunghi Creek crossing consists of tundra with several lakes. Near the crossing, a lake is located approximately 200 m upstream and several pools have been documented (Bonhomme, 2018). Figure 2-1 shows characteristic of the Gunghi Creek at the crossing. Substrates immediately upstream and downstream of the crossing are mainly fines with some organics and cobbles (upstream), and gravels, cobbles and boulders (downstream) (Bonhomme, 2018). Larger substrates (e.g. cobbles and boulders) are only located immediately upstream and downstream of the crossing indicating that they were likely deposited during the road and culvert construction (Bonhomme, 2018). The floodplain consists of mosses and shrubs (Stantec, 2018). Based on survey information, the average streambed width, height of bank and top width of the channel are 5.9 m, 0.96 m and 9.1 m, respectively.

The Atlas of Canada – Toporama tool was used to delineate the drainage basin upstream the crossing. An approximate value of 60 km^2 was estimated as shown in Figure 2-2. A value of 56 km^2 was previously estimated by Stantec which is in the same order of magnitude (Stantec, 2018). The lake area is approximately 30% of the 60 km^2 watershed area.

Mr. Lee McMann (Allen Services & Contracting Ltd.), Mr. Riaz Abbas, P.Eng. (Wood) and Mr. Arshed Mahmood (Wood) conducted a site visit on July 25, 2019 to assess site conditions in regard to Gunghi Creek hydrotechnical assessment and open bottom concrete arch structure constructability. Site visit photos are included in **Appendix A.**

The design flow as per the request for proposals is a 1:100 year return period flow (Q_{100}). A regional analysis was used to estimate Q_{100} based on the regional flood frequency curve developed by Kavik-Stantec (Kavik-Stantec, 2012). With this method, Q_{100} was estimated to be 16 m^3/s. Stantec also used the regional flood frequency curve developed by Kavik-Stantec and their estimated Q_{100} was 15 m^3/s which is in the same order of magnitude as the estimated value by Wood (Stantec, 2018). A surveyed cross-sections was also modeled with Alberta Transportation (AT) HydroChan tool (Version 1.3) which is 1-D flow model, to verify the channel capacity based on its morphology. A surveyed channel slope of 0.0015 m/m was used in the model. The results show that the floodplain would be activated for Q_{100} and the depth of water over the floodplain would be 0.6 m. This value is reasonable when considering Gunghi Creek morphology. The HydroChan results are presented in **Appendix B**.

This study also considered a check flow (Q_{check}). Based on experience with ITH, a Q_{check} of 2 times Q_{100} was used. The value of Q_{check} is therefore 32 m^3/s. The 1:2 year return period flow (Q_2) was also calculated for the Gunghi Creek crossing based on the regional flood frequency curve developed by Kavik-Stantec (Kavik-Stantec, 2012). Q_2 was calculated to be 4.8 m^3/s. As per the request for proposal,

the 3 day delay flow with a probability of 1:10 year (3Q10) was used for fish passage. 3Q10 was estimated by using a regional frequency analysis. Since Gunghi Creek at crossing location is ungauged creek, Fish flow 3Q10 was estimated using a regional analysis as per the Guide to Bridge Hydraulics (Edition 2004, Section 2.3.2 Design Discharge and High Water Levels) the methodology as per the Introduction to Fishway Design by Chris Katopodis, P.Eng. (1992 Edition, Section 5 Fishway Hydraulics) and tool developed by Alberta Transportation. These are industry accepted practices used to calculate 3Q10 flow. The Water Survey Canada (WSC) gauges used for the regional frequency analysis were the same as the one used by Kavik-Stantec (Kavik-Stantec, 2012). Table 2-1 provides the 3Q10 results for the WSC gauges assessed. Based on these results, a regional equation that can be applied to an un-gauged stream crossing was calculated and it is shown in Figure 2-3. For Gunghi Creek, 3Q10 was estimated to be 6.6 m^3/s based on the equation shown in Figure 2-3.
Table 2-2 provides a summary of the flows assessed for this study.

Figure 2-1 Gunghi Creek Crossing at km 131.2 ITH (No. 10)

Table 2-1: 3Q10 Estimate for WSC Gauges

Station ID	Station Name	Drainage Area (km^2)	3Q10 (m^3/s)
10LC017	Havikpak Creek near Inuvik	15	2.0
10LC010	Boot Creek near Inuvik	28	3.2
10ND002	Trail Valley Creek near Inuvik	68	9.0
10LC003	Rengleng River below Hwy No. 8 (Dempster Highway)	1,300	88.8
10LC007	Caribou Creek above Hwy No. 8 (Dempster Highway)	590	40.5

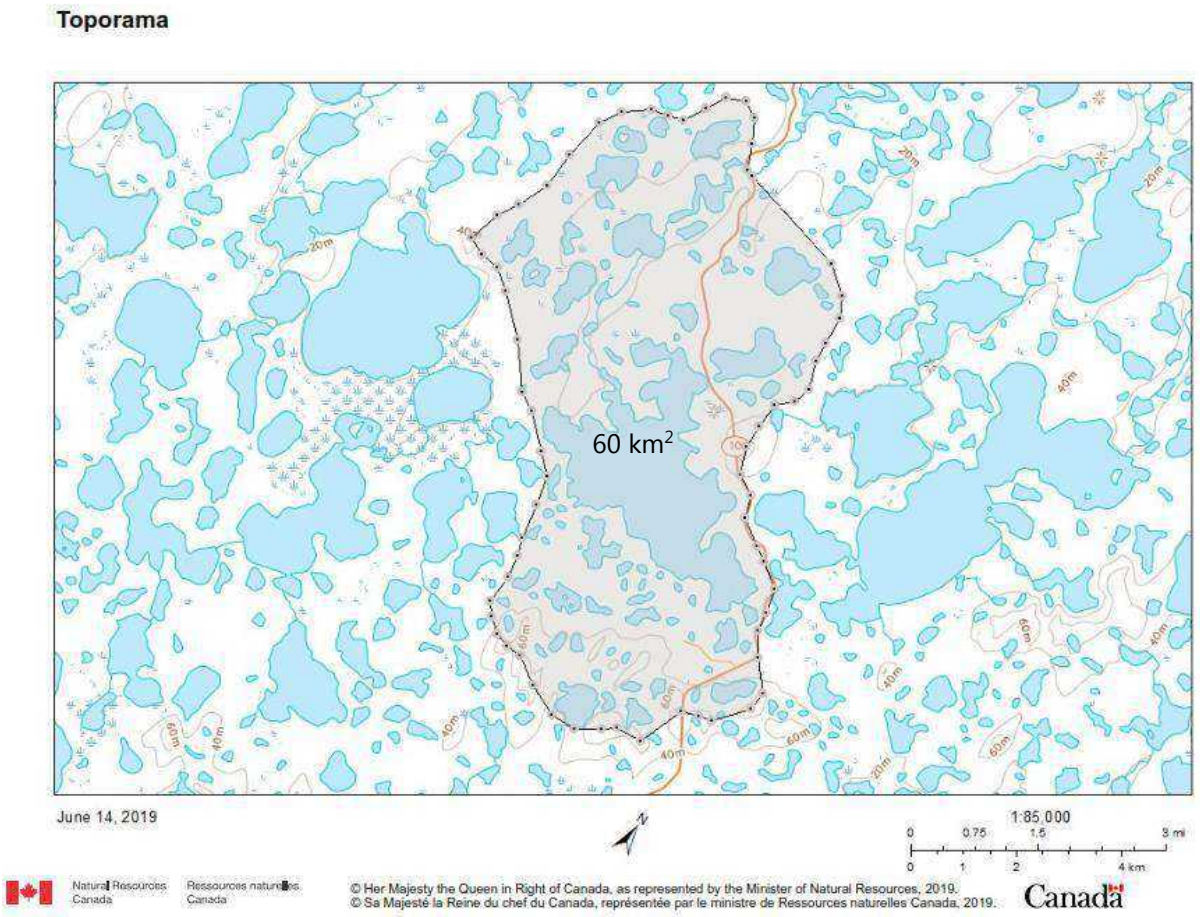
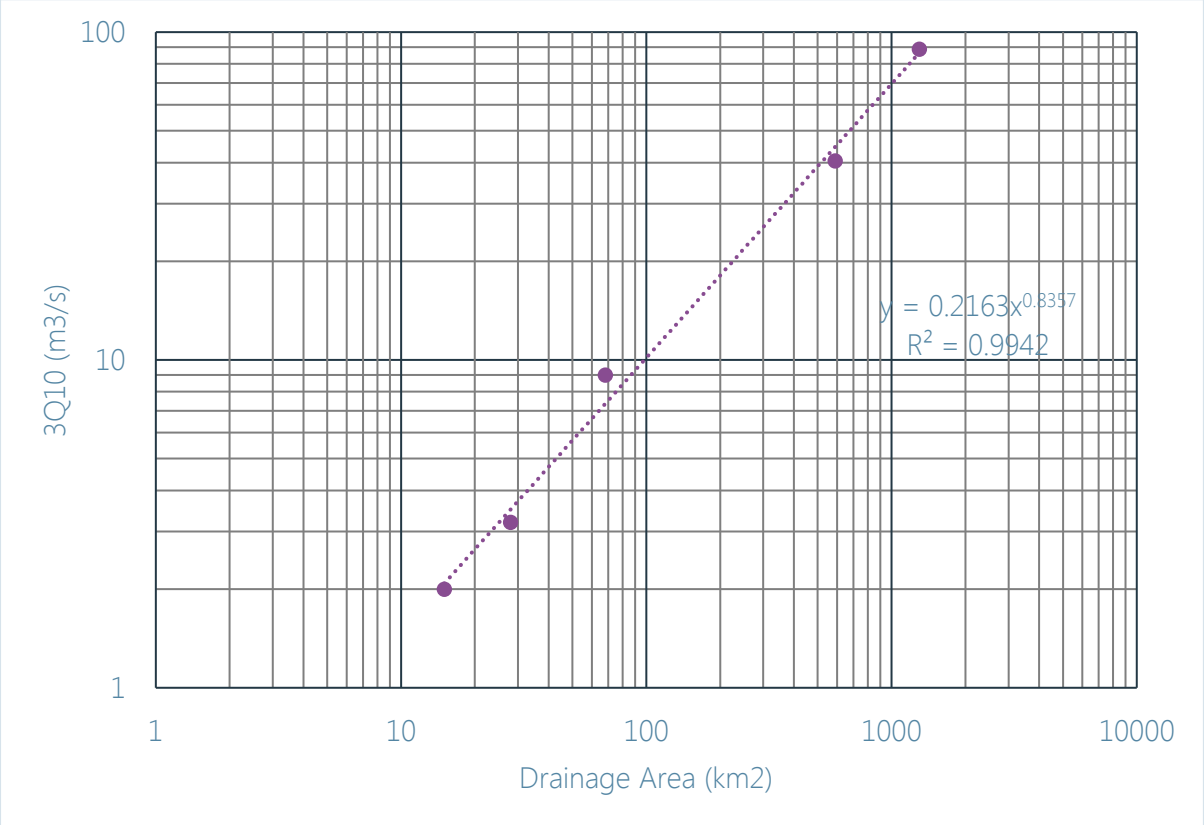


Figure 2-2 Drainage Area Upstream of Gunghi Creek Crossing

Table 2-2: Estimated Flows for Gunghi Creek Crossing

Return Period	Flow (m^3/s)
Q_{100}	16
3Q10 (fish passage flow)	6.6
Q_2	4.8
Q_{check}	32



3.0 Ice

Photos of the ice buildup in the existing 2000 mm in diameter culvert was available as part of the request for proposal. Based on these photos, the ice thickness appears to be 1.2 m. A design ice thickness of 0.8 m was provided by Stantec (Stantec, 2018). On April 6, 2018, drilling on both upstream and downstream side of Gunghi Creek was carried out to measure ice thickness according to the Government of Northwest Territories (GNWT) Department of Infrastructure (email to Wood, June 20, 2019). Based on this email, a maximum ice thickness of 1.4 m was measured on the downstream side of the culvert 3.0 m away from the outlet on the creek centerline. The ice was made of 2 distinct layers of frozen water and overflow. The email also mentioned that the creek is prone to thick icing events particularly if an obstacle is introduced into the creek which causes ice built-up and leads to complete inlet ice blocking.

As part of this assessment, a report produced by the Northwest Territories Geological Survey (NWTGS) was reviewed (Connon et al., 2019). This report provided preliminary analysis of historical climate and hydrometric data which illustrated that warmer and wetter late summer conditions are occurring as well as rising fall and winter discharge in small streams along the Dempster Highway. It also summarizes field instrumentation and general site conditions at locations where icing and infrastructure dynamics are being investigated in detail. The report also mentions that preliminary field observations reveal that icings is predominantly related with small watersheds (< 30 m^2) characterized with lake storage capacity. It also mentions that optical and thermal unmanned aerial vehicle (UAV) surveys were effective at delineating icing extents, seasonal surface displacements related with injection ice development and degradation and water tracks. Further work will resume in developing datasets and assessing the potential of using UAV methods to assess icing volumes. At this time, the study did not provide information that would help estimate the design ice thickness for the Gunghi Creek. Nonetheless, pressure transducers were installed on Gunghi Creek downstream of ITH as part of this study. Pressure transducers will provide concurrent records of water level or hydrostatic water level which is the level to which water would rise if a hole was drilled through the ice cover.

Wood has also tried to contact the Aurora College which have research professionals that currently have their focus on ITH. Unfortunately, Wood was not able to talk to any research professionals focused on ITH prior to the completion of this report.

Based on engineering judgement, site visit, considering all the information gathered, an ice thickness of 1.5 m was estimated for the Gunghi Creek crossing under ITH at Km 131.2.

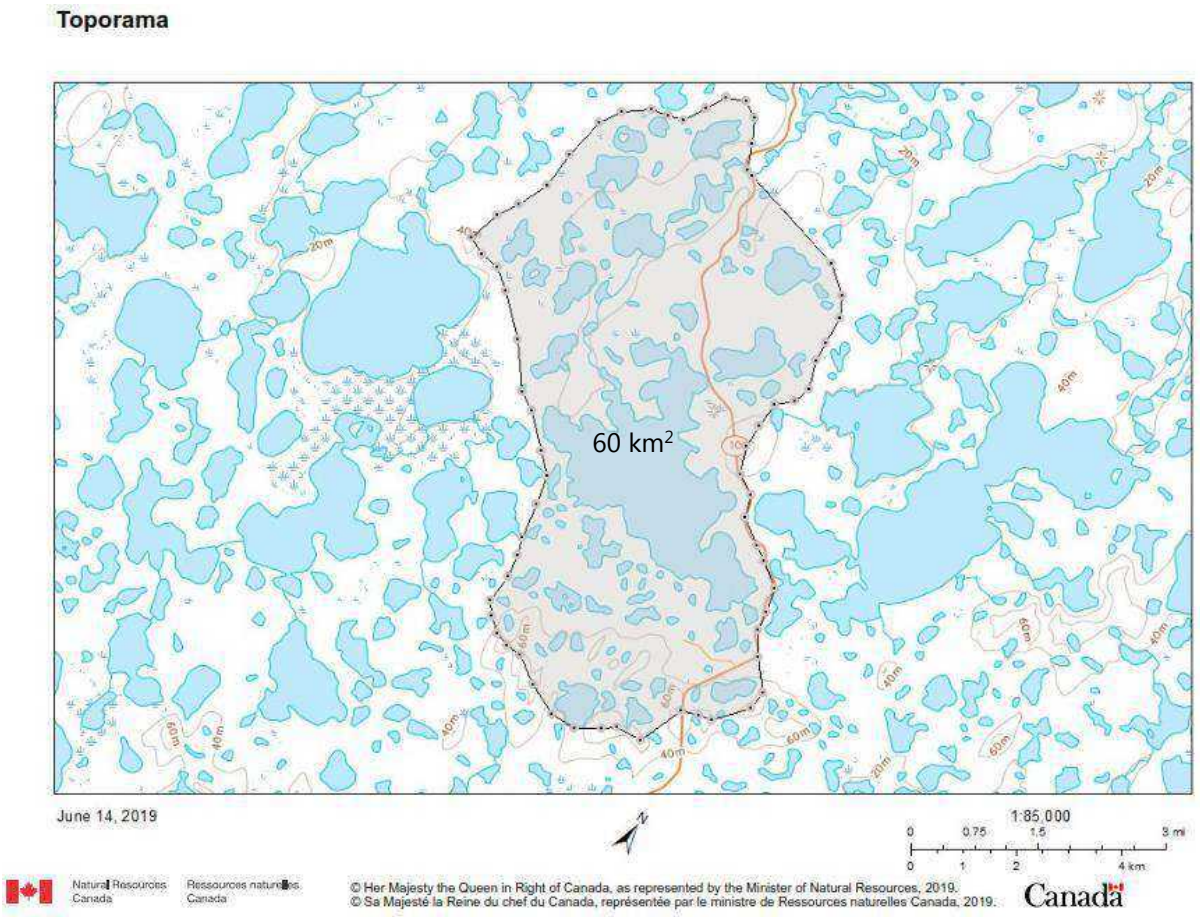


Figure 3-1 Drainage Area Upstream of Gunghi Creek Crossing

4.0 Structure Hydraulics

The proposed replacement structure at the Gunghi Creek crossing is a 7518 mm wide and 3500 mm high open bottom concrete arch culvert with an invert length of 38.966 m on a 40° right hand forward skew with ITH CL at Km 131.2. The instream footprint of the proposed structure is significantly less than the existing 2000 mm in diameter CSP. It also provides adequate flow capacity during design flood (Q100) and spring freshet over design ice events.

AT's HydroCulv software was used for the hydraulic analysis of the open bottom concrete arch culvert. Detailed results are included in **Appendix B**. Table 4-1 below provides details of the open bottom arch culvert hydraulic response for open water (i.e. **with no ice condition**). Table 4-2 below provides details of the open bottom concrete arch culvert hydraulic response **with 1.5 m of ice**.

Table 4-1: Hydraulic Summary for Open Bottom Concrete Arch Culvert with Open Water Condition

Flow	Natural Channel		Concrete Arch Culvert		
	Depth (m)	Velocity (m/s)	Inlet Velocity (m/s)	Outlet Velocity (m/s)	Freeboard (m)
Q_{100} (16 m^3/s)	1.7	0.9	1.7	1.8	1.6
3Q10 (6.6 m^3/s)[1]	1.3	1.01	0.97	0.95	2.1
Q_2 (4.8 m^3/s)	1.1	0.98	0.87	0.84	2.3
Q_{check} (32 m^3/s)	2.3	1.1	2.5	2.6	0.7

Note(s)

1. 3Q10 is fish passage flow.

Table 4-2: Hydraulic Summary for Open Bottom Concrete Arch Culvert with 1.5 m Ice Condition

Flow	Natural Channel		Concrete Arch Culvert		
	Depth (m)	Velocity (m/s)	Inlet Velocity (m/s)	Outlet Velocity (m/s)	Freeboard (m)
Q_{100} (16 m^3/s)	1.7	0.9	1.9	1.8	0.1
3Q10 (6.6 m^3/s)	1.3	1.01	0.91	0.88	0.7
Q_2 (4.8 m^3/s)	1.1	0.98	0.76	0.73	0.9
Q_{check} (32 m^3/s)	2.3	1.1	3.5	3.5	-1.3

Note(s)

1. 3Q10 is fish passage flow.

Table 4-1 shows that the open water velocity within the proposed concrete arch culvert are smaller than the channel velocity for low flows (Q_2 and 3Q10). This comparison between the mean velocities demonstrate that the fish can swim in the proposed concrete arch culvert since velocities in the culvert are lower than the natural channel section for Q_2 and the fish flow (3Q10). Table 4-1 also shows a freeboard of 1.6 m for the design flow (Q_{100}) and 0.7 m for the check (Q_{check}).

The 3Q10 (or 3DQ10) is the acceptable delay for fish passage. Fish passage is normally estimated for the results of frequency analyses that take into consideration the streamflow for each year that corresponds to the largest streamflow that is equaled or exceeded for 3 consecutive days during the spawning migration period. The 3 day delay discharge with a 10% probability (3DQ10) of exceedance is typically selected as the fish passage discharge (velocity).

During winter conditions, it is expected that Gunghi Creek would have low or no flow (Bonhomme, 2018). It is also expected that fish use of Gunghi Creek is seasonal (open-water) (Bonhomme, 2018). Therefore, the culvert velocities under ice conditions would likely not impact fish migration. Table 4-2 also shows the freeboard is 0.1 m for Q_{100} . Based on the velocity calculated for Q_{100}, Class 1 rock riprap is recommended for this project. A summary of the hydrotechnical design parameters are provided in Table 4-3 and **Appendix C** provides preliminary drawings of the proposed replacement structure.

Table 4-3: Bridge Hydraulic Summary for Gunghi Creek Open Bottom Concrete Arch Culvert Replacement

Bridge Hydraulic Summary	
Drainage area	60 km^2
Average estimated channel slope	0.0015 m/m
Design streambed elevation	0.63 m
Design streambed width	5 m
Design ice thickness	1.5 m
Design discharge (Q_{100})	16 m^3/s
Open water depth of flow in concrete arch culvert during Q_{100}	1.9 m
Ice condition, depth of flow in concrete arch culvert during Q_{100}	3.4 m
Open water freeboard for Q_{100}	1.6 m
Fish discharge (3Q10)	6.6 m^3/s
Open water depth of flow in concrete arch culvert during 3Q10	1.4 m
Q_2	4.8 m^3/s
Open water depth of flow in concrete arch culvert during Q_2	1.2 m
Q_{check}	32 m^3/s
Open water depth of flow in concrete arch culvert during Q_{check}	2.8 m
Rock riprap	Class 1

5.0 Fish Passage at Gunghi Creek

Table 5-1 lists the known or expected fish species reported in Gunghi Creek (Stantec 2018). Of the nine (9) fish species identified as potentially occurring in the creek, only 3 species (broad whitefish, northern pike, and ninespine stickleback) were identified as being known to inhabit the creek. None of the suspected nine species are listed as a species classified as extirpated, endangered or threatened under *Species at Risk Act*. Based on regional observations of the fish habitat in the freshwater coastal drainages of the Tuktoyaktuk Peninsula, as summarized by Stantec (2018), fish habitat within the vicinity of the crossing likely supports reported migratory coregonid species, foraging lake whitefish and least cisco, and all life stages and functions of northern pike and ninespine stickleback. Stantec (2018) also reported that there is potential for use by other species potentially present in Gunghi Creek given utilization of similar freshwater drainages nearby.

The pool habitats upstream and downstream of the Gunghi Creek crossing were rated by Stantec (2018) as 'moderate' for spawning of northern pike and small-bodied species. Otherwise, spawning habitat was considered poor for coregonid species. Pools habitats along Gunghi Creek were considered to be too shallow to provide overwintering habitat for any species.

Table 5-1: Fish Species Known or Expectd to Occur Within Gunghi Creek, NT[1]

Species	Scientific Name	Presence	Sport Fish?	NWT GSRank[5]	SARA Status[6]
Lake whitefish	*Coregonus clupeaformis*	Potential[1]	Yes	Secure	None
Broad whitefish	*Coregonus nasus*	Known[2]	Yes	Secure	None
Least cisco	*Coregonus sadinella*	Potential[1,2]	No	Secure	None
Northern pike	*Esox lucius*	Known[2]	Yes	Secure	None
Pond smelt	*Hypomesus olidus*	Potential[1]	No	Undetermined	None
Burbot	*Lota lota*	Potential[1]	Yes	Secure	None
Ninespine stickleback	*Pungitius pungitius*	Known[2]	No	Secure	None
Lake trout	*Salvelinus namaycush*	Potential[1]	Yes	Secure	None
Inconnu	*Stenodus leucichthys*	Potential[3,4]	Yes	Sensitive	None

Notes:

1. Bond and Erickson (1985), Chang-Kue and Jessop (1992)
2. IMG-Golder (2009)
3. Sawatsky et al. (2007)
4. The use of Gunghi Creek by inconnu ("coney") was suggested by the local wildlife monitor
5. NWT GSRank = species General Status Rank in the Northwest Territories (GNWT 2016)
6. SARA Status = species status under the federal *Species at Risk Act* (ECCC 2018)

The replacement open bottom concrete arch culvert was designed to accommodate migratory adult northern pike suspected to be utilizing the watercourse crossing structure during peak flows. As per the DFO Tool, at the design velocity 0.97 m/s (inlet velocity, Table 4.1), 50% of northern pike can swim a distance of 13 m, while 87.5% can swim 6 m. Accordingly, the arch culvert design can incorporate rock boulders (Class 2 [800 mm in diameter]) spaced at 5.0 m intervals along the arch culvert invert to provide rest areas for fish and promote fish passage. Katopodis and Gervais (2016) have identified that fish have the ability to detect and utilize zones of lower velocity, where the Class 1 riprap along the headslopes and bank margin and Class 2 rock boulders are expected to increase roughness and reduce local flow velocities through flow turbulence and provide resting areas for fish moving upstream. As such, fish passage for northern pike is anticipated to be accommodated through the replacement structure with the installation of the Class 2 rock boulders and Class 1 riprap to provide resting areas (See Drawings in Append C)

Further, the proposed crossing, associated riprap protection, low flow channel design, and channel enhancement have been designed to improve and maintain channel connectivity and the natural flow regime through the replacement structure, at the 1:2 year flood, as shown in Table 4-1, and at a lower flow velocity than the existing natural channel.

[1] Stantec 2018

6.0 Conclusion

The proposed replacement structure at the Gunghi Creek crossing is 7518 mm wide x 3500 mm high open bottom concrete arch culvert with an invert length of 38.97 m on a 40° right hand forward skew with ITH CL at Km 131.2. Based on Wood Environment & Infrastructure Solutions hydrotechnical assessment presented above for the proposed replacement structure provides adequate flow capacity during design flood (Q100) and design flood over design ice (spring freshet) events with freeboard of 1.6 m and 0.1 m, respectively. The instream footprint of the proposed structure is significantly less than the existing 2000 mm diameter x 38 m long CSP.

This structure also provides fish passage during fish passage design flow (Q2 and 3Q10) events. The replacement open bottom concrete arch culvert was designed to accommodate migratory adult fish suspected to be utilizing the watercourse crossing structure during peak flows.

Proposed arch culvert preliminary design drawings are included in **Appendix C.**

7.0 Closure

Please contact the undersigned should you have any questions or comments regarding this report.

Wood Environment & Infrastructure Solutions
a Division of Wood Canada Limited

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Bridge / Water Resource Engineer

Jessica Parker, B.Sc., P. Biol.
Environmental Biologist

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Senior Environmental Geoscientist

Permit to Practice No. P047

Reviewed by:

REGISTERED PROFESSIONAL ENGINEER
A. MAHMOOD
LICENSEE
NT/NU

August 29, 2019

Arshed Mahmood, M.Sc., P.Eng.
Bridge / Water Resource Engineer

8.0 References

Bonhomme, E. (October 15, 2018). *Fish Habitat Assessment for Crossing Structure Replacement: NWT Highway 10 at KM 7.5 (Gunghi Creek)* [Memorandum]. Yellowknife, NT: Stantec.

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Katopodis, C, and R Gervais. 2016. "Fish Swimming Performance Database and Analyses. DFO Can. Sci. Advis. Sec. Res. Doc. 2016/002*., 550.*

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Appendix A **Photos**

Project Photos	Description
	Looking North (Towards Tuk) along ITH at Gunghi Creek Crossing, Existing 2000 mm CSP culvert is at 40-degree RHF skew with roadway CL at Station 131.2. Persons are standing along culvert orientation. Photo taken July 25, 2019.
	Looking south at the upstream culvert end inlet. Note the culvert end is uplifted. Photo taken July 25, 2019.

Looking west (upstream) Note Ponding and class 1M rock. Channel is not well defined. Photo taken July 25, 2019.

Looking west (upstream) Note Ponding and class 1M rock. Channel is not well defined. Photo taken July 25, 2019.

Looking east (upstream culvert end) Note class 1M rock. Photo taken July 25, 2019.

Looking South (Towards Inuvik) along ITH at Gunghi Creek Crossing, Existing 2000 mm SPCSP culvert is at 40 degree RHF skew with roadway CL at Station 131.2. Persons are standing along culvert orientation. Photo taken July 25, 2019.

Looking East (Downstream) Note scour pool/ponding and class 1 rock. Existing 2000 mm culvert is undersized Channel is not well defined. Photo taken July 25, 2019.

Looking north at the downstream culvert end outlet Note the culvert end is uplifted. Photo taken July 25, 2019.

Looking north (Towards Tuk) at the downstream culvert end outlet Note the culvert end is uplifted. Scour pool downstream. Culvert is under sized Photo taken July 25, 2019.

Appendix B **Hydrotechnical Results**

Project Gunji Creek_ITH_Section_-113

XS Geometry

STA (m)	ELEV (m)
-8.06	2.28
-7.33	2.21
-5.93	2.14
-4.24	2.09
-3.30	2.21
-2.42	1.62
-0.45	1.18
-0.24	0.93
0.00	0.92
2.16	0.88
2.61	1.33
3.50	1.98
3.95	1.97
11.45	2.26
15.00	2.13

Channel Partition :

Left Overbank	-3.3
Right Overbank	3.5

Rating Curve :

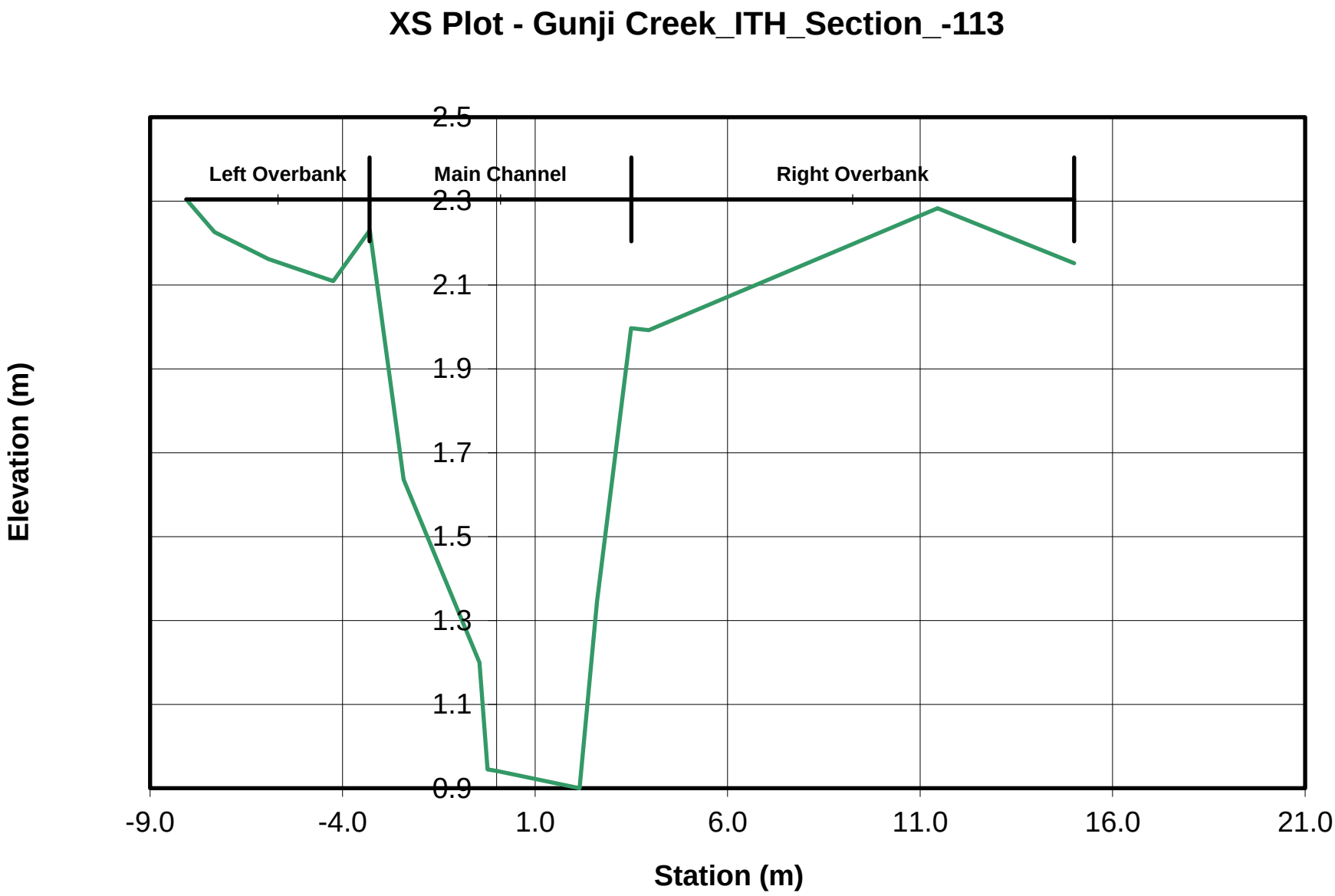
Max depth	6
Increment	0.1

Hydraulic Parameters :

Roughness Type	n
Main Channel Roughness	0.03
Left Overbank Roughness	0.045
Right Overbank Roughness	0.045
Channel Slope	0.0015

Boundary Conditions :

	Description	Q (m^3/s)	TW Elev (m)
1	Scenario 1	100	883
2			
3			
4			
5			
6			
7			
8			
9			
10			


XS Plot - Gunji Creek_ITH_Section_-113
Left Overbank
Main Channel
Right Overbank
2.5
2.3
2.1
1.9
1.7
1.5
1.3
1.1
0.9
Elevation (m)
-9.0
-4.0
1.0
6.0
11.0
16.0
21.0
Station (m)

	Left Overbank			Main Channel			Right Overbank			Total	Average Velocity	
Elevation	A	V	Q	A	V	Q	A	V	Q	Q	Vavg	
(m)	(m^2)	(m/s)	(m^3/s)	(m^2)	(m/s)	(m^3/s)	(m^2)	(m/s)	(m^3/s)	(m^3/s)	m/s	
0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
0.98	0.00	0.00	0.00	0.19	0.23	0.04	0.00	0.00	0.00	0.04	0.23	
1.08	0.00	0.00	0.00	0.45	0.38	0.17	0.00	0.00	0.00	0.17	0.38	
1.18	0.00	0.00	0.00	0.74	0.49	0.36	0.00	0.00	0.00	0.36	0.49	
1.28	0.00	0.00	0.00	1.05	0.55	0.58	0.00	0.00	0.00	0.58	0.55	
1.38	0.00	0.00	0.00	1.43	0.61	0.87	0.00	0.00	0.00	0.87	0.61	
1.48	0.00	0.00	0.00	1.86	0.67	1.24	0.00	0.00	0.00	1.24	0.67	
1.58	0.00	0.00	0.00	2.35	0.72	1.70	0.00	0.00	0.00	1.70	0.72	
1.68	0.00	0.00	0.00	2.90	0.79	2.28	0.00	0.00	0.00	2.28	0.79	
1.78	0.00	0.00	0.00	3.47	0.86	2.97	0.00	0.00	0.00	2.97	0.86	
1.88	0.00	0.00	0.00	4.07	0.92	3.74	0.00	0.00	0.00	3.74	0.92	
1.98	0.00	0.00	0.00	4.71	0.98	4.60	0.00	0.03	0.00	4.60	0.98	Q1:2_ Qbankful
2.08	0.00	0.00	0.00	5.36	1.04	5.57	0.20	0.13	0.03	5.60	1.01	
2.18	0.00	0.00	0.00	6.03	1.10	6.61	0.65	0.20	0.13	6.74	1.01	3Q10
2.28	0.57	0.21	0.12	6.71	1.16	7.75	1.65	0.23	0.38	8.25	0.92	Q1:10
2.38	1.05	0.30	0.32	7.39	1.21	8.95	2.80	0.32	0.91	10.18	0.91	
2.48	1.53	0.38	0.58	8.07	1.26	10.20	3.95	0.40	1.59	12.37	0.91	
2.58	2.00	0.44	0.89	8.75	1.31	11.49	5.10	0.47	2.41	14.78	0.93	Qdesign
2.68	2.48	0.50	1.23	9.43	1.36	12.82	6.25	0.53	3.34	17.39	0.96	
2.78	2.95	0.55	1.61	10.11	1.40	14.18	7.40	0.59	4.38	20.18	0.99	
2.88	3.43	0.59	2.02	10.79	1.44	15.57	8.55	0.65	5.52	23.12	1.02	
2.98	3.91	0.63	2.46	11.47	1.48	17.00	9.70	0.70	6.74	26.20	1.05	
3.08	4.38	0.67	2.92	12.15	1.52	18.45	10.85	0.74	8.05	29.41	1.07	
3.18	4.86	0.70	3.40	12.83	1.55	19.92	12.00	0.79	9.43	32.74	1.10	QDesign
3.28	5.33	0.73	3.89	13.51	1.59	21.42	13.15	0.83	10.88	36.19	1.13	
3.38	5.81	0.76	4.40	14.19	1.62	22.94	14.30	0.87	12.39	39.73	1.16	
3.48	6.29	0.78	4.92	14.87	1.65	24.48	15.45	0.90	13.96	43.37	1.18	
3.58	6.76	0.81	5.46	15.55	1.67	26.04	16.60	0.94	15.59	47.09	1.21	
3.68	7.24	0.83	6.01	16.23	1.70	27.62	17.75	0.97	17.28	50.90	1.24	
3.78	7.71	0.85	6.57	16.91	1.73	29.21	18.90	1.01	19.01	54.79	1.26	
3.88	8.19	0.87	7.14	17.59	1.75	30.82	20.05	1.04	20.79	58.75	1.28	
3.98	8.67	0.89	7.71	18.27	1.78	32.44	21.20	1.07	22.62	62.78	1.30	
4.08	9.14	0.91	8.30	18.95	1.80	34.08	22.35	1.10	24.49	66.87	1.33	
4.18	9.62	0.92	8.89	19.63	1.82	35.73	23.50	1.12	26.40	71.02	1.35	

4.28	10.09	0.94	9.49	20.31	1.84	37.39	24.65	1.15	28.35	75.23	1.37
4.38	10.57	0.96	10.10	20.99	1.86	39.07	25.80	1.18	30.33	79.50	1.39
4.48	11.05	0.97	10.71	21.67	1.88	40.75	26.95	1.20	32.35	83.82	1.40
4.58	11.52	0.98	11.33	22.35	1.90	42.45	28.10	1.22	34.41	88.18	1.42
4.68	12.00	1.00	11.95	23.03	1.92	44.16	29.25	1.25	36.49	92.60	1.44
4.78	12.47	1.01	12.58	23.71	1.93	45.87	30.40	1.27	38.61	97.05	1.46
4.88	12.95	1.02	13.21	24.39	1.95	47.59	31.55	1.29	40.75	101.56	1.47
4.98	13.43	1.03	13.84	25.07	1.97	49.33	32.70	1.31	42.93	106.10	1.49
5.08	13.90	1.04	14.48	25.75	1.98	51.07	33.85	1.33	45.13	110.68	1.51
5.18	14.38	1.05	15.13	26.43	2.00	52.82	35.00	1.35	47.35	115.29	1.52
5.28	14.85	1.06	15.77	27.11	2.01	54.57	36.15	1.37	49.60	119.94	1.54
5.38	15.33	1.07	16.42	27.79	2.03	56.33	37.30	1.39	51.87	124.63	1.55
5.48	15.81	1.08	17.08	28.47	2.04	58.10	38.45	1.41	54.17	129.35	1.56
5.58	16.28	1.09	17.73	29.15	2.05	59.88	39.60	1.43	56.49	134.10	1.58
5.68	16.76	1.10	18.39	29.83	2.07	61.66	40.75	1.44	58.83	138.87	1.59
5.78	17.23	1.11	19.05	30.51	2.08	63.45	41.90	1.46	61.18	143.68	1.60
5.88	17.71	1.11	19.71	31.19	2.09	65.24	43.05	1.48	63.56	148.52	1.62
5.98	18.19	1.12	20.38	31.87	2.10	67.04	44.20	1.49	65.96	153.38	1.63
6.08	18.66	1.13	21.05	32.55	2.12	68.84	45.35	1.51	68.37	158.26	1.64
6.18	19.14	1.13	21.72	33.23	2.13	70.65	46.50	1.52	70.81	163.17	1.65
6.28	19.61	1.14	22.39	33.91	2.14	72.46	47.65	1.54	73.26	168.11	1.66
6.38	20.09	1.15	23.07	34.59	2.15	74.28	48.80	1.55	75.72	173.06	1.67
6.48	20.57	1.15	23.74	35.27	2.16	76.10	49.95	1.57	78.20	178.04	1.68
6.58	21.04	1.16	24.42	35.95	2.17	77.93	51.10	1.58	80.70	183.04	1.69
6.68	21.52	1.17	25.10	36.63	2.18	79.76	52.25	1.59	83.21	188.06	1.70
6.78	21.99	1.17	25.78	37.31	2.19	81.59	53.40	1.61	85.73	193.10	1.71
6.88	22.47	1.18	26.46	37.99	2.20	83.43	54.55	1.62	88.27	198.16	1.72

Project	No Ice n=.03

Culvert Data

Pipe No.		1	2	3	4	5
Include (Y/N)		Y				
Station (m)		100				
U/S Invert El (m)		0.059				
D/S Invert El (m)		0.000				
Length (m)		39.00				
Roughness	n	0.030				
Ent. Loss Coeff.		0.7				
Exit Loss Coeff.		0.4				
Shape		U				
Rise (m)						
Span (m)						

Boundary Conditions :

Slope 0.00151282

	Description	Q (m^3/s)	TW Elev (m)	D/S Vel (m/s)	TW Depth
1	Q1:100	16	1.700	0.93	1.7
2	3Q10	6.6	1.300	1.01	1.3
3	Q1:2	4.8	1.100	0.98	1.1
4	Qcheck	32	2.300	1.1	2.3

Performance Curve Parameters

Output Summary - No Ice n=.03

BC No.	1	2	3	4		
Q (cms)	16.0	6.6	4.8	32.0		
TW (m)	1.70	1.30	1.10	2.30		
Vds (m/s)	0.93	1.01	0.98	1.10		
HW (m)	2.01	1.44	1.23	2.89		
Headloss (m)	0.26	0.09	0.08	0.53		

BC No. 1 - Q1:100

	Pipe 1				
Q (cms)	16.00				
Freeboard (m)	1.55				
Ynorm (m)	1.94				
Ycrit (m)	1.09				
Vout (m/s)	1.76				
Vin (m/s)	1.71				
Flow Desc.	M2				

BC No. 2 - 3Q10

	Pipe 1				
Q (cms)	6.60				
Freeboard (m)	2.12				
Ynorm (m)	1.15				
Ycrit (m)	0.65				
Vout (m/s)	0.95				
Vin (m/s)	0.97				
Flow Desc.	M1				

BC No. 3 - Q1:2

	Pipe 1				
Q (cms)	4.80				
Freeboard (m)	2.33				
Ynorm (m)	0.97				
Ycrit (m)	0.54				
Vout (m/s)	0.84				
Vin (m/s)	0.87				
Flow Desc.	M1				

BC No. 4 - Qcheck

	Pipe 1				
Q (cms)	32.00				
Freeboard (m)	0.67				
Ynorm (m)	3.50				
Ycrit (m)	1.60				
Vout (m/s)	2.65				
Vin (m/s)	2.48				
Flow Desc.	M2				

Project Ice = 1.5 m n=0.01

Culvert Data

Pipe No.		1	2	3	4	5
Include (Y/N)		Y				
Station (m)		100				
U/S Invert El (m)		0.059				
D/S Invert El (m)		0.000				
Length (m)		39.00				
Roughness (Ice)	n	0.010				
Ent. Loss Coeff.		0.7				
Exit Loss Coeff.		0.4				
Shape		U				
Rise (m)						
Span (m)						

Boundary Conditions :

Slope 0.00151282

	Description	Q (m^3/s)	TW Elev (m)	D/S Vel (m/s)	TW Depth
1	Q1:100	16	1.700	0.93	1.7
2	3Q10	6.6	1.300	1.01	1.3
3	Q1:2	4.85	1.100	0.98	1.1
4	Qcheck	32	2.300	1.1	2.3

Output Summary - Ice = 1.5 m n=0.01

BC No.	1	2	3	4		
Q (cms)	16.0	6.6	4.9	32.0		
TW (m)	1.70	1.30	1.10	2.30		
Vds (m/s)	0.93	1.01	0.98	1.10		
HW (m)	1.96	1.40	1.18	3.31		
Headloss (m)	0.21	0.05	0.04	0.95		

BC No. 1 - Q1:100

	Pipe 1				
Q (cms)	16.00				
Freeboard (m)	0.10				
Ynorm (m)	0.94				
Ycrit (m)	0.86				
Vout (m/s)	1.84				
Vin (m/s)	1.87				
Flow Desc.	M1				

BC No. 2 - 3Q10

	Pipe 1				
Q (cms)	6.60				
Freeboard (m)	0.66				
Ynorm (m)	0.49				
Ycrit (m)	0.47				
Vout (m/s)	0.88				
Vin (m/s)	0.91				
Flow Desc.	M1				

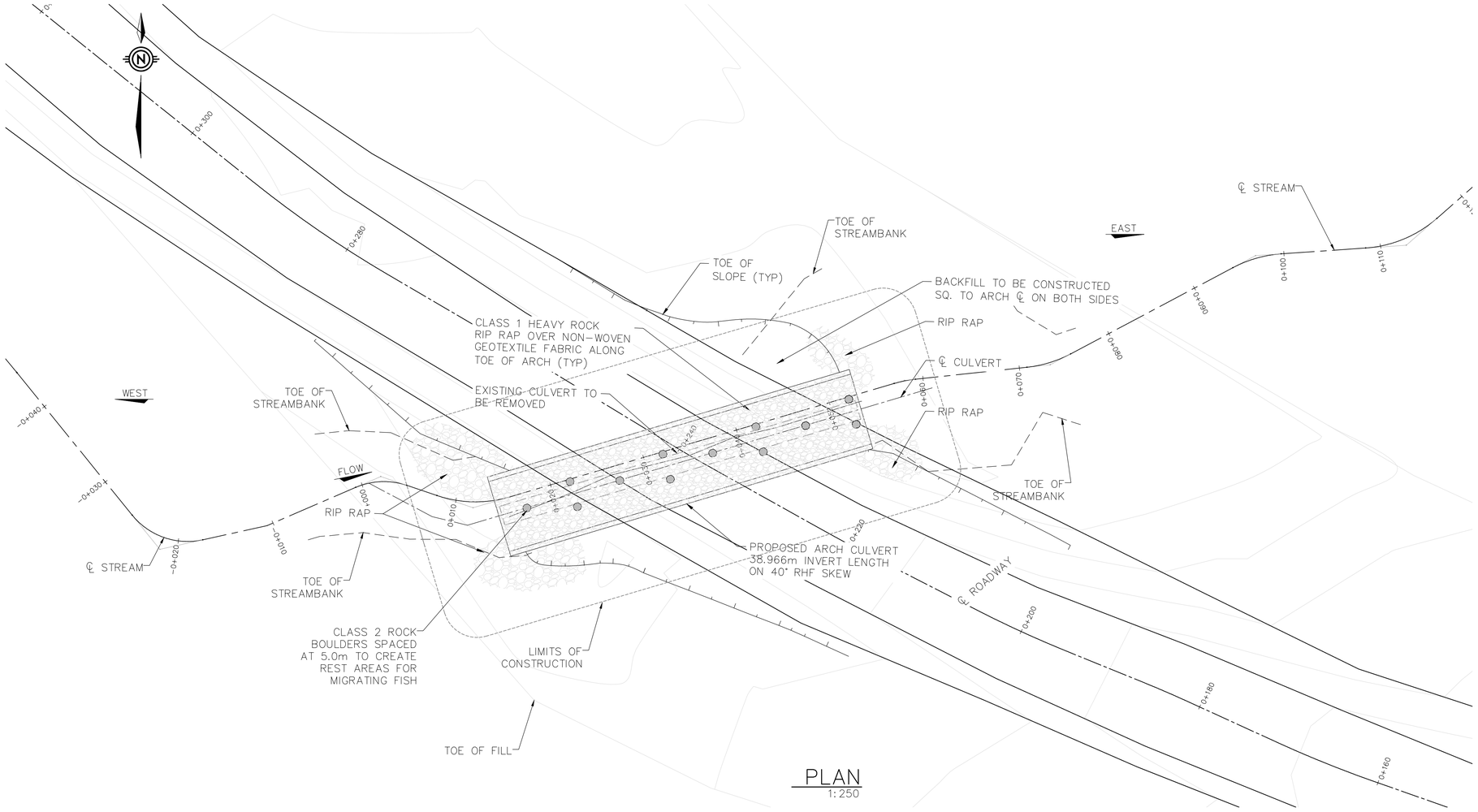
BC No. 3 - Q1:2

	Pipe 1				
Q (cms)	4.85				
Freeboard (m)	0.87				
Ynorm (m)	0.40				
Ycrit (m)	0.38				
Vout (m/s)	0.73				
Vin (m/s)	0.76				
Flow Desc.	M1				

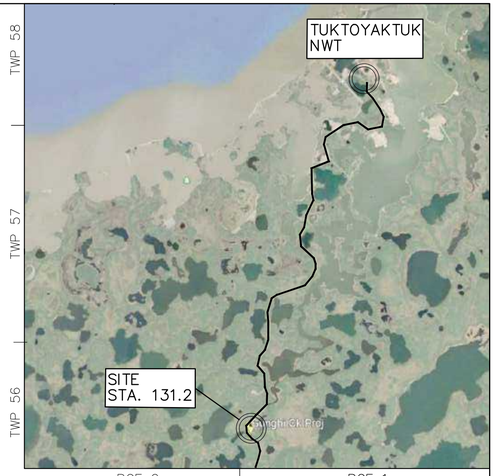
BC No. 4 - Qcheck

	Pipe 1				
Q (cms)	32.00				
Freeboard (m)	-1.25				
Ynorm (m)	2.00				
Ycrit (m)	1.35				
Vout (m/s)	3.49				
Vin (m/s)	3.49				
Flow Desc.	ow (Inlet Control)				

Appendix C **Drawings**



PLAN
1:250



SITE MAP

DEMPSTER HIGHWAY — N.T.S.
LOCAL ROAD

SURVEY AND BENCHMARK

- MACKENZIE DELTA GEOMATICS LIMITED UNDER THE DIRECTION OF CA, AUGUST 28, 2017
  BM1 : N 7693990.504 E 577210.810 EL. 4.261
  BM2 : N 7693947.488 E 577291.821 EL. 4.136

HYDROTECHNICAL DATA

- DRAINAGE AREA = 60 Km²
- ESTIMATED AVERAGE CHANNEL SLOPE = 0.0015 m/m
- DESIGN DISCHARGE Q = 16.0 m³/s 100
- MEAN OUTLET VELOCITY AT PROPOSED ARCH STRUCTURE OUTLETS FOR DESIGN DISCHARGE = 1.8 m/s
- MEAN ANNUAL DISCHARGE (Q_a) = 4.80 m³/s
- MEAN OUTLET VELOCITY AT PROPOSED ARCH STRUCTURE DURING MEAN ANNUAL DISCHARGE = 0.84 m/s
- 3-DAY DELAY Q_{10} FLOW ($3Q_{10}$) = 6.6 m³/s
  MEAN OUTLET VELOCITY DURING $3Q_{10}$ FLOW = 0.95 m/s

PROPOSED STRUCTURE

- 1-7518 SPAN x 3500 RISE ARCH CULVERT
  38.966 m INVERT LENGTH ON 40° RHF SKEW

GENERAL NOTES

- DIMENSIONS AND ELEVATIONS ARE GIVEN IN METRES UNLESS NOTED OTHERWISE
- ROADWAY DESIGN STANDARD RLU-209G-90 (POSTED SPEED 80km/h)
- STRUCTURAL DESIGN IN ACCORDANCE WITH CAN/CSA S6-14 AND CL 800 DESIGN LIVE LOAD
- CULVERT AND HEAVY ROCK RIPRAP EXTEND BEYOND BASIC RIGHT OF WAY. ADDITIONAL RIGHT OF WAY AS SHOWN ON THE PLAN IS REQUIRED FOR THE INSTALLATION.
- WORK FOR RIP RAP TO BE DONE IN CONFORMANCE WITH SECTION 10 OF STANDARD SPECIFICATIONS FOR BRIDGE CONSTRUCTION (EDITION 16), ALBERTA TRANSPORTATION CULVERT ASSEMBLY, BACKFILL AND OTHER TYPICAL DETAILS SHALL BE IN ACCORDANCE WITH THE DRAWINGS, DWG S-1418-17 AND SECTION 18 OF SPECIFICATIONS FOR BRIDGE CONSTRUCTION (EDITION 16), ALBERTA TRANSPORTATION
- THE INFORMATION AND SPECIFICATIONS INCLUDED ON THIS PLAN MEET THE STANDARDS SPECIFIED IN (c) AND (d) OF PART 1 OF SCHEDULE 2 OF THE WATER ACT CODE OF PRACTICE FOR WATERCOURSE CROSSING.

ITEM		UNIT	ESTIMATE	AS CONST
SUPPLY 1-7316 SPAN x 3200 RISE ARCH CULVERT		m	38.966	
INSTALL 1-7316 SPAN x 3200 RISE ARCH CULVERT		m	38.966	
SUPPLY 900 x 900 x 12475 PRE-CAST PILE CAP		UNIT	4	
INSTALL 900 x 900 x 12475 PRE-CAST PILE CAP		UNIT	4	
SUPPLY 900 x 900 x 14000 PRE-CAST PILE CAP		UNIT	2	
INSTALL 900 x 900 x 14000 PRE-CAST PILE CAP		UNIT	2	
REMOVAL OF EXISTING CULVERTS		LUMP	1	
EXCAVATION - STRUCTURAL		m^3	-	
BACKFILL			-	
CRUSHED AGGREGATE MATERIAL		m^3	-	
WOVEN GEOTEXTILE FILTER FABRIC		m^2	-	
324ø x 12.7 PLAIN STEEL PIPE PILE	SUPPLY	m	760	
	SET-UP	PILE	40	
	INSTALLATION	m	760	
141ø X 6.4 PLAIN STEEL PIPE PILE	SUPPLY	m	152	
	SET-UP	PILE	8	
	INSTALLATION	m	152	
BRIDGE IDENTIFICATION TAG		UNIT	-	
ROLLED EROSION CONTROL PRODUCT TYPE C		m^2	-	
HEAVY ROCK RIPRAP - CLASS 1		m^3	-	
NON-WOVEN GEOTEXTILE FILTER FABRIC		m^2	-	
GEOTEXTILE FENCE BARRIER (SILT FENCE)		m	-	
ROADWAY WORK		LUMP	1	

QUANTITY ESTIMATE

SHEET	DESCRIPTION	DRAWING
8	CONCRETE CULVERT - PILING PLANS, DETAILS AND NOTES	SHEET-08
7	CONCRETE CULVERT - PILE CAP REINFORCING DETAILS	SHEET-07
6	CONCRETE CULVERT - PLANS, SECTIONS AND DETAILS	SHEET-06
5	INFORMATION SHEET - 3	SHEET-05
4	INFORMATION SHEET - 2	SHEET-04
3	INFORMATION SHEET - 1	SHEET-03
2	STREAMBED AND ROAD PROFILES	SHEET-02
1	GENERAL LAYOUT	SHEET-01

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A DIVISION OF WOOD CANADA LIMITED

SCALES SHOWN ARE CORRECT FOR 22" x 34" SHEET SIZE

JOB No. EB193003

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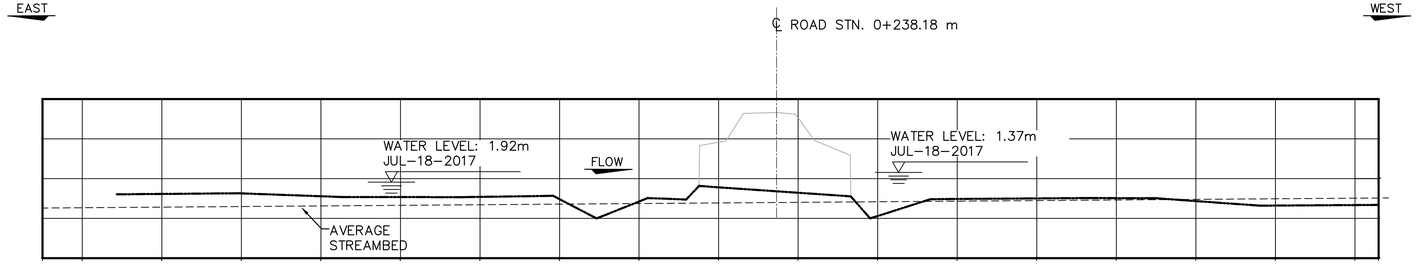
GOVERNMENT OF THE NWT
DEPARTMENT OF INFRASTRUCTURE

ITH 131.2
GENERAL LAYOUT

DEPARTMENT BAR CODE	DATE	STREAM	LOCATION	HIGHWAY	FILE	SHEET	DRAWING
	2019-08-30	GUNGHI CREEK	DEMPSTER HIGHWAY	LOCAL	-	1 OF 8	SHEET-01

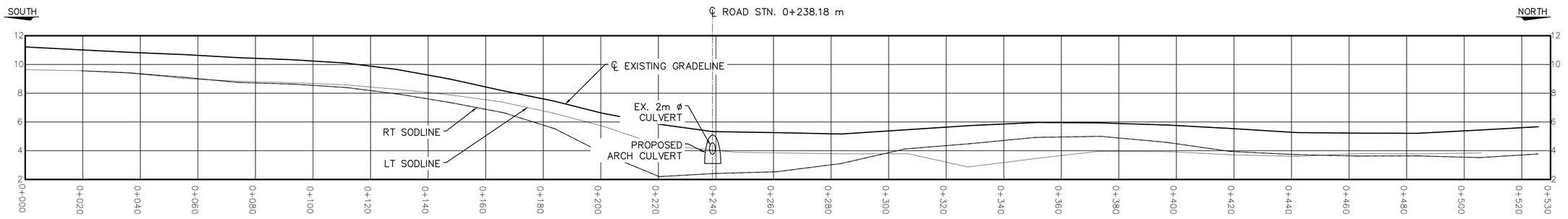
NOTE:

THIS DRAWING TO BE READ IN CONJUNCTION WITH OTHER DRAWINGS.



STREAMBED PROFILE

LOOKING NORTH H 1:1500, V 1:150



ROAD PROFILE

LOOKING WEST H 1:2000, V 1:200

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STREAMBED AND ROAD PROFILES

DEPARTMENT BAR CODE	DATE	STREAM	LOCATION	HIGHWAY	FILE	SHEET	DRAWING
	2019–08–30	GUNGHI CREEK	DEMPSTER HIGHWAY	LOCAL	–	2 OF 8	SHEET–02

NOTE:

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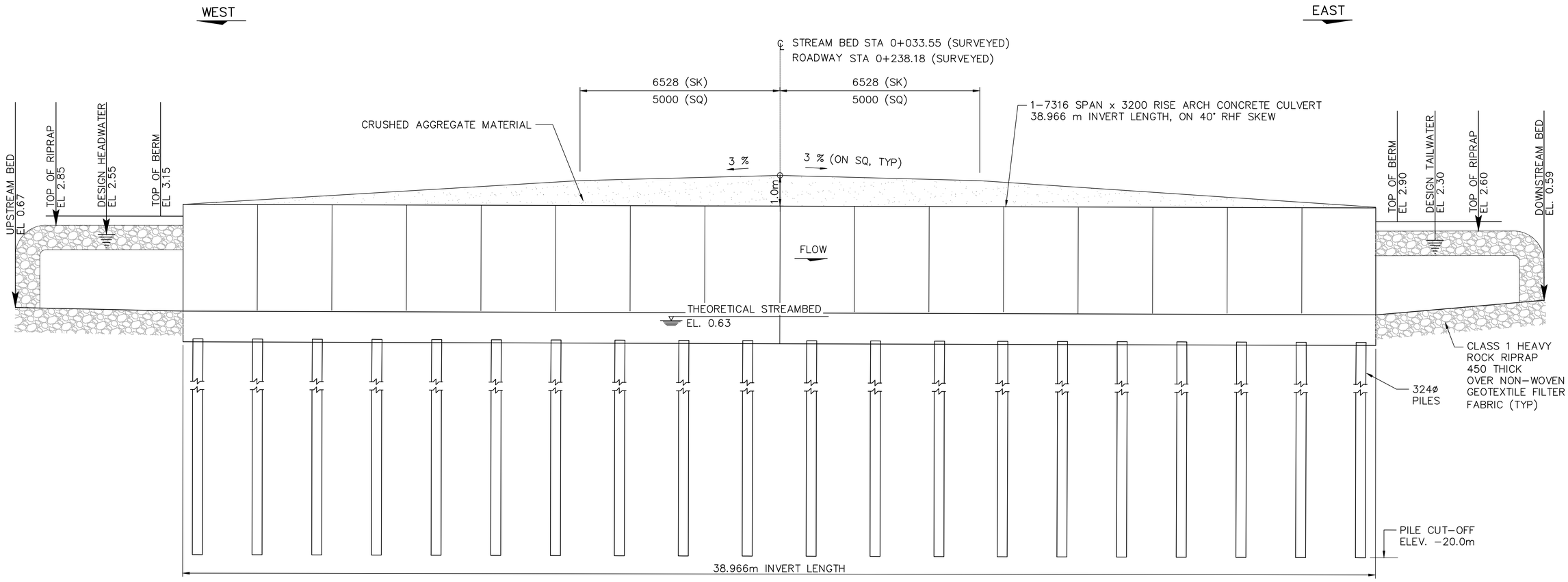

LONGITUDINAL SECTION

(ALONG CULVERT CENTER LINE) 1:75
(LOOKING NORTH)

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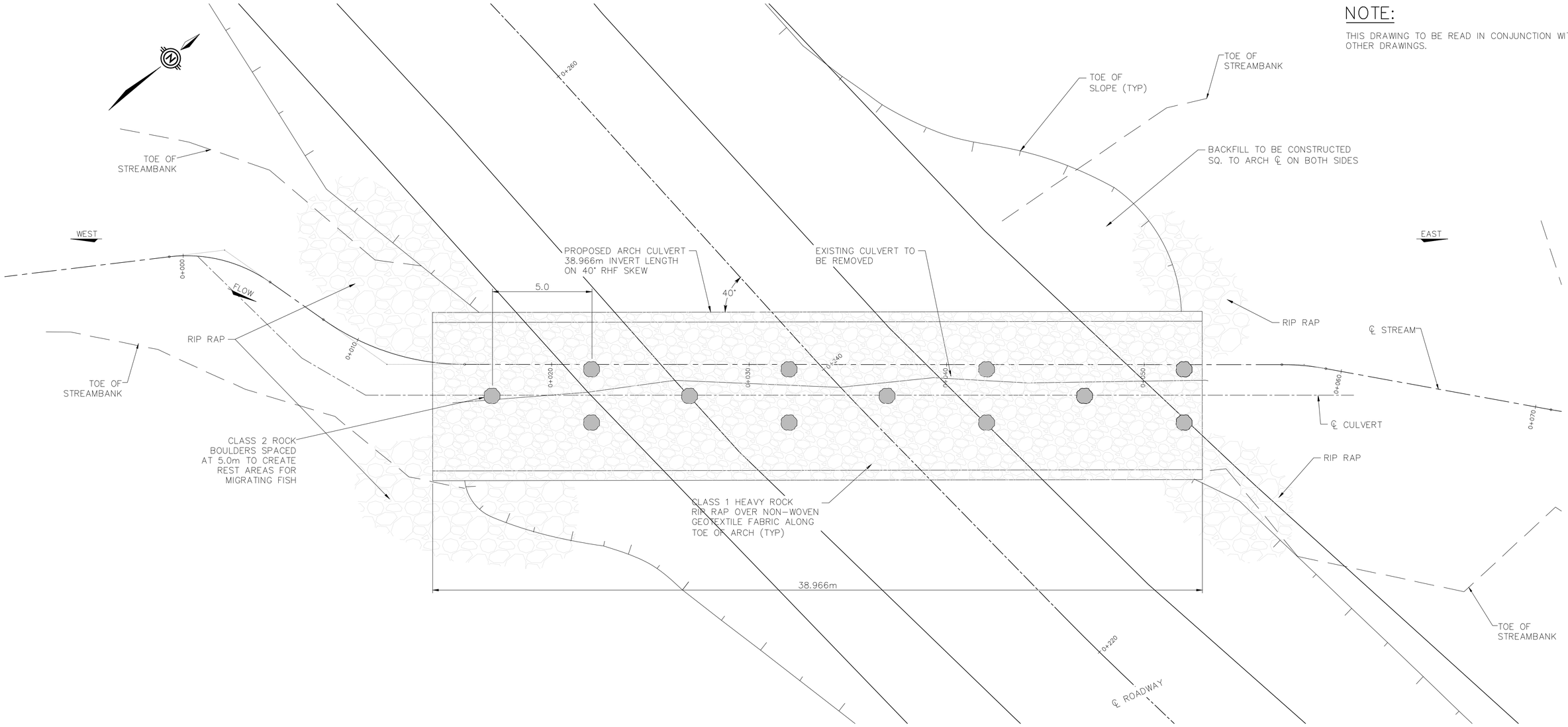
DEPARTMENT BAR CODE	DATE	STREAM	LOCATION	HIGHWAY	FILE	SHEET	DRAWING
	2019–08–30	GUNGHI CREEK	DEMPSTER HIGHWAY	LOCAL	–	3 OF 8	SHEET–03

NOTE:

THIS DRAWING TO BE READ IN CONJUNCTION WITH OTHER DRAWINGS.



PLAN
1:100

GENERAL NOTES

DIMENSIONS AND ELEVATIONS ARE GIVEN IN METRES UNLESS NOTED OTHERWISE

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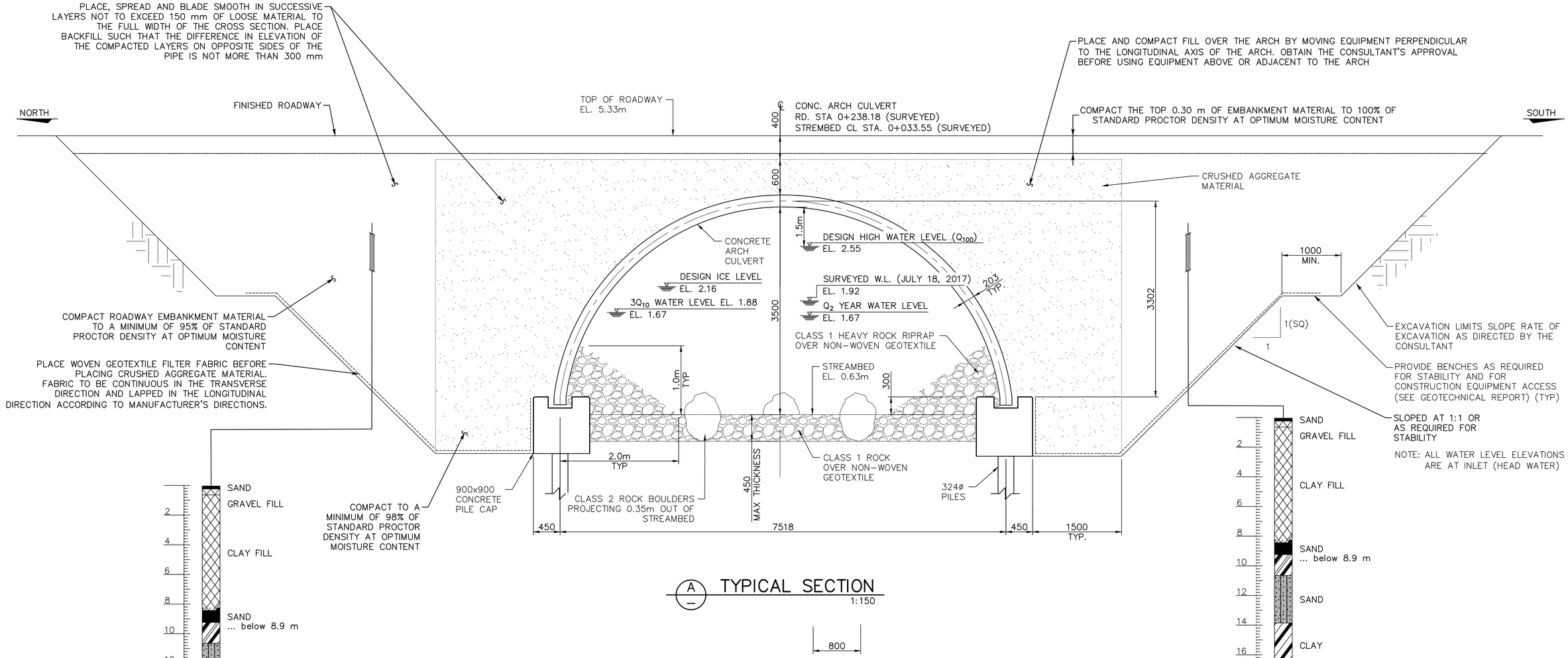
ITH 131.2
INFORMATION SHEET 2

DEPARTMENT BAR CODE	DATE	STREAM	LOCATION	HIGHWAY	FILE	SHEET	DRAWING
	2019-08-30	GUNGHI CREEK	DEMPSTER HIGHWAY	LOCAL	-	4 OF 8	SHEET-04



A TYPICAL SECTION
1:150

TEST HOLE: GUNGHI BH–02
STA: 0+
ELEV 00.00 m
2017–02–23

END OF BOREHOLE AT 20.4 m
25mm ø PVC PIPE INSTALLED TO 20.4m
3 SINGLE BEAD THERMISTOR STRINGS INSTALLED AT 9.0, 13.0 AND 15.0m DEPTHS.

TEST HOLE: GUNGHI BH–01
STA: 0+
ELEV 00.00 m
2017–02–23

END OF BOREHOLE AT 20.4 m
25mm ø PVC PIPE INSTALLED TO 20.4m
3 SINGLE BEAD THERMISTOR STRINGS INSTALLED AT 9.0, 13.0 AND 15.0m DEPTHS.

NOTE:

- THIS DRAWING TO BE READ IN CONJUNCTION WITH OTHER DRAWINGS.
- BACKFILLING OPERATIONS AT THE SIDES OF THE ARCH SHALL NOT COMMENCE BEFORE THE KEYWAY GROUT HAS ATTAINED 17.5 MPa.
- BACKFILL IS TO BE DONE WITH DRAINAGE INCLUDING FILTER PACKAGE TO AVOID WASHOUT OF FINE PARTICLES TO MINIMIZE THE UPLIFT OR FLOW WATER PRESSURE.
- COMPACT BACKFILL MATERIAL BY MECHANICAL MEANS. FLOODING OR JETTING IS TO BE AVOIDED.
- EXCAVATION AND BACKFILLING TO BE DONE IN CONFORMANCE WITH SECTION 1 AND SECTION 2 OF STANDARD SPECIFICATION FOR BRIDGE CONSTRUCTION EDITION 16, ALBERTA TRANSPORTATION.

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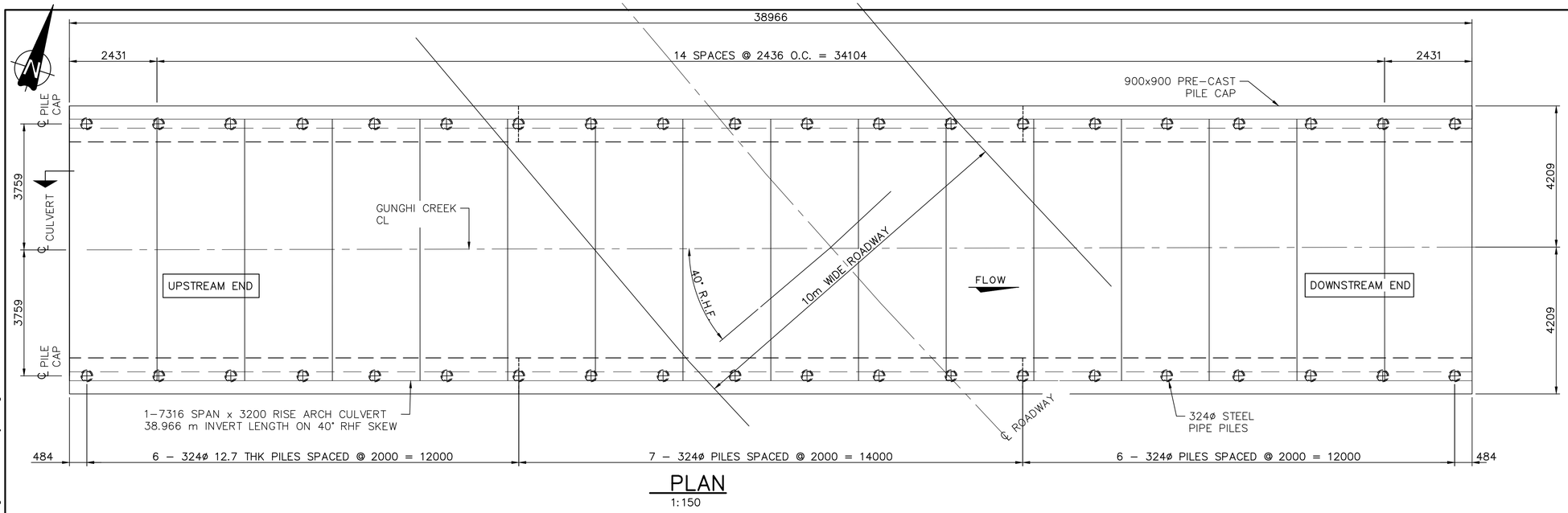
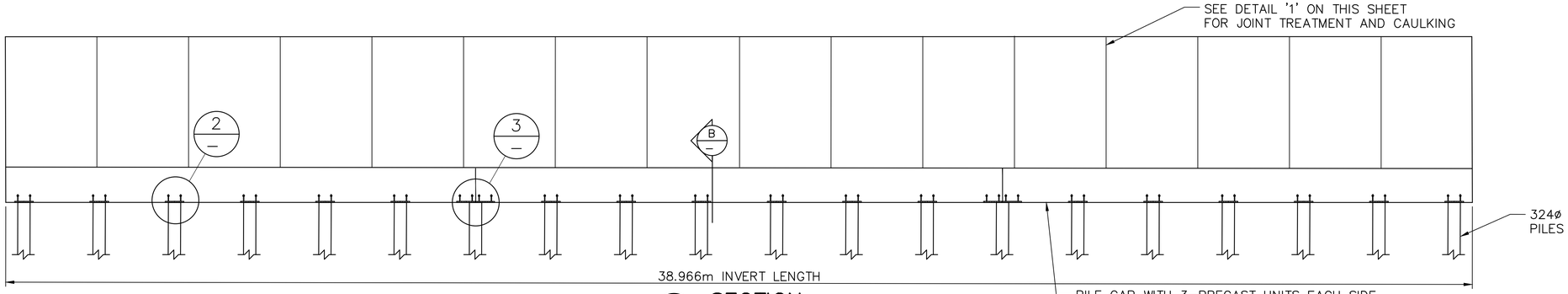
ITH 131.2
INFORMATION SHEET 3

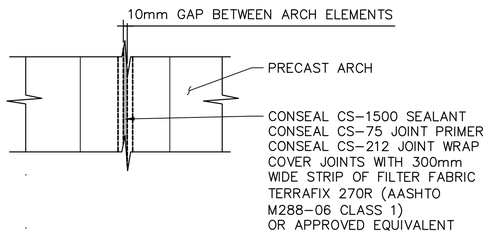
DEPARTMENT BAR CODE	DATE	STREAM	LOCATION	HIGHWAY	FILE	SHEET	DRAWING
	2019–08–30	GUNGHI CREEK	DEMPSTER HIGHWAY	LOCAL	–	5 OF 8	SHEET–05



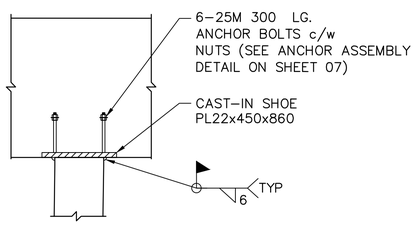
PLAN
1:150



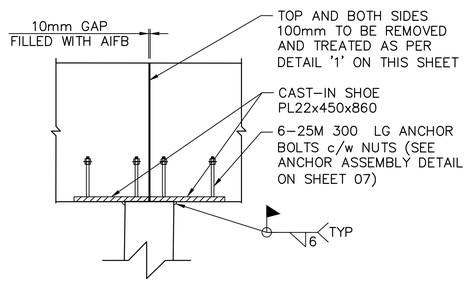
A SECTION
1:150



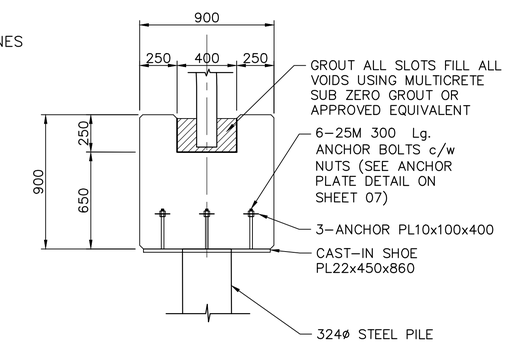
1 DETAIL - ARCH ELEMENT JOINT
1:10



2 DETAIL
1:20



3 DETAIL
1:20



B SECTION
1:10

GENERAL NOTES

- ALL DIMENSIONS SHOWN ARE IN MILLIMETERS UNLESS NOTED OTHERWISE
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH OTHER DRAWINGS
- ALL PRE-CAST CONCRETE SHALL BE IN CONFORMANCE WITH SECTION 7 OF CURRENT EDITION OF STANDARD SPECIFICATIONS OF BRIDGE CONSTRUCTION OF ALBERTA TRANSPORTATION (EDITION 16).
- ALL EXPOSED CORNERS OF PRECAST CONCRETE UNITS TO HAVE 20 MM CHAMFER.
- THE MINIMUM COVER TO REINFORCING STEEL SHALL BE 50 MM UNLESS OTHERWISE NOTED.
- ALL WELDING TO CONFORM TO AWS SPECIFICATION D1.5
- EXPOSED SURFACES OF BASE/SHOE PLATES SHALL BE COATED WITH AN APPROVED COATING SYSTEM.

MATERIAL STRENGTH

- ARCH CONCRETE SHALL BE CLASS 'HPC' WITH 28-DAY COMPRESSIVE STRENGTH MINIMUM 45 MPa.
- PILE CAP CONCRETE SHALL BE CLASS "C" WITH 28-DAY COMPRESSIVE STRENGTH MINIMUM 35 MPa
- ALL REINFORCING STEEL SHALL CONFORM TO CAN/CSA G30.18 GRADE 400.
- CONCRETE GROUT SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH SAME AS FOR PILE CAP CONCRETE. THE PROCEDURE OF APPLICATION SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS THAT RESULT IN 100% CONTACT OVER GROUTED AREA.
- ALL STEEL PLATES SHALL CONFORM TO CAN/CSA G40.21-300WT OR EQUIVALENT.
- ALL ANCHOR BOLTS TO CONFORM TO ASTM A307. NUTS AND WASHERS TO CONFORM TO A194, GRADE 2H AND F436 RESPECTIVELY.

FABRICATION AND INSTALLATION

- PILES SHALL BE INSTALLED AS PER EBA GEOTECHNICAL RECOMMENDATIONS AND IN CONFORMANCE WITH SECTION 3 OF STANDARD SPECIFICATIONS FOR BRIDGE CONSTRUCTION EDITION 16, ALBERTA TRANSPORTATION.
- BOTH ARCH AND PILE CAP SHALL BE PRECAST IN KNELSEN PLANT IN UNITS, AS SHOWN ON DRAWING, TO BE INSTALLED ON SITE.
- ARCH ELEMENTS SHALL BE INSTALLED AS PER BEBO ARCH SYSTEMS INSTALLATION GUIDE, BEBO ARCH INTERNATIONAL AG

CODES AND STANDARDS

WORK IS TO BE DONE IN CONFORMANCE WITH FOLLOWING STANDARDS.

- STANDARD SPECIFICATIONS OF BRIDGE CONSTRUCTION (EDITION 16) ALBERTA TRANSPORTATION (AT)
- CAN/CSA A23.1-14/A23.2-14 - CONCRETE MATERIALS AND METHODS OF CONCRETE CONSTRUCTION/TEST METHODS AND STANDARD PRACTICES FOR CONCRETE.
- CAN/CSA S6-14 - CANADIAN HIGHWAY BRIDGE DESIGN CODE.

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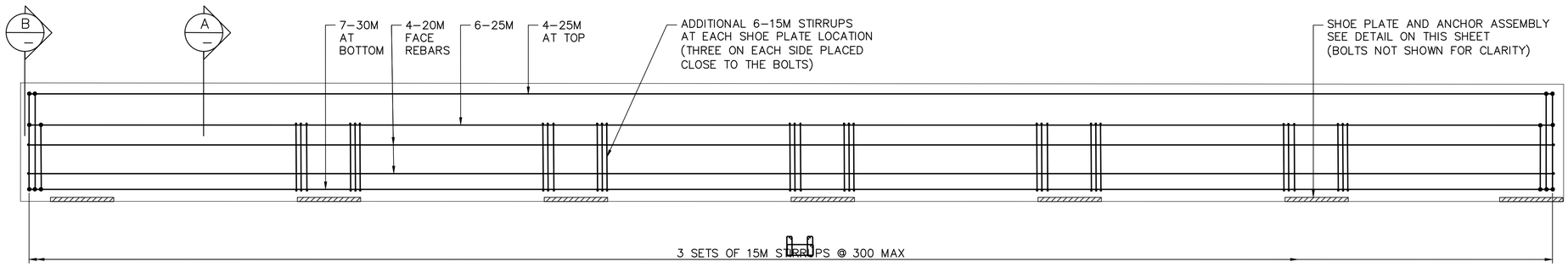
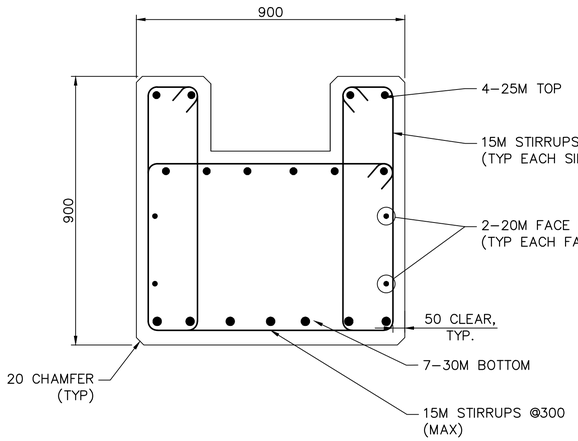
ITH 131.2
CONCRETE CULVERT
PLAN, SECTIONS & DETAILS

DEPARTMENT BAR CODE	DATE	STREAM	LOCATION	HIGHWAY	FILE	SHEET	DRAWING
	2019-08-30	GUNGHI CREEK	DEMPSTER HIGHWAY	LOCAL	-	6 OF 8	SHEET-06

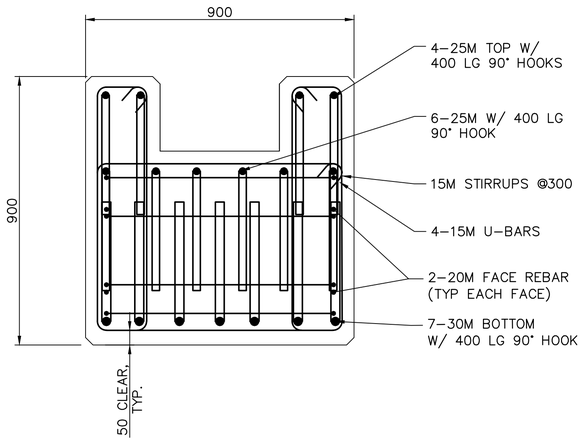


PRECAST PILE CAP UNIT – REINFORCEMENT DETAIL

(12484 LG. SHOWN, OTHERS WITH SIMILAR DETAILS) 1:20



A SECTION 1:10

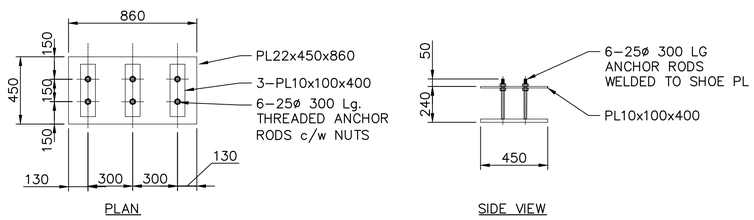


B PILE CAP END (SAME FOR BOTH ENDS) 1:10

LAP LENGTHS

REINFORCEMENTS LAP LENGTHS AS FOLLOWS:

30M – 1500 LONG
25M – 1200 LONG
20M – 900 LONG



1 DETAIL – SHOE PLATE AND ANCHOR ASSEMBLY 1:20

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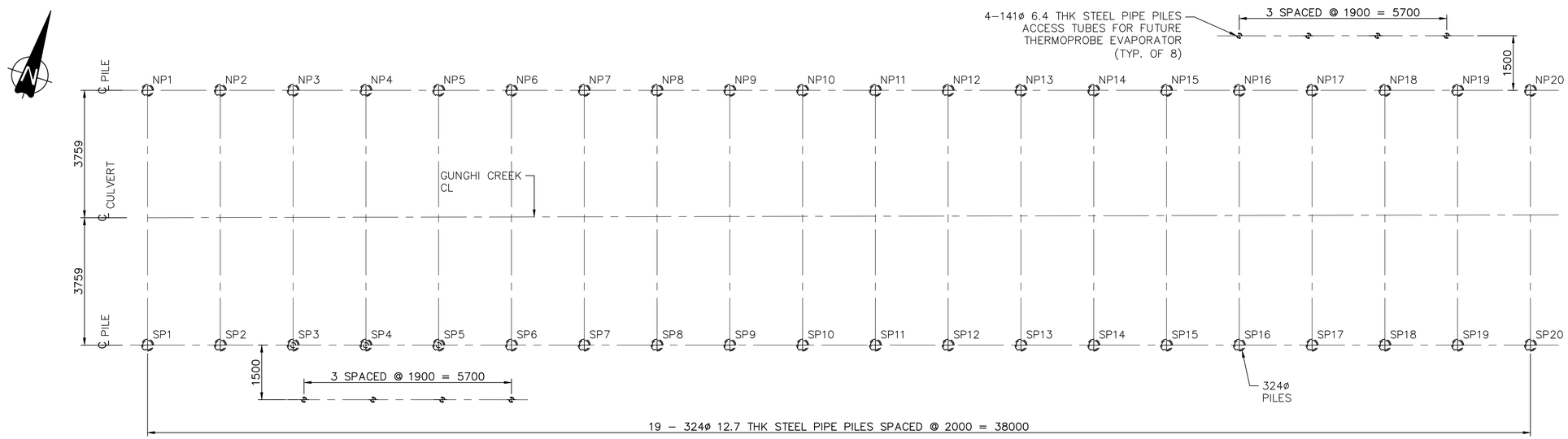
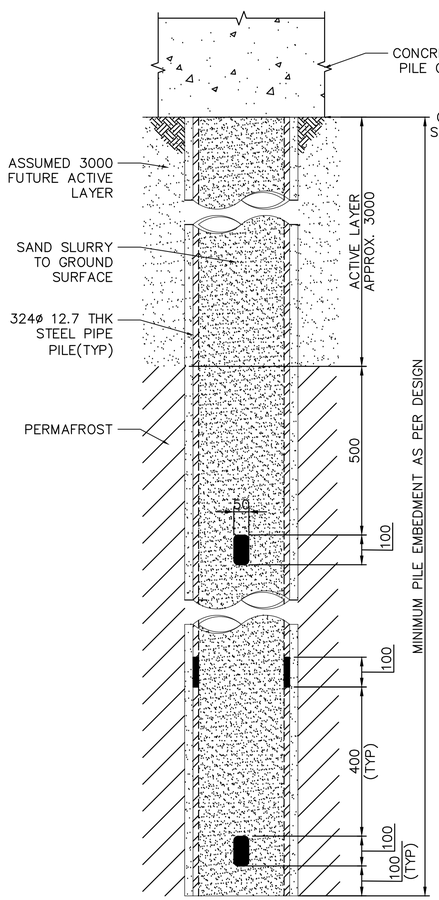
CONCRETE CULVERT
PILE CAP REINFORCING DETAILS

DEPARTMENT BAR CODE	DATE	STREAM	LOCATION	HIGHWAY	FILE	SHEET	DRAWING
	2019-08-30	GUNGHI CREEK	DEMPSTER HIGHWAY	LOCAL	–	7 OF 8	SHEET-07

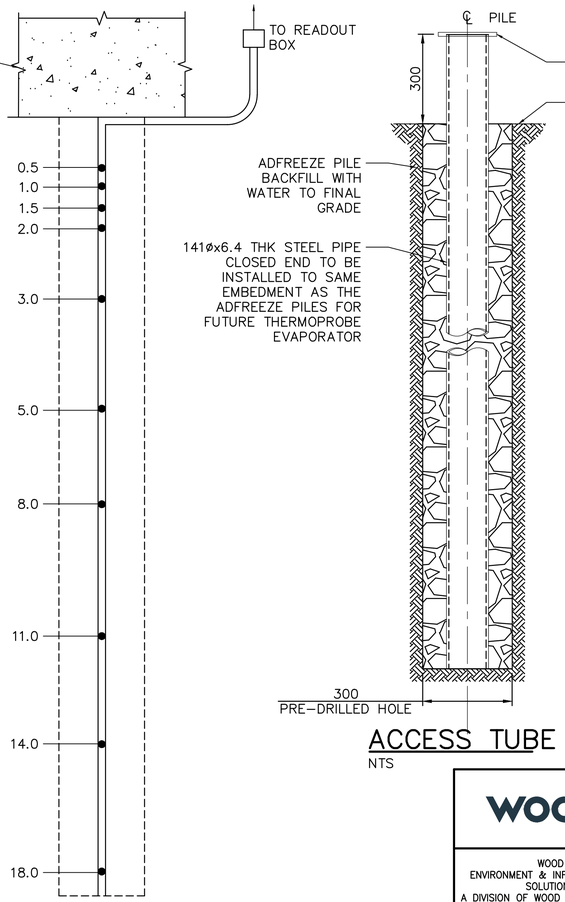


NOTES: INSTALL MULTI–BEAD THERMISTOR CABLE ON PILE NP1, NP9, SP14 AND SP20

PILING PLAN
1:150



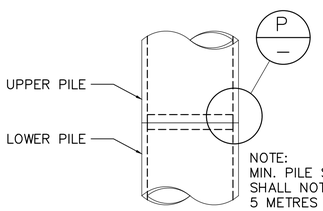
PILE EMBEDMENT
NTS



THERMISTOR CABLE DETAILS
NTS (TO BE INSTALLED INSIDE THE PILE)

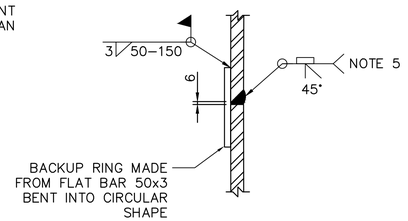
ACCESS TUBE
NTS

FOUNDATION PILE DESIGN LOAD (kN)	
LOAD COMBINATION	
SLS 1 (PERMANENT)	400
SLS 1 (DEAD + LIVE)	550
ULS 1 (PERMANENT)	500
ULS 1 (EXTREME)	750



1. THE LOWER PILE SHALL BE TRIMMED TRUE AND SQUARE.
2. THE BEVEL ON THE UPPER PILE SHALL BE FLAME CUT USING A MECHANICAL PIPE BEVELING MACHINE.
3. THE BACKUP PLATE SHALL BE WELDED TO THE UPPER PILE.
4. THE UPPER PILE SHALL BE POSITIONED WITH THE BACKUP RING FITTED INTO THE LOWER PILE.
5. FIELD WELDING SHALL BE IN ACCORDANCE WITH PROJECT SPECIFICATION.

PILE SPLICE
NTS



P DETAIL
NTS

GENERAL NOTES

- THE GEOTECHNICAL INVESTIGATION IS AVAILABLE FROM "ADFREEZE STEEL PIPE PILE RECOMMENDATIONS FOR PRECAST BRIDGE CULVERT GUNGHI CREEK, KM 131.2 INUVIK–TUKTOYAKTUK HIGHWAY REVISION 1" PROVIDED BY KIGGIAK–EBA. FILE: KE1077/ENG.YARC03163, JULY 2019
- THE FOUNDATION PILES ARE ADFREEZE TYPE (SLOTTED). NUMBER OF PILES, LENGTHS AND TIP ELEVATIONS ARE BASED ON THE RECOMMENDATIONS MADE BY KIGGIAK–EBA CONSULTING LTD..
- ALL PILES SHALL BE INSTALLED PLUMB TO THE PILE TIP ELEVATIONS SHOWN ON THE GENERAL LAYOUT DRAWING OR LOWER TO PROVIDE THE REQUIRED DESIGN CAPACITY NOTED IN THE PILE LOAD TABLE.
- THE CONTRACTOR SHALL BE PREPARED TO USE AN AUGER OR OTHER MEANS OF PASSING PILES THROUGH FROST OR BOULDERS.
- USE A TEMPLATE FOR ACCURATE HORIZONTAL PLACEMENT OF PILES IS RECOMMENDED.
- PILES SHALL BE INSTALLED TO THE FOLLOWING TOLERANCES:
  –MAXIMUM TOLERANCE FOR PILE SPACING IN PLAN IS 50 MM
  –FINISHED PILE CUT–OFF ELEVATION TO BE WITHIN 3 mm OF REQUIRED ELEVATION.
  –MAX OFFSET FROM PILE CENTERLINE BY 25 mm.
- STEEL PIPE PILING SHALL MEET THE REQUIREMENTS OF SPECIFICATION ASTM 252 GRADE 2, EXCEPT THAT HYDROSTATIC TESTING IS NOT REQUIRED. IMPERIAL EQUIVALENT PILING IS ACCEPTABLE. MILL CERTIFICATES SHALL BE PROVIDED TO CONSULTANT FOR REVIEW PRIOR TO PILE SUPPLY.
- ALL WELDING SHALL CONFORM TO THE REQUIREMENTS OF CURRENT AWS SPECIFICATION D1.5.
- ANY VOIDS DEVELOPED IN THE VICINITY OF THE PILES FROM ADJACENT SOIL DURING INSTALLATION SHALL BE BACKFILLED WITH GRANULAR FILL OR GROUT TO MAINTAIN THE LATERAL GROUND RESISTANCE.
- PILES SHALL BE INSTALLED IN THE DRILLED HOLES OF DIAMETER 100 MM LARGER THAN THE PILE DIAMETER. THE VOIDS BETWEEN THE PILE AND THE DRILLED HOLE SHALL BE FILLED WITH ADFREEZE GRANULAR MATERIAL AND WATER.
- CONTRACTOR SHALL ENGAGE A QUALIFIED GEOTECHNICAL ENGINEER WHO SHALL DEVELOP AND MONITOR FOR DRILLING AND PILE INSTALLATIONS BASED ON THE EQUIPMENT CONTRACTOR PROPOSES TO USE. THE CONTRACTOR SHALL SUBMIT THE PROPOSED INSTALLATION FOR REVIEW BY THE ENGINEER.
- REFER TO GEOTECHNICAL INVESTIGATION REPORT BY EBA ENGINEERING CONSULTANT LTD FOR PREDICTED ADFREEZE PILE INTERVENTION TIMING AT THIS CROSSING.
- PILES SHALL BE 19m LONG.
- DELIVER PILES IN THE LONGEST LENGTHS POSSIBLE TO MINIMIZE FIELD SPLICES. HOWEVER IF REQUIRED, SPLICING SHALL BE DONE AS SHOWN ON DRAWING.
- GRADATION OF ADFREEZE PILE BACKFILL MATERIAL IS AS SHOWN IN THE TABLE. THE BACKFILL MATERIAL SHALL BE PLACED WITH WATER.
- TO CONTAIN A SATURATED, BUT CONSOLIDATED ADFREEZE BACKFILL, WATER SHOULD BE PLACED FIRST FOLLOWED BY AGGREGATE IN AN ALTERNATING SEQUENCE. MAINTAINING FREE WATER ABOVE THE LEVEL OF BACKFILL SHOULD ACHIEVE THE OBJECTIVES OF SATURATION AND ADEQUATE CONSOLIDATION.
- THE ADFREEZE AGGREGATE SHALL BE PLACED AT A CONTROLLED RATE TO AVOID THE POTENTIAL FOR ARCHING THE ANNULUS BETWEEN THE PIPE PILE AND THE WALL OF THE PILE HOLE.
- FIELD WELDING SHOULD BE CONFIRM TO PROJECT SPECIFICATION.

ADFREEZE PILE BACKFILL MATERIAL	
SIEVE SIZE	% BY WEIGHT
20	100%
10	65–100
5	40–100
1.5	20–90
0.63	15–65
0.315	10–35
0.160	5–20
0.080	0–10
PLASTICITY INDEX	NP–6m
POREWATER SALINITY	0–5 PPT

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DEPARTMENT OF INFRASTRUCTURE

ITH 131.2
CONCRETE CULVERT
PILING PLAN, DETAILS AND NOTES

DEPARTMENT BAR CODE	DATE	STREAM	LOCATION	HIGHWAY	FILE	SHEET	DRAWING
	2019–08–30	GUNGHI CREEK	DEMPSTER HIGHWAY	LOCAL	–	8 OF 8	SHEET–08

Appendix C

Terms Used to Define Construction and Operational Residual Effects

Table C1. Framework Used to Characterize Residual Effects

Criteria	Characteristics
Direction of Impact	
Negative (Adverse)	Net loss to the resource
Positive	Net benefit to the resource
Neutral	No net benefit or loss to the resource
Magnitude of Impact	
Negligible	Measured or estimated impact results in slight apparent change to the indicator (quality, quantity or other attribute), but too low to be meaningful, or within the range of natural variation and can be mitigated by implementing best management practices. Such impacts are not assessed further,
Low	Disturbance predicted to be somewhat above typical background conditions or concentrations, but within established or accepted protective standards, or to cause no detectable change in biological, social or economic parameters
Moderate	Disturbance predicted to be above background conditions or concentrations, but within established criteria or scientific effects thresholds, or to cause a detectable change in biological, social or economic parameters
High	Disturbance predicted to exceed established criteria or scientific effects thresholds, or to cause a detectable change in biological, social or economic parameters beyond the range of natural variability or social tolerance
Geographical Extent of Impact	
PDA	The project footprint or principle disturbance area (PDA)
Local	Effects are not likely to extend beyond the proposed footprint of the Project and adjacent landbase within the LSA.
Sub-regional	Impact extends beyond the local study area (LSA), but is limited to approximately 1000 m from the Project activities or facilities
Regional	Impact extends beyond the sub-regional boundaries
Duration of Impact	
Short-term	Within the construction phase (i.e. < 1 year)
Moderate	Encompasses construction phase and 1 year of reclamation phase (i.e. 1-2 years)
Long-term	Encompasses the reclamation/restoration phase and 5 year period of operations
Degree of Reversibility of Impact	
Reversible	Impact can be naturally returned to original conditions over ten years
Irreversible	Impact is permanent
Scientific Confidence	
Low	Confidence in the impact rating is low as a result of incomplete baseline data or a poor understanding of cause-effect relationships
Medium	Confidence in the impact rating is limited by either incomplete baseline data or an incomplete understanding of cause-effect relationships
High	Confidence in the impact rating is high as a result of sufficient site specific baseline data and a good understanding of cause-effect relationships
Significance	
Not Significant	Impacts are point-like or local in geographic extent, short to long term, and low to moderate in magnitude. Effect ranges from indistinguishable from natural physical, chemical or biological characteristics and processes to effects distinguishable at the level of the individual or sub-population.
Significant	Impacts are negative in direction, regional to local in scale, long term, and high in magnitude. Distinguishable structural and/or functional changes in populations or ecosystems are predicted.

Appendix D

Environmental Management Plans

Environmental Management Plans: Erosion and Sediment Control Plan, Hazardous Materials Management Plan, Waste Management Plan, Wildlife Management Plan, Spill Contingency Plan Aquatic Effects Monitoring Plan, Permafrost Monitoring Plan, and Closure and Reclamation Plan

Construction of Concrete Arch Bridge along Inuvik to Tuktoyaktuk Highway (ITH) at km 131.2 over Gunghi Creek

Prepared for:

Allen Services & Contracting Ltd.

Prepared by:

Wood Environment & Infrastructure Solutions,
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Edmonton, AB T6B 3P6
Canada
T: 780-436-21525 November 2019

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1.0 Introduction

The Gunghi Creek crossing is located along the Inuvik to Tuktoyaktuk Highway (ITH) at km 131.2. The project consists of replacing the existing 2000 mm in diameter Corrugated Steel Pipe (CSP) with an invert length of 38 m that has major sagging in the center. The proposed replacement structure is a 7518 mm span by 3200 mm rise precast concrete arch bridge. The new bridge will have a 38.96 m length and be installed on a 40° left hand forward (LHF) skew. The project is scheduled for construction during the 2019/2020 winter when environmental impacts such as dust, erosion and silt contamination can be minimized. The following provides information on environmental management of erosion and sediment control, hazardous materials, waste management, wildlife management, spill contingency, aquatic effects and permafrost monitoring, site closure and reclamation, and emergency response.

2.0 Environmental Management Plan Implementation

2.1 Training and Communication

The Contractor will ensure all workers are aware of applicable environmental legislation and project specific requirements before construction starts. Environmental Management Plans (EMP) will be communicated to all staff by means of Site Orientation and through regular on-site Safety Meetings and daily Tailgate meetings. Potential topics will include:

- Environmental Management Plan Contents and Onsite location;
- Environmental Management Plan Team Roles and Responsibilities;
- Location of Environmentally Sensitive Areas;
- Permit Requirements Best Management Practices and Mitigation Measures;
- Erosion and Sediment Control Measures;
- Hazardous Material and Waste Management;
- Wildlife Encounter Management;
- Spill Contingency Plans and Location of Spill Kits;
- Emergency Response Procedures;
- Aquatic Effects and Permafrost Monitoring;
- Monitoring & Reporting Procedures;
- Environmental Emergency Response;
- Site Closure and Reclamation; and
- Contact Information.

Following an environmental impact event, the site superintendent will hold an onsite tailgate meeting to inform crew, discuss the event, receive feedback, assess the response, determine how effective the EMP was in dealing with the event, discuss changes to be made and concerns of workers, supervisors and/or the Contract Authority. Updates will made to the EMP's, as required and implemented immediately following the meeting. This meeting will be held as soon as reasonably practical after the event.

2.2 Monitoring & Reporting

The Contractor will incorporate EMP monitoring and inspections into established corporate safety site inspections. Regular (daily and/or weekly) inspections will be conducted as outlined in the individual EMP's herein. Inspection checklists and reports will be prepared and maintained onsite. Any changes to EMP's, monitoring, or reporting requirement will be communicated during project meetings.

2.3 Documentation

The Contractor will identify a location in the Site Office (trailer) for all applicable EMP documentation including:

- Current Environmental Management Plan's;
- Regulatory permits, approvals, authorizations, and/or notifications;
- Relevant training and meeting (tailgate, meeting minutes) records;
- Current erosion and sediment control plan and drawings;
- Hazardous/non-hazardous material inventory;
- Records of environmental incidents (spill reports);
- Completed environmental inspection checklists, reports, and resolutions;
- Completed environmental monitoring reports (inspections); and
- Site orientation, safety meeting, tailgate meeting and project progress minutes.

3.0 Erosion and Sediment Control Plan

As construction activities under this contract are being carried out in the winter, the potential for erosion is considered to be very low. The Contractor will continually monitor the site for signs of erosion and will implement Erosion and Sediment Control (ESC) measures as necessary, as per the contract. The Contractor will install silt fencing along areas of disturbance soils/stockpiles where required to reduce the chance of erosion and/or silt contaminating the waterbodies once the thaw occurs. All ESC measures will be inspected regularly to ensure that they are functioning properly and are maintained, cleaned and/or upgraded as required until complete revegetation of all disturbed areas is achieved. All disturbed areas will be stabilized, vegetated and/or seeded as soon as possible after construction.

Where the watercourse is dry or frozen to the channel bottom at the time of work, the requirement to isolate the instream worksite from flowing water may not be required. Any instream works in flowing water conditions will be isolated during construction. 100% of downstream flow will be maintained at all times. All diverted or discharged water will meet the requirements of the federal water quality guidelines[1].

1 Canadian Council of Ministers of the Environment. 2002. Canadian water quality guidelines for the protection of aquatic life: Total particulate matter. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

4.0 Hazardous Materials Management Plan

4.1 Fuel

No fuel will be stored onsite. However, a double wall fuel tank as part of the light tower/power source will be onsite. All reasonable precautions will be taken to ensure no contamination is caused due to spills. Industry best practices will be followed including the use of spill containment (trays) and spill kits, fire extinguishers, and barriers (e.g., spill mats, drip pans, trays) to protect workers and the environment during onsite refueling of stationary and mobile equipment. Spill mats and/or drip pans / trays will be placed under all mobile fueling containers and under equipment when not in use.

An emergency spill response kit will be kept onsite in case of leaks or spills from machinery. Regular inspection and maintenance of all vehicles/machinery will be conducted. Washing, refueling, servicing and staging of machinery and equipment will be conducted at least 100 m from a water body to prevent the release of any deleterious substances to the water body.

4.2 Lubricating and Hydraulic Oil

The Contractor will make every effort to ensure the area remains free of oil products, including secondary containment for the storage of oil products, and the use of drip trays under parked machinery and when oil servicing. In the unlikely event of a spill (ex. broken hydraulic hose), the Contractor will use industry best practices, to minimize the spill, contain, and clean-up in a safe and timely way. Biodegradable oils and lubricants (e.g., white lithium greases and vegetable oil hydraulic fluid) will be used in any equipment that will be working in the watercourse. The Contractor will keep emergency spill kits onsite in case of fluid leaks or spills from machinery as a contingency for such an occurrence. Contingency plans, mitigation and emergency response will be implemented to prevent and address equipment leaks and spills.

5.0 Waste Management Plan

5.1 Construction Material Waste

The Contractor expects to generate waste construction material onsite including, packaging from deliverables, steel banding, plastic bag material, cut-offs from Styrofoam board, wooden dunnage and culvert demolition waste. All of this waste will be stored on site in a refuse bin and transported to the landfill in Inuvik as required.

5.2 Waste Generated by the Contractor

Waste potentially generated during the project includes: sediment, sewage, solid, and hazardous waste (e.g., fuels, oils, batteries and lubricants), as outlined in Table 1. All waste generated onsite by the Contractor, including empty oil containers, oil and fuel filters, spill clean-up material, will be stored in designated spill resistant containers and transported to proper disposal facility in Inuvik. Table 2 outlines disposal methods for potential waste generated by the project. The project area will be inspected daily for waste and any waste will be collected and properly disposed of.

For sewage and solid waste generated on site, service will be provided by Allen's in Inuvik, or a Tuktoyaktuk Municipal Contractor and will be disposed of according to the Hamlet of Tuktoyaktuk or Town of Inuvik regulation.

Hazardous materials and wastes (e.g., fuels, oils, batteries and lubricants) will be stored in a clearly marked area (e.g. signs and/or flagging) more than 100 m from the high-water mark of any water body. Hazardous wastes will be transported to an approved facility for treatment / disposal.

If other contaminated materials require disposal (i.e., spill pads), these will be disposed of through a licensed facility.

Table 1. Gunghi Creek Crossing Replacement Potential Waste Types

Waste Type	Description
Solid Waste	Food waste, wrappings, waste paper, non-recyclables and empty containers.
Sewage	sewage waste from onsite.
Recyclable Waste	Beverage containers
Hazardous waste	Empty oil containers, oil and fuel filters, and spill cleanup material (Sorbent pads, booms, free liquids and solids).

Table 2. Gunghi Creek Crossing Replacement Waste Type, Volume and Disposal Methods

Waste Type	Hazardous or Non-hazardous	Estimated Volume (m^3)	Disposal Method
Solid Waste	Non-hazardous	TBD	Transported to an approved solid waste facility.
Sewage	Non-hazardous	TBD	Transported to a sewage lagoon facility for disposal or treatment.
Recyclable Waste	Non-hazardous	TBD	Transport to recycling facility
Hazardous waste	Hazardous	TBD	Transported to an approved facility for disposal or treatment

6.0 Wildlife Management Plan

Wildlife in the area may include terrestrial and aquatic mammals, including muskrats and waterfowl. As construction activities will be conducted in the winter months, when the region is not expected to support migratory birds, the *Migratory Birds Convention Act* and its regulation will not be an issue. If for any reason work is carried out over into the spring, this plan will be updated.

An onsite Wildlife Monitor will be aware of the potential species of concern in the area and conduct monitoring of construction activities as they relate to wildlife and wildlife habitat protections and the mitigation measures outlined in the EMP. Monitoring activities will provide a means of measuring the effectiveness of mitigation measures in avoiding or minimizing potential effects on wildlife.

The following mitigation measures will be implemented to ensure protection of wildlife and wildlife habitat:

- Prior to construction a survey will be conducted to ensure no active grizzly/ black bear, wolverine or lynx dens occur within 250 m of the project site. Where dens are identified the appropriate management agency will be identified to determine appropriate mitigation.
- All wildlife sightings will be documented and reported to the appropriate management agency;
- Daily and weekly reporting will be completed by the Wildlife Monitor and include, location (UTM coordinates or latitude / longitude), date, species, number, sex/age if known, wildlife behavior, and any wildlife -vehicle / human interactions;
- Workers will not feed, harass, or approach wildlife;
- Firearms or hunting, trapping and fishing by workers will not be allowed;
- When possible, wildlife will be given the right-of-way and will be left alone, unless there is a human safety issue;
- All project personnel will undergo a wildlife awareness program, which will include prevention measures for wildlife mortality and reporting procedures for wildlife-related incidents;
- Waste will be stored, handled, and transported in accordance with the Waste Management Plan, including storage of all solid waste in sealed, bear-proof containers;
- The project area will be inspected daily for waste. Any waste will be collected and properly disposed of;
- The GNWT Bear Encounter Response Guidelines will following in the event of a bear encounter;
- Where caribou approach the construction site or active ungulate mineral/salt licks are observed a temporary suspension of construction may be required to adhere to recommended setback distances outlined in Table 3. Where caribou or active mineral/salt licks are observed appropriate the environmental management agencies should be contacted to determine appropriate mitigation.

Table 3. Recommended Wildlife Setback Distances[2]

Wildlife	Feature or Habitat	Setback Distance
Caribou	N/A	500 m
Ungulates (general)	Mineral/salt lick	1 km

7.0 Spill Contingency Plan

Spills that are a potential environmental or human health hazard, including oil or fuel spills may occur on-site. A spill that meets criteria for a reportable spill defined as a substance that is likely to be an imminent environmental or human health hazard or meets or exceeds the volumes of "reportable quantities for spills in the NWT" as outlined in Appendix A will be reported to the Spill Report Line at **(867) 920-8130** and a Spill Report Form will be completed and submitted by fax (**(867) 873-6924**) or email (**spills@gov.nt.ca**).

NT/NU SPILL REPORT LINE / 24-hour Spill Report Line:
Phone: (867) 920-8130
Email: spills@gov.nt.ca
Fax: (867) 873-6924

All staff will be trained in spill response prior to working onsite. All Spill Report documents will be available in the site office. Local Fire, Ambulance, and Police contacts are included in Contractors Site Emergency Response Plan. The Contractor Emergency Contact Numbers will be posted in Site Office and

2 Aboriginal Affairs and Northern Development Canada, Fisheries and Oceans, Environment Canada – Canadian Wildlife Service and GNWT – Department of Environment and Natural Resources (AANDC). 2012. Northern Land Use Guidelines – Volume 9a: Northwest Territories Seismic Operations.

are included in the Emergency Response Plan. The following spill response materials will be maintained on-site:

- Spill Kits in equipment and vehicles, which will contain sorbent material, a disposable container, safety gloves and goggles, and a shovel.
- Extra spill kits and materials will be available to contain larger spills and be stored at in the on-site trailer.
- Sorbent material to be carried in vehicles and equipment vehicles: **10 pads and 2 socks.**
- Fuel and service trucks: **200 pads and 12 socks.**

7.1 Preventative Measures

The Contractor will take every precaution to avoid any type of environmental impact. The following preventative measures will be put in place:

1. Verify last maintenance records for all mobile/heavy equipment and ensure good condition before starting the equipment;
2. Complete the pre-use inspection on all mobile/heavy equipment;
3. Pay special attention to lines, fuel tanks, hydraulics, etc.;
4. Complete a worksite inspection and note all locations which could be contaminated;
5. Review SDS for hazardous products such as oil and fuel;
6. Prepare required PPE such as gloves, goggles, etc.;
7. Use spill donuts to create a barricade between the creek and equipment, where reasonably practicable;
8. Have fully stocked spill kits near by; and
9. Ensure phone numbers are available on-site for NWT Spill Report Line.

7.2 Spill Response Procedures

In the event of a spill onto the ground or into the creek, which are expected to be frozen at time of construction, the following procedures will be initiated:

1. Stop work, shut down equipment.
2. Evaluate the spill situation. Determine the source and if the spill is hazardous or non-hazardous material, quantities of material, areas of concern, potential chemical reactions.
3. Evaluate the need for Personal Protective Equipment.
4. Confine the spill area: stop the flow at the source, use absorbent socks, absorbent booms, or construct a dyke around the spill.
5. Absorb the released product: use absorbent mats and pads or granular absorbent.
6. Contact the Site Supervisor and report the spill.
7. Package and dispose of contaminated material: any materials used to absorb the spill and contaminated soil will be stored in an approved container and disposed of at the appropriate facility.
8. Reporting: Complete any required health and safety and environmental reports as required by the type and quantity of materials spilled in coordination with the Site Supervisor and Site safety Representative.
9. Smoke will not be permitted in emergency situations, including spills.

Spills adjacent to a water body must be cleaned up as quickly as possible to prevent them from entering the water body. Once area is safe and spill has been contained start clean up. Ensure traffic is minimized

on and around contaminated areas. The use of a vacuum truck may be appropriate to skim off contaminates.

7.2.1 Large Spills

1. A command and control center may be needed.
2. Temporary access roads may be needed.
3. Establish Zones may be needed. (i.e.: Hot Zone (downwind first))

	Minor Leak	Small Leak	Large Leak
Liquid Spill:	100ft (30m)	400ft (125m)	1,200ft (375m)

- Record names and functions of all personnel on site.
- Establish an evacuation area.
- Implement a safety indoctrination procedure for spill site.
- Establish a communication system.
- Set up 24 hour supervision of site.

Note: For Fuel or hydraulic spills the threshold limit is 100 liters. When reporting a spill of 100 liters or more to the NWT Spills Hotline, the person reporting the spill shall provide the following:

1) Date and time of spill;
2) Direction spill is moving (or if it has stopped);
3) Name and phone number of persons close to the location of the spill;
4) Type of released product and quantity spilled;
5) Cause of spill;
6) Whether the spill is continuing or has stopped;
7) Description of the existing containment;
8) Actions taken to recover, clean-up and dispose of spilled product;
9) Name, address and phone number of person reporting the spill; and
10) Name of the person in charge of management or control at the time of the spill.

7.2.2 Erosion Event of Land

As construction activities will be carried out in the winter months, it is unlikely erosion will occur during construction activities. Measures outlined in the Erosion and Sediment Control Plan (Section 3.0) will be implemented to prevent and/or mitigate potential environmental effects resulting from erosion.

7.3 Discovery of Historic Contamination

Immediately stop work. Contact site superintendent, and contract authority. Contain the immediate area to ensure contamination doesn't spread. Site superintendent and contract authority will determine the proper steps to proceed with clean-up and/or inspection from another authority.

8.0 Aquatic Effects Monitoring Plan

Potential direct or indirect construction-related effects to the aquatic environment of Gunghi Creek include the following:

Release of Deleterious Substance: accidental release of a deleterious substance (sediments, debris, hydrocarbons, and hydraulic fluids).

Fish Passage: the replacement open bottom concrete arch culvert is anticipated to improve fish passage at the watercourse crossing and was designed to accommodate fish passage during peak flows for the weakest swimmer of species potentially occurring in Gunghi Creek and improved fish passage. As such, further monitoring of fish passage is not expected to be required.

Fish and Fish Habitat: the proposed works will affect an area that has previously been disturbed by the existing crossing and no critical habitat for fish was identified at the Project site. Overall, productive capacity of fish habitat through the crossing structure is anticipated to improve. As such, further monitoring of is not expected to be required.

It is expected the monitoring will support the implementation of environmental protection measures to minimize impacts of construction and to provide a feedback mechanism so that mitigation measures can be adjusted where and when necessary.

8.1 Mitigation

Mitigation measures outlined below as well as those included in the Erosion and Sediment Control Plan, Hazardous Materials and Waste Management Plans are intended to mitigate/address potential aquatic environment effects.

General

- Instream works will be avoided during the restricted activity timing window of April 1 to July 15.
- The construction limits will be conspicuously marked with flagging tape to ensure that construction personnel know the disturbance must remain within the proposed footprint and right-of-way.
- All work will be conducted from above the streambanks, wherever possible, to avoid disturbance to riparian vegetation. Disturbed areas will be stabilized, vegetated and/or seeded as soon as possible after construction.
- An Erosion and Sediment Control Plan (ESCP) will be prepared and implemented. Effective ESC measures will be in place prior to disturbance, during and after construction to prevent sediment from entering the watercourse and wetlands. All ESC measures will be inspected regularly to ensure that they are functioning properly and are maintained, cleaned and/or upgraded as required until complete revegetation of all disturbed areas is achieved.
- Minimize clearing of riparian vegetation (where possible, prune or top vegetation rather than uprooting/grubbing), minimize removal of any instream natural structures (e.g., woody debris, boulders; if removed, return to its original location), and use existing roads, cut lines and trails when accessing the work area to minimize further disturbance within the riparian area (soil compaction, clearing).
- Any excavated areas of the channel bed will be backfilled with material that is the same quality and gradation that was removed.
- Only clean rock, appropriately sized and free of deleterious substances will be used for riprap. These materials will be obtained off site and will not be taken from below the average high-water level of any watercourse.
- Construction will be halted during periods of heavy precipitation.

- All equipment and machinery will be assembled, cleaned and checked for proper mechanical operation prior to entering the work site. Regular inspections will be completed to ensure that hydraulic, fuel, and lubrication systems are in good condition and equipment is free of leaks.
- Biodegradable oils and lubricants (e.g., white lithium greases and vegetable oil hydraulic fluid) will be used in any equipment that will be working in the watercourse.
- Washing, refueling, servicing and staging of machinery and equipment will be conducted at least 100 m from a water body to prevent the entry of any deleterious substances.
- If fuel is to be stored on site, it must be placed within a lined containment berm that is to be located at least 100 m from any water body. The berm is to have a capacity of 110% relative to the volume of fuel being stored.
- All equipment that is to be used will be free of weed species and aquatic invasive species.
- All spoil materials and debris will be removed from the site and properly disposed of above the high-water mark so that they do not enter any water body.
- The Contractor will prepare an emergency spill response plan and contingency measures.

Instream Isolation

Where the watercourse is dry or frozen to the channel bottom at the time of work the requirement to isolate does not apply.

- Any instream works in flowing water conditions will be isolated during construction. 100% of downstream flow should be maintained at all times. Where ice is present, the diverted water will
  - be returned to the watercourse under the ice. All diverted or discharged water will meet the requirements of the federal water quality guidelines[1].
- Any bypass pumping or water withdrawal will be conducted as follows:
  - Must pass through a screen with openings that are no larger than 2.54 mm and at a velocity that does not result in the entrainment and entrapment of fish or fish fry.
  - The fish screen must be constructed of materials that can withstand extreme winter temperatures.
  - The screen should be kept clean of ice and debris, be inspected for damage before each withdrawal, pump should be stopped if any sign of fish impingement or entrainment, and a secondary screen should be kept onsite in case the primary screen gets frozen or damaged.
  - The inlet screen will not be placed directly on the bottom of the water body and will be placed in a manner that prevents disturbance on the channel bed material
  - All openings for guides and seals will be smaller than the opening width of the screen material (2.54 mm) so fish cannot pass through.
  - Protect large screens with trash racks fabricated of bar (150 mm spacing is typical) or grating in areas where there is debris loading (i.e. woody material, leaves or algae mats).
  - Approach velocity directly in front of the screen will not exceed the designed approach velocity at any location.
  - Ensure there is enough structural support to prevent sagging or collapsing of the screen panel.
  - Where ice is present on the water body, the diverted water will be returned to the water body downstream of the instream worksite, under the ice.
- Materials in isolation berms will be made of non-earthen materials and not introduce clay or silt into any watercourse. Instream works will be confined to the isolated channel section. Accumulations of deposited sediment will be removed from within the isolated area prior to removing the isolation barrier.
- Should the need for dewatering arise, water will be released into a well vegetated area or settling basin and not directly into any water body. Water returning to the watercourse will be of equal or better quality than the water in the watercourse.

- If water, standing or flowing, is present in the isolated work zone at the time of construction, a fish rescue program will be completed prior to the start of instream work to ensure all fish are protected.
- Any fish will be rescued from the isolated area prior to construction and be relocated, unharmed, into an area containing sufficient flow and cover. Fish rescue may require a territorial license. Rescue operations employing effective methods (e.g. electrofishing, seine netting, minnow trapping) carried out as stipulated in the research license.

Temporary Access Road -Snow Fill

- It is understood that construction of the temporary access will not require pumping of any water from any nearby water body.
- Construct approaches or access road crossings perpendicular to the watercourse where possible.
- Construct approaches using clean (ambient), compacted snow and ice to a sufficient depth to protect the stream banks or shoreline.
- Where logs are used to stabilize the approach the logs are to be clean and securely cabled together. No logs and woody debris are to be left in the river or on the banks or shoreline.
- The snow bridge should be V-notched once construction is completed to allow it to melt from the center.
- Remove compacted snow from snow fills prior to the spring freshet.

8.2 Monitoring

A monitoring program will be developed, where required for the release of deleterious substance.

In the event of spill, a water quality monitoring plan will be developed to monitor the released product (fuel, hydraulic fluids, hydrocarbons etc.).

Where water is present during construction the Contractors operations will be subject to the maximum allowable increase in Total Suspended Solids/Turbidity in the watercourse, as specified by the *Canadian Water Quality Guidelines*[1]. These guidelines provide threshold levels for which a turbidity monitoring program will be developed.

9.0 Permafrost Monitoring Plan

As the proposed development occurs within an area that has been previously disturbed by the exiting highway and watercourse crossing potential negative effects to permafrost (permafrost melt) are expected to be fully mitigated with the implementation of the following mitigation measures and permafrost monitoring is not expected to be required:

- Timing of Construction. To avoid rutting and erosion in permafrost terrain, construction and overland travel will only take place during the winter when the active layer is well-frozen.
- In areas of ice-rich permafrost, cross drains will be stacked on top of each other to maintain drainage in the event that the lower cross drain freezes, where required.
- Prior to the spring melt/freshet, the disturbed soil will be stabilized using effective erosion and sediment measures, vegetated and/or seeded. In areas with permafrost, care will be exercised to ensure these measures do not cause thawing or frost heave;
- At least 2 m of spoil material or other suitable material will be placed on any exposed ice surfaces to provide insulation.

10.0 Site Closure and Reclamation Plan

There are no plans for the closure of the ITH anytime in the foreseeable future and no requirements for any reclamation of the highway and highway right-of-way as no activities will be carried out outside of the actual highway embankment, with the exception of a temporary detour around the construction site, which will be within the highway right-of-way. Therefore, the following Closure and Reclamation Plan will only address the temporary detour.

- No water withdrawal from nearby water bodies will be required for the temporary detour. Any water required for the project will be transported to site from the Hamlet of Tuktoyaktuk and will not be locally sourced.
- The temporary detour will only be operational when the ground is sufficiently frozen a nd there is an adequate layer of snow to prevent damage to the ground by vehicles.
- The snow bridge should be V-notched once construction is completed to allow it to melt from the center; and
- Compacted snow from snow fills will be removed prior to the spring freshet; and
- winter ice roads will be allowed to deteriorate naturally at the end of winter, following the construction period.

11.0 Emergency Response Plan

The Contractor has prepared Emergency Response Procedures, provided in Appendix B. The document includes emergency contact numbers and reposnse procedures in the event of a personnal injury, incident or emergency, leak or spill, bomb threat, explosion, severe weather, or natural disaster.

Appendix A

Reportable Quantities for Spills in the Northwest Territories

Table A1. Reportable Quantities for Spills in the Northwest Territories

Substance	Reportable Quantity
Explosives Compressed gas (toxic/corrosive) Infectious substances Sewage and Wastewater (unless otherwise authorized) Radioactive materials Unknown substance	Any amount
Compressed gas (Flammable) Compressed gas (Non-corrosive, non-flammable)	Any amount of gas from containers with a capacity greater than 100L
Flammable liquid	≥100 L
Flammable solid Substances liable to spontaneous combustion Water reactant substances	≥ 25 kg
Oxidizing substances	≥ 50 L or 50 kg
Organic peroxides Environmentally hazardous substances intended for disposal	≥1 L or 1 kg
Toxic substances	≥ 5 L or 5 kg
Corrosive substances Miscellaneous products, substances or organisms	≥ 5 L or 5 kg
PCB mixtures of 5 or more ppm	≥ 0.5 L or 0.5 kg
Other contaminants--for example, crude oil, drilling fluid, produced water, waste or spent chemicals, used or waste oil, vehicle fluids, wastewater.	≥ 100 L or 100 kg
Sour natural gas (i.e., contains H_2S) Sweet natural gas	Uncontrolled release or sustained flow of 10 minutes or more
Flammable liquid Vehicle fluid	≥ 20 L When released on a frozen water body that is being used as a working surface
Reported releases or potential releases of any size that: are near or in an open water body; are near or in a designated sensitive environment or habitat; Pose an imminent threat to human health or safety; or Pose an imminent threat to a listed species at risk or its critical habitat	Any amount

Appendix B

Allen Services and Contracting Emergency Response Procedures

EMERGENCY RESPONSE PROCEDURES

GUNGHI CREEK CULVERT REPLACEMENT PROJECT

Project Location:
Inuvik - Tuktoyaktuk Highway, Marker 131.2, 14 km south of Tuktoyaktu

Table of Contents

1.0 Emergency Phone Numbers

Tuktoyaktuk Health Services

Main Phone 8:30 – 17:00……..(867) 977 - 2321
Satellite Phone……..01-8816-326-17088
After Hours Emergency/Nurse……..(867) 977 - 2321

Tuktoyaktuk Fire Department……(867) 977 - 2222
Tuktoyaktuk Police (RCMP)……...(867) 977 - 1111

Regulatory Contacts

NWT Spill Hotline……..24 hrs……(867) 920 - 8130
Poison Centre……24 hrs……(800) 332 - 1414
WSCC Reporting Line……..24 hrs……(800) 661 - 0792
WSCC Information……(867) 678 - 2301
NWT Chief Safety Officer……(800) 661 - 0792

Utilities

Natural Gas……..Inuvik Gas……(800) 511 - 3447
Electrical……NWT Power Corp……...(800) 668 - 5506

Allen Services & Contracting Ltd.

Brian McCarthy Sr……Supervisor…….....(780) 271- 5666
Barry Setzer.....Site Safety Rep.....(867) 678 - 5078
Lee McMann …….Supervisor.....(780) 999 - 0177
Allen Services Office……..…….....(867) 777 - 4000

Other Phone Numbers

Roger Gruben – camp location Tuktoyaktuk.....(867) 977 - 2230

1.1 General Information for Emergency Response on Active Work Sites

1. In the event that the Media arrives on site – please DO NOT answer any questions;

   **REFER ALL MEDIA QUESTIONS TO AS&C Media Spokespersons ONLY:

   - **Brian McCarthy (Northwest Territories)**
   - **Dean Smith (Alberta)**

2. Do not smoke in emergency situations!

3. Wardens:

   On work sites, the Site Supervisor is always the 1st Chief Warden. The 1st Chief Warden will appoint a 2nd Chief Warden for the events that the 1st Chief Warden is absent.

- If 1st Chief Warden is absent, the 2nd Chief Warden becomes the 1st Chief Warden.
- A Warden must be always present at an active work site – plan ahead!
- If working in remote locations – establish contact with medical emergency facilities and fire department. Provide details of potential emergencies and of your location. Sending a map of the location ahead of time can save valuable time during an emergency and will aid the responders in finding the location faster.
- If working in remote location – remember that a simple first aid kit may not be sufficient. Ensure to have a stretcher, blankets, splints, designated first aid room, etc. in place.
- Ensure the vehicle for transportation of injured or ill is large enough to accommodate a stretcher.
- Familiarize yourself with the routes to medical services, if ambulance services are not available.

2.0 Fire Response Procedure

1. If you are the first one to discover the fire **sound the alarm with 3 short blasts on the air horn, short pause, then 3 short blasts on the air horn again.**
2. Attempt to extinguish the fire only if it is safe to do so. As a rule of the thumb, **if you can't put the fire out within 5 seconds, abandon your efforts.** Remember these steps:

   P – Pull the pin
   A – Aim low at the base of the fire
   S – Squeeze the handle
   S – Sweep from side to side

3. Report the fire to your Chief Warden, the Chief Warden will notify the Fire Department of the fire from a safe location by two-way radio or mobile phone. Fire Department should be called ONLY by the Chief Warden. Provide the address and or description of the location.
4. Shut down your tools and/or equipment, if it is safe to do so.
5. **CALMLY** evacuate the area on a direct and safe way, don't run.
6. Assist others, if it is safe to do so.
7. Assembly at Muster Point for a head count.
8. Report any information about the fire to your Warden.
9. Remain at the Muster Point until cleared to go back ONLY by your Warden or Fire Department authority.
10. Do not smoke in emergency situations!

If You Are On Fire

- **STOP** where you are
- **DROP** to the floor or ground and
- **ROLL** your body to smother the fire.

3.0 Medical Emergency Response Procedure (General)

1. Assess the scene and take charge of the situation, if it is safe to do so.
2. If there are others around you, call them to assist you. Call for the Chief Warden.
3. If the scene is unsafe, proceed with evacuation procedure.
4. Attempt to rescue the victim only if it does not endanger yourself and others.
5. If the scene is safe, check the victim for vital signs as instructed in First Aid Training. If you do not have First Aid Training call someone who has completed the training as listed on the First Aid Attendant list. Do not move the injured unless absolutely necessary.
6. If there are life-threatening injuries or the victim is unresponsive call for medical assistance immediately or instruct someone to call and to report back to you.
7. In case of rendering assistance to personnel exposed to hazardous materials, consult the Safety Data Sheet (SDS) and wear the **appropriate personal protective equipment.**
8. Continue to assist the victim until help arrives or until ready for transportation
9. Do not smoke in emergency situations!

3.1 First Aid Procedure

Administer immediate first aid to injured or exposed personnel using the following steps:

1. Move injured personnel only if necessary to prevent their exposure to further harm.
2. For spills affecting small portions of skin, immediately flush with flowing water for at least 15 minutes. If no visible burn exists, wash with warm water and soap, removing any jewelry to facilitate proper decontamination.
3. For spills on clothes or large areas of skin, quickly initiate showering while removing all contaminated clothing, shoes and jewelry. It may be necessary to cut the clothes off in some instances to prevent contamination of the eyes.
4. Contaminated clothes should be laundered when possible (at work, separate from other clothing, or use a contracted laundering service), decontaminated or discarded. Never take contaminated clothing home.
5. Do not use creams, lotions or salves, except to neutralize the spilled material (e.g., calcium gluconate gel for hydrofluoric acid exposure and polyethylene glycol [PEG 300] for phenol exposure).
6. For splashes into the eyes, immediately irrigate the eyes at an eyewash station for at least 15 minutes. Hold the eyelids away from the eyeball, moving eye in all directions to wash thoroughly behind the eyelids.
7. If necessary administer artificial respiration, but only if CPR trained.

In all cases, the exposed or injured person must seek medical attention:

1. Call emergency services.
2. Relevant safety information such as an SDS should accompany the person.
3. Notify the injured person's supervisor as soon as possible.
4. For non-life threatening/non-critical injuries or illnesses, see Reporting Accidents & Injuries, section 10, of the safety manual.

3.2 Amputation Injuries and Emergencies

If you witness an amputation:

- Call emergency services.
- Stop the bleeding. A complete amputation may not bleed very much. The cut blood vessels may spasm, pull back into the injured part, and shrink. This slows or stops the bleeding. If there is bleeding, do the following:
    - If available, wash your hands with soap and water and put on disposable gloves. If gloves are not available, use many layers of clean cloth, plastic bags, or the cleanest material available between your hands and the wound.
    - Have the injured person lie down and elevate the site that is bleeding.
    - Remove any visible objects in the wound that are easy to remove and remove or cut clothing from around the wound.
    - Apply steady direct pressure for a full 15 minutes. If blood soaks through the cloth, apply another one without lifting the first. If there is an object in the wound, apply pressure around the object, not directly over it.
    - If moderate to severe bleeding has not slowed or stopped, continue direct pressure while getting help. Do all you can to keep the wound clean and avoid further injury to the area.
    - Mild bleeding usually stops on its own or slows to an ooze or trickle after 15 minutes of pressure. It may ooze or trickle for up to 45 minutes. Use the Check Your Symptoms section to determine your next steps.
- Check and treat for shock. The trauma of the accident or severe blood loss can cause the person to go into physiologic shock. Signs of physiologic shock include:
    - Passing out (losing consciousness).
    - Feeling very dizzy or light-headed, like the person may pass out.
    - Feeling very weak or having trouble standing up.
    - Being less alert. The person may suddenly be unable to respond to questions, or he or she may be confused, restless, or fearful.
- Emotional stress from the event may cause symptoms such as light-headedness or fainting. This is sometimes called "emotional shock." Light-headedness and fainting from emotional stress may be confused with physiologic shock.

3.3 Care for an Amputated Body Part

- Recover the amputated body part, if possible, and transport it to the hospital with the injured person. If the part can't be found right away, transport the injured person to the hospital and bring the amputated part to the hospital when it is found.
- Gently rinse off dirt and debris with clean water, if possible. Do not scrub.
- Wrap the amputated part in a dry, sterile gauze or clean cloth.
- Put the wrapped part in a plastic bag or waterproof container.
- Place the plastic bag or waterproof container on ice. The goal is to keep the amputated part cool but not to cause more damage from the cold ice. Do not cover the part with ice or put it directly into ice water.

3.4 Care for the Part of the Body Where the Amputation Occurred

- Stop the bleeding.
- Elevate the injured area.
- Wrap or cover the injured area with a sterile dressing or clean cloth until medical treatment is received.

3.5 Care for a Partially Amputated Body Part

- Elevate the injured area.
- Wrap or cover the injured area with a sterile dressing or clean cloth. Apply pressure if the injured area is bleeding. This will slow the bleeding until the person receives medical care. You don't want to cut off the blood flow to the partially amputated part, so pressure needs to be light—just enough to slow blood loss.
- Gently splint the injured area to prevent movement or further damage.

3.6 Heart Attack First Aid

If you believe you are having a heart attack:

- Call emergency authorities. Don't ignore or attempt to tough out the symptoms of a heart attack. If you don't have access to emergency medical services, have a co-worker drive you to the nearest hospital.
- Do not drive yourself to the hospital.
- Chew and swallow an aspirin, unless you are allergic to aspirin or have been told by your doctor never to take aspirin.
- Take nitroglycerin, if prescribed. If you think you're having a heart attack and your doctor has previously prescribed nitroglycerin for you, take it as directed. Don't take anyone else's nitroglycerin, because that could put you in more danger.

If someone else is having a heart attack:

- Call 9-1-1 immediately.
- Begin CPR if the person is unconscious. If you are with a person who is unconscious, tell the 9-1-1 dispatcher or another emergency medical specialist. You may be advised to begin cardiopulmonary resuscitation (CPR).
- If you haven't received CPR training, doctors recommend performing only chest compressions (about 100 to 120 compressions a minute). The dispatcher can instruct you in the proper procedures until help arrives.
- If an Automated External Defibrillator (AED) is immediately available and the person is unconscious, follow the device instructions for using it.
- If the person is conscious, ask if they have medication for their condition.
- Find/get the medication for them and hand it to them. Do not administer the medication, let the person administer the medication themselves.
- Call 9-1-1 and/or transport the person to the Hospital.

4.0 Emergencies in Individuals With Diabetes

Patients with diabetes may develop complications of the disease, which may present as a medical emergency. Two emergencies that the OFA attendant will most commonly encounter are:

1. **Hypoglycemia** — low blood sugar
2. **Hyperglycemia** — high blood sugar

When managing a patient with diabetes and a decreased level of consciousness, the OFA attendant can often find it difficult to determine if the patient is suffering from hypoglycemia or hyperglycemia.

Hypoglycemia Signs and Symptoms

The OFA attendant must suspect hypoglycemia whenever a patient with diabetes becomes confused or behaves irrationally. Because of the brain's dependence on adequate levels of glucose, failure to quickly recognize and treat hypoglycemia will result in progressive deterioration of the patient's condition and possibly death.

The earliest signs of hypoglycemia are:

- hunger
- pale, clammy skin
- dizziness, trembling, weakness
- confusion, restlessness, irrational behaviour

As hypoglycemia progresses, the patient may develop slurred speech or collapse, or become unresponsive. Seizures and profound sweating are also quite common. The patient's respiration and pulse may increase somewhat but, they often remain normal despite the changes to the patient's level of consciousness.

Hypoglycemia Management

1. The basic principle of treatment is to provide glucose in any form.
2. If the patient is conscious, any sugar-containing substance will suffice — honey, syrup, sugar and water, fruit juice, soft drinks, (not diet drinks), glucose tablets, or candy.
3. The OFA attendant should not be concerned about giving too much sugar. Sips of juice or small amounts of candy are insufficient. A full glass of juice with sugar added or a whole candy bar is usually required.
4. All individuals, even if they regain their normal status, should be referred for medical assessment. All patients with diabetes and a decreased level of consciousness are in the Rapid Transport Category.
5. If the patient has a decreased level of consciousness and is thus not able to take anything by mouth, the OFA attendant has limited options. For hypoglycemic patients in a remote workplace or where medical resources are not readily accessible, it is recommended that a small amount of sugar be placed under the lateral or ¾-prone patient's tongue.
6. Concentrated glucose jelly or glucose tablets are commercially available.

7. Care must be taken when administering sugar because such patients are at very high risk of choking or of aspirating liquid, even if the patients are placed 3⁄4-prone or suction equipment is available. The most effective way to give glucose to these patients is intravenously.
8. After conducting the primary survey and managing any life-threatening conditions, the OFA attendant should position the patient in the lateral or 3⁄4-prone position.
9. With the patient in the lateral or 3⁄4-prone position, the OFA attendant completes the secondary survey. If medical assistance (ambulance) is delayed, the attendant should attempt to place a teaspoon of sugar or concentrated sugar solution — e.g., honey or syrup - under the patient's tongue and the area between the inside of the cheek and the teeth and gums while awaiting transport or en-route.
10. The OFA attendant must take care not to place the sugar at the back of the throat because it may cause the patient to choke. Special attention must be devoted to maintaining the airway of the comatose patient.

Hyperglycemia

When the blood sugar of a person with diabetes rises to high levels, a chain of events is triggered in the body's metabolism. In the absence of adequate amounts of insulin, the body's cells are unable to use glucose and they begin to malfunction. High levels of blood glucose cause excessive urination, which in turn causes severe dehydration and thirst. The changes to the body's metabolism result in acidic waste products accumulating in the blood. This causes a loss of appetite, nausea, vomiting, and deep, rapid breathing. The breath has a characteristic fruity, sweet odour, caused by the accumulation of these acid waste products.

This sequence of events develops gradually, usually over the course of a few days. However, it can progress to coma and, ultimately, death if not adequately treated. At this extreme, hyperglycemia becomes a true emergency.

Hyperglycemia Signs and Symptoms

The earliest signs of hyperglycemia are:

- thirst
- excessive urination
- loss of appetite
- weakness, dizziness

As the hyperglycemia progresses and the body's metabolism alters in other ways, the following signs and symptoms develop:

- nausea, vomiting
- deep, rapid breathing
- dry mouth
- breath has a characteristic fruity sweet odour • weak, rapid pulses
- warm, dry skin
- decreased level of consciousness, coma

Hyperglycemia Management

The OFA attendant can do little to treat hyperglycemia. These patients require prompt treatment in hospital with intravenous fluids and insulin. The OFA attendant must manage the patient's ABCs and complete the primary survey. The patient with a decreased level of consciousness requires special attention to the airway.

5.0 Burn Emergencies

5.1 Major Burn Wound Management

1. Cooling may limit the depth of the burn for some first- and second-degree burns — e.g., from a propane flash or scald. Cooling is soothing and provides some pain relief for all types of burns. Cooling should start within 5 minutes of the burn and be applied for a maximum of 20 minutes.
   A helper can continue the cooling during RTC packaging or the secondary survey. Cooling should be limited to 20% of the body surface. Cooling of a greater portion of the body surface can cause hypothermia. Never apply ice. Any available source of water may be used — e.g., tap water from a kitchen sink or a garden hose. Sterile water or saline solution is neither superior to tap water nor necessary.

2. If water is used to put out the fire, the patient's entire body may have to be covered. This is done to put out the fire but should not be prolonged. In these circumstances, once the fire is out, wet and burned clothing should be removed. Do not cool more than 20% of the body surface except to extinguish flames.

3. Remove burned clothing to ensure all smouldering or melting fabric is no longer in contact with the skin.

4. Remove rings, wrist watches, and footwear, if possible.

5. Elevate burned extremities, if possible. This may decrease fluid loss and tissue swelling. Do not splint burned limbs unless there is an obvious fracture or dislocation.

6. Do not break blisters.

7. Do not apply creams, ointments, or topical anaesthetics to burns.

8. Apply wet dressings on burns to less than 20% of the body surface. Any burn in excess of 20% can be covered with dry dressings or clean sheets. Do not apply tight, encircling dressings.

9. After the burns are dressed, keep the patient comfortable and cover him or her with blankets if necessary.

10. Monitor the patient's ABCs frequently en-route to the hospital.

5.2 Minor Burn Care First - Degree Burns

- Unless a first-degree burn has involved a very large area — e.g., 40% to 50% — of the body surface, a patient with a first-degree burn usually does not require hospitalization. The principal problem in first-degree burns is pain, which can be relieved by cold water compresses. These should be applied only to a maximum 20% of the body surface at any one time. Cold towels are usually effective for burns of the trunk or face. Stop the cooling if the patient starts to shiver.

5.3 Partial-Thickness Second-Degree Burns

- The principal problems with second-degree burns are infection, pain, and shock caused by loss of fluid into blisters. Treatment is similar to that of a first-degree burn. Cooling applied within 5 minutes of burn may limit the depth of this type of burn and reduce pain.
- Do not deliberately break blisters because this may lead to secondary infection.
- If blisters do spontaneously rupture, allow the fluid to drain and treat the burn as outlined previously.

5.4 Third-Degree Burns and Full-Thickness Second-Degree Burns

- All full-thickness burns, regardless of size, should be referred to medical attention as soon as possible.

5.5 Chemical Burns

Chemical burns result from contact with corrosive or caustic substances, usually strong acids or alkalis. A chemical will continue to burn as long as the substance remains in contact with the skin. Early removal of the chemical is of great importance.

The type of tissue injury varies with the chemical properties of the substance involved. The OFA attendant should be familiar with the substances used in his or her particular workplace.

Three primary factors determine the severity of an injury:

1. properties of the chemical
2. concentration of the chemical
3. length of exposure to the chemical

Management of Chemical Burns

The management of chemical burns follows the Priority Action Approach with special emphasis on the following considerations. Throughout the management, the OFA attendant must be careful not to come into contact with the substance.

1. Immediately dilute and remove the chemical
   by copious flushing with water (see Figure 37- 5). Speed is essential. Dry powder chemicals should be brushed from the skin before flushing is started, unless large

quantities of water are immediately available (see Figure 37-6). For the specific management of hydrofluoric acid see Hydrofluoric Acid.

2. Begin flushing immediately, preferably with a hose or shower (see Figure 37-7) and flush vigorously with water for 30 consecutive minutes — by the clock. When the chemical is known not to be water soluble or the substance causing the burn is unknown and not dissolving in the water irrigation, mineral oil should be liberally applied to the burn site for 1 minute. Immediately following the mineral oil application, continue to flush with water for 30 minutes.

3. The use of buffer-irrigating solutions has been considered as an alternative to flushing with water for years. The purpose of the buffer or neutralizing agent is to neutralize the substance rendering chemicals harmless through chelation and encapsulation, eliminating or reducing the severity of the burn. The idea is logical, but impractical. Neutralizing agents are rarely as available as water and some create heat during the neutralizing process, harming the patient. Water irrigation is safe and practical. Immediate access to a flushing system is key in affecting outcomes.

4. Remove any of the patient's clothing that is soiled with the chemical. Continue flushing until the burning sensation stops.

5. Estimate the degree and extent of the burn using the Rule of Nines, as with a heat burn.

6. Continue flushing or use saline-soaked dressings, reapplied every 30 minutes, when possible.

7. Transport to medical aid, constantly monitoring and recording the patient's condition. It may be necessary to continue flushing the area during transportation.

6.0 Gas Leaks and Spills

6.1 Gas Leaks

1. Upon smelling or noticing a gas leak or strong unusual vapors, evaluate the situation. If you believe it to be of dangerous nature, sound the alarm with **3 short blasts on the air horn, short pause, then 3 short blasts on the air horn again.**
2. Shut down your tools and equipment, if it is safe to do so.
3. **CALMLY** evacuate the building on a direct and safe way through the nearest exit, don't run.
4. Assist others on your way out and shut all doors, if it is safe to do so.
5. Assembly at Muster Point for a head count.
6. Report any information about leak/smell to your Warden. The Warden will contact emergency authorities.
7. Remain at the Muster Point until cleared to go back ONLY by your Warden or Emergency Authority (i.e. Police, Fire Department).
8. Do not smoke in emergency situations!

6.2 Chemical and Reportable Spills

1. Evaluate the spill situation: determine if the spill is hazardous or non-hazardous material, quantities of material, areas of concern, potential chemical reactions.
2. Evaluate the need for Personal Protective Equipment.
3. Block any drains if you are inside or in an area where storm sewers are present.
4. Confine the spill area: use absorbent socks or absorbent booms to confine the spill area.
5. Absorb the confined area: use absorbent mats and pads or granular absorbent to absorb the spill.
6. Contact the Chief Warden and report the spill.
7. Package and dispose of contaminated material: any materials used to absorb the spill and contaminated soil should be stored in an approved container and disposed of in an appropriate facility.
8. Reporting: Complete any required health and safety and environmental reports as required by the type and quantity of materials spilled in coordination with the Chief Warden and/or Safety representative.
9. Do not smoke in emergency situations!

6.3 Non-Hazardous Spills

- Will be contained using the spill kits available in at the facility/job site.
- Will be reported based on volume and type of material.
- Contaminated soil will be removed and bagged for safe disposal.
- Contaminated soil will only be disposed of at an approved facility.

6.4 Hazardous Spills

- Allen Service & Contracting Ltd. employees are not trained to respond to hazardous material spills and should contact specially trained crews to control the spill.

7.0 Bomb Threats and Explosions

7.1 Bomb Threats

1. If a threat is received by phone, mail or other means, get as much information as possible.
2. If the threat is received by phone, try to keep the person on the line for as long as possible. Do not hang up the phone, even after the call has been terminated.
3. If a threat is received in person, try to get as much information as possible.
4. Contact your Chief Warden immediately when possible and if it is safe to do so.
5. If a suspicious device is identified, sound the alarm with **3 short blasts on the air horn, short pause, then 3 short blasts on the air horn again.**
6. Shut down your equipment or tools, if it is safe to do so.
7. Evacuate the immediate area and notify your Chief Warden to notify local Emergency Authorities (i.e. Police).
8. **CALMLY** evacuate the building on a direct and safe way through the nearest exit, don't run.
9. Assembly at Muster Point for a head count, if the Muster Point area is safe. If it is not safe, assembly in an area close to the Muster Point where you are visible.
10. Report any information about the bomb threat to your Warden.
11. Remain at the Muster Point until cleared to go back ONLY by your Warden or Emergency Authorities (i.e. Police, Fire Department).
12. Do not smoke in emergency situations!

7.2 Explosions

1. Get down on the floor, take shelter under tables or desks, and protect your face and head against flying glass and debris.
2. **Once it is safe to do so, CALMLY** evacuate the building on a direct and safe way through the nearest exit, don't run.
3. Assist others on your way out, if it is safe to do so.
4. Assembly at Muster Point for a head count, if the Muster Point area is safe. If it is not safe, assembly in an area close to the Muster Point where you are visible.
5. If applicable, assist injured persons and provide first aid.
6. Report any information about the explosion to your Warden.
7. Remain at the Muster Point until cleared to go back ONLY by your Warden or Emergency Authority (i.e. Police, Fire Department).
8. Do not smoke in emergency situations!

8.0 Severe Weather and Natural Disasters

8.1 Tornado

1. When you notice severe weather, seek inside shelter.
2. Seek shelter under desks or tables, if possible.
3. Heavy items that may cause injury should be moved to the floor.
4. Stay away from outside walls and windows
5. Use arms to protect head and neck
6. Remain sheltered until the tornado threat is announced to be over.

8.2 Blizzard

1. Stay calm and await instructions from your Warden.
2. Stay indoors!
3. If there is no heat:
    i. Close off unneeded rooms or areas
    ii. Stuff towels or rags in cracks under doors
    iii. Cover windows at night
4. Eat and drink. Food provides the body with energy and heat. Fluids prevent dehydration.
5. Wear layers of loose-fitting, light-weight, warm clothing, if available.

9.0 Workplace Violence

1. Notify your Chief Warden immediately by phone or other means and report the occurrence. If not possible, contact or let someone contact emergency authorities.
2. Do NOT attempt to physically intervene. Protect yourself first.
3. **STAY CALM**, stay out of way and wait for authorities to arrive.
4. Report all information to your Chief Warden and emergency authorities (i.e. Police).

10.0 Trucker's and Driver's Emergencies

Hi-way trucks are equipped with GEO-TRAC and two-way radio for tracking, monitoring and communication.

Before beginning a trip, all hi-way truck drivers must:

- Inspect their truck and trailer, if applicable
- Ensure fire extinguisher and first aid kit are available
- Check if GEO-TRAC is functioning
- Check if two-way radio is functioning
- Ensure they have a functioning and charged cell phone with them and a charger
- Trips should be planned as to avoid night driving or driving after 10pm

Before beginning a trip, all pick-up drivers must:

- Inspect their vehicle and trailer, if applicable
- Ensure fire extinguisher and first aid kit and reflective triangles are available
- Ensure they have a functioning and charged cell phone with them and a charger
- Trips should be planned as to avoid night driving or driving after 10pm

In case of a break down or accident not involving other vehicles/traffic and physical injuries:

- Put on your hi-vis vest or clothing with hi-vis stripes
- Turn on your hazard lights
- Before Exiting the vehicle ensure there is not traffic or that you step onto traffic
- Secure the scene/vehicle by placing reflecting triangles 100 meters behind the truck/vehicle
- Investigate the problem
- Call your trip supervisor, report and follow instructions

In case of physical injuries:

- If you are or another person are injured, try to administer first aid, if possible
- Call 9-1-1 for medical aid
- Call your trip supervisor immediately
- Report the injury and severity of injury
- Wait for help to arrive, if applicable

What to do if there is no cell service:

- Try calling other truckers with the two-way radio
- Communicate your problem and ask to make a call for you
- If other truckers don't have service, ask for other truckers to help you
- Try waving other traffic down – follow procedure for break down or accident

If you are stranded in remote area:

- Try contacting other truckers with two-way radio
- If the two-way radio is broken, try contacting your supervisor with your cell phone
- If there is no cell service, push the distress/panic button on GEO-Track

EMERGENCY RESPONSE PLAN

Project: Gunghi Creek Culvert Replacement (CT2346)
Location: Inuvik - Tuktoyaktuk Highway, Marker 131.2, 14 km south of Tuktoyaktuk

Approximate Work Location

N

- First Aid Kit and other Emergency Equipment
- Fire Extinguisher
- Spill Kit
- Eyewash Station
- Air Horn
- Muster Point
- Job Shack

* All equipment may be transported to location 2

EMERGENCY RESPONSE PLAN

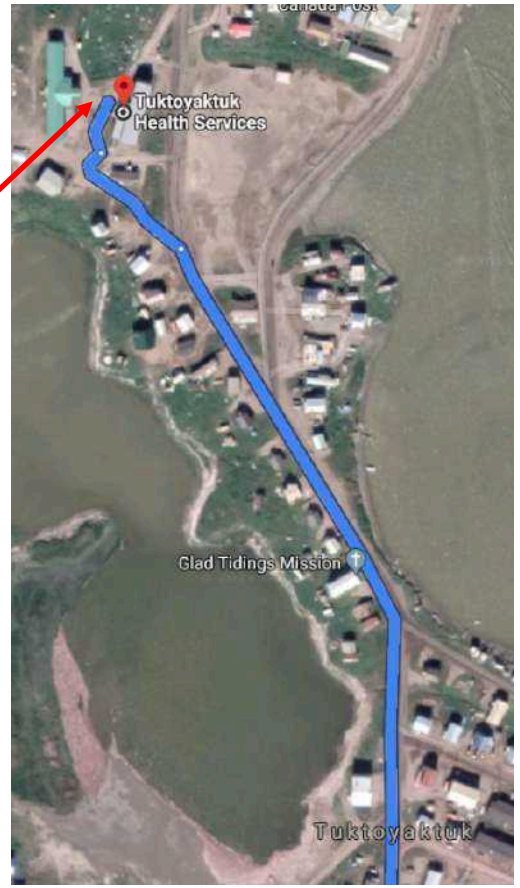
Project: Gunghi Creek Culvert Replacement (CT2346)
Location: Inuvik - Tuktoyaktuk Highway, Marker 131.2, 14 km south of Tuktoyaktuk

Tuktoyaktuk

Work Area (approx.)

Inuvik

Area Overview and Medical Aid



Directions from work area to Tuktoyaktuk Health Services

Distance: ca. 14.8 km and ca. 20 min (across frozen river)

1. Head east on Dempster Hwy/NT-8 N for ca. 14 km

2. Turn left onto Tetlit Gwich'In Rd and keep driving for ca. 1 km

Tuktoyaktuk Health Services

Address:
Bag Service 1000
Tuktoyaktuk, NT X0E 1C0

Main phone: 867-977-2321
Satellite phone: 01-8816-326-17088

After Hours Emergency: 867-977-2321

Hours of Operation:
Monday to Friday: 08:30-17:00

EMERGENCY RESPONSE PLAN

Project: Gunghi Creek Culvert Replacement (CT2346)
Location: Inuvik - Tuktoyaktuk Highway, Marker 131.2, 14 km south of Tuktoyaktuk

Basic Emergency Response Procedure

- Do not panic, stay calm
- Shut down your equipment, if it is safe to do so
- Assess the scene
- Sound the alarm – 3 short blasts on the air horn, short pause, then again 3 short blasts or shout: HELP-HELP-HELP

- If a person is injured, ensure first aid is provided
- Assess the injury - If severe injury, call Health Services for assistance/guide and to announce arrival with injured

- If fire, use the fire extinguisher and try to extinguish the fire
- If the fire is too big, leave the area immediately
- Call the Fire Department

- Assemble at Muster Point, if not assisting
- Remain at Muster Point until given clear by Site Supervisor

- For all other emergencies, follow the specific Emergency Response Procedures for type of emergency

Remember: DO NOT DISTURB the scene
DO NOT SMOKE in emergency situations
Do not talk to media

EMERGENCY RESPONSE PLAN

Project: Gunghi Creek Culvert Replacement (CT2346)
Location: Inuvik - Tuktoyaktuk Highway, Marker 131.2, 14 km south of Tuktoyaktuk

Emergency Phone Numbers

First Aiders on site marked with 

Tuktoyaktuk Health Services
Main Phone 8:30 – 17:00……..(867) 977 - 2321
Satellite Phone……..……...01-8816-326-17088
After Hours Emergency/Nurse……..……....(867) 977 - 2321

Tuktoyaktuk Fire Department……(867) 977 - 2222
Tuktoyaktuk Police (RCMP)……....(867) 977 - 1111

Regulatory Contacts
NWT Spill Hotline……..24 hrs……..….(867) 920 - 8130
Poison Centre……24 hrs……..….(800) 332 - 1414
WSCC Reporting Line……..24 hrs……..….(800) 661 - 0792
WSCC Information…….....(867) 678 - 2301
NWT Chief Safety Officer……(800) 661 - 0792

Utilities
Natural Gas……..Inuvik Gas……..….(800) 511 - 3447
Electrical……..……NWT Power Corp……...(800) 668 - 5506

Allen Services & Contracting Ltd.

Brian McCarthy Sr……Supervisor…….(780) 271- 5666

Barry Setzer.....Site Safety Rep....(867) 678 - 5078

Lee McMann ……Supervisor..... (780) 999 - 0177

Allen Services Office……..……..….(867) 777 - 4000

Other Phone Numbers

Roger Gruben – camp location Tuktoyaktuk.....(867) 977 - 2230

Appendix E

Inuvik Hunters and Trappers Committee - Letter of Support

Inuvik Hunters & Trappers Committee
102 Mackenzie (2nd Floor)
PO Box 1720, Inuvik NT, X0E0T0
Phone:867-777-3671, Fax: 867-777-2478
Email: inuvikhtc@hotmail.com

November 4, 2019

Dean S. Smith
Allen Services
55104 Lamoureux Drive
Sturgeon County, AB
T8L 5 A8

RE: Changing Culvert on the ITH

To: Dean,

The Inuvik Hunters and Trappers Committee (IHTC) gives support to remove the existing conventional culvert and replace it with the buried arch bridge structure for better water flow.

If you have any further questions, please contact our office at (867)-777-3671 or email Inuvikhtc@hotmail.com

Thank you,

Vice-President Douglas Esagok

Appendix F

Photo Documentation

Photo 1. July 26, 2019. Facing downstream at the Gunghi Creek crossing. Note low and dwarf shrub riparian vegetation and surrounding upland tundra.

Photo 2. July 26, 2019. Facing upstream at the Gunghi Creek crossing. Note low and dwarf shrub riparian vegetation and surrounding upland tundra.

Photo 3. July 26, 2019. Facing upstream at the Gunghi Creek crossing, showing pool habitat at the existing culvert inlet.

Photo 4. July 26, 2019. Facing across the channel downstream at the Gunghi Creek crossing, showing pool habitat at the existing culvert outlet.