Worley Canada Services Ltd.,
Ikpiaryuk Services Ltd., in joint venture

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22 December 2020

Our Ref: 317071-00037

Nunavut Water Board
Gjoa Haven, NU
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Attention: Derek Donald, Technical Advisor
Email: derek.donald@nwb-oen.ca

Dear Mr. Donald:

RE: TYPE B PERMIT APPLICATION FOR ARCTIC BAY HARBOUR DEVELOPMENT PROJECT DRILLING PROGRAM

1 Introduction

Worley Canada Services Ltd. and Ikpiaryuk Services Ltd. in joint venture, operating as Advisian-Ikpiaryuk JV, have been retained by Public Services and Procurement Canada (PSPC) to perform detailed design, community consultation and regulatory support services for the development of a small craft harbour (SCH) in the Hamlet of Arctic Bay, Nunavut (the Project). This harbour is part of the Inuit Impact and Benefit Agreement (IIBA) (IIBA 2019) negotiated for the Tallurutiup Imanga (TI) (Lancaster Sound) National Marine Conservation Area (NMCA), which was announced on August 1, 2019. Arctic Bay is located within the North Baffin Regional Land Use Plan (NBRLUP) Region (NPC 2000) on the northwest coast of Baffin Island (Borden Peninsula) (73° 1.529'N, 85° 7.203'W) (see Figure 1-1). PSPC is managing the procurement process on behalf of Fisheries and Oceans Canada – Small Craft Harbour (DFO-SCH) who will be the owner once operational.

1.1 Background

Leading up to the Project, Advisian completed a four-harbour feasibility study, and during the 2019 open water season, a field program was undertaken to conduct environmental, geoscience, geophysics and archaeological baseline studies in Arctic Bay (the Field Program). The initial Field Program was permitted under an NPC letter of conformity (File No. 149402) and a Nunavut Impact Review Board (NIRB) Screening Decision Report (SDR) (File No. 19YN031). An amendment request was submitted to the NPC for the 2021 field program, and the conformity determination was re-issued to confirm that the existing NIRB SDR is sufficient. Other permits obtained for the Field Program are identified in Section 3. In the open water season of 2020, a second field program was conducted for the environmental and geophysics scope and

was performed with permit renewals from NPC and the Nunavut Research Institute (NRI) (File No. 02 058 19N-M).

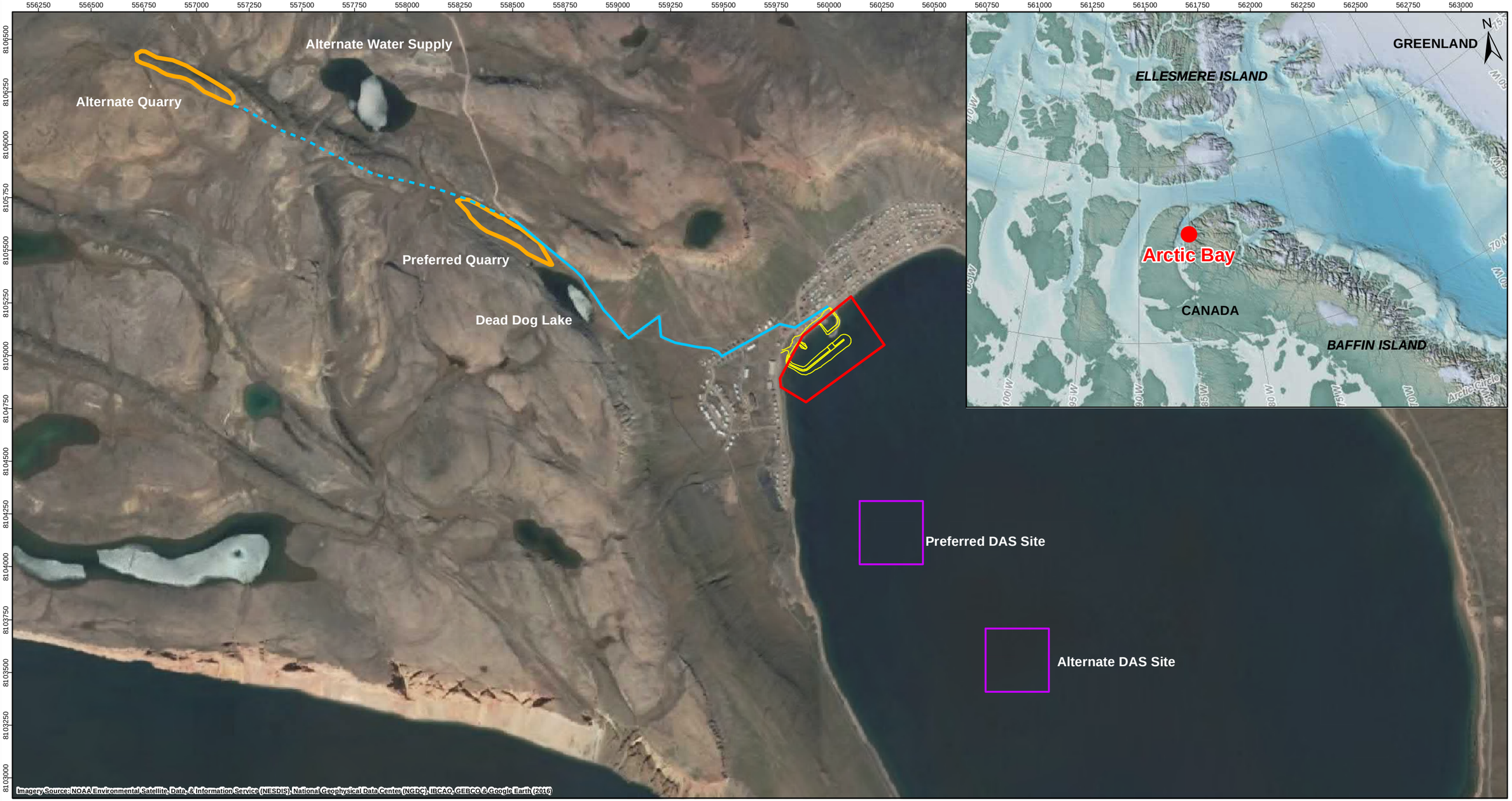
1.2 Purpose

The purpose of the Program is to gather relevant information for the design of the SCH and the quarry development. Key information includes: confirmation of bedrock depth within the SCH and to identify the presence of obstructions; marine sediment sample collection for analysis should disposal at sea (DAS) be required; core samples within the preferred quarry location to investigate rock quality. All boreholes will be performed at the preferred quarry and SCH (see Figure 1-1). The preferred quarry is approximately 1.5 km from Arctic Bay on the road toward Victor Bay, and the SCH is immediately fronting the Community. The Geotechnical Program will be the third field program supported by the existing NPC, NIRB and NRI approvals and will be performed in the late winter/early spring of 2021.

This letter is the project summary that supports the Nunavut Water Board (NWB) Permit Type B Application for drilling at the quarry location, specific to water withdrawal and drill fluids disposal.

If the current travel restrictions to Nunavut are still in place at the time of the field program, all personnel travelling to Nunavut will undertake the Government of Nunavut (GN) mandatory isolation and comply with any other required COVID-19 measures.

The planned changes to the Program are discussed in Section 2, with Advisian's proposal for management of effects described in Section 4, and pertinent required permits discussed in Section 3.



Legend

- Site Location
- **SCH Footprint**
  - Option 1 Layout
  - SCH Study Area
- **DAS SIte**
  - DAS Site
- **Haul Route**
  - Potential Haul Route - Existing Road
  - Potential Haul Route
- Potential Quarry

0 200 400 800
Metres

1:18,000

WGS 1984 UTM Zone 16N

N

Aerial Image: GoogleEarth, July 2016
Locations approximate.

PUBLIC SERVICES AND PROCUREMENT CANADA
ARCTIC BAY HARBOUR DEVELOPMENT

PROJECT LOCATION

Date: 16-DEC-20	Drawn by: KR	Edited by: KR	App'd by: VB
Public Services and Procurement Canada / Advisian / Kpiaryuk Services Ltd.		Project No. 317071-00037	
		FIG No 1-1	REV 0

PLOT DATE & TIME: 2020-12-16 9:43:37 AM USER NAME: Kenneth W.Ritchie
SAVE DATE & TIME: 2020-11-10 11:57:33 AM ISSUING OFFICE: BURNABY GIS

FILE LOCATION: U:\YVR\317071\00037_PWGS_ArcBayCES\10_Eng\16_Geomatics\01_MXD\Baseline\Fig1-1_AB_Site_Location.mxd

2 2021 Geotechnical Program

2.1 Activity

The Geotechnical Program is anticipated to require approximately ten (10) days in total to complete with 24/7 operations. A 24/7 drilling program is required to keep the equipment running which will prevent water and fuel lines from freezing. Constant operation will also minimize the risk of casing and drill rods getting stuck in sea ice and/or below seabed resulting in loss or damage to equipment and having to re-drill.

An estimated eight (8) boreholes will be drilled; three (3) terrestrial and five (5) marine. The locations of the boreholes will be field selected, but will be within the preferred quarry and SCH footprints (Figure 1-1). Terrestrial boreholes are expected to be drilled up to 15 m below ground surface (mbgs) and marine boreholes drilled from 5 to 10 m below seabed, which is approximately -7 to -20 m Chart Datum (CD).

An ice auger will be used to create a hole through the sea ice to allow for extraction of seawater for drilling marine boreholes (approximately 2,000 to 3,000 litres per borehole). Water for Terrestrial boreholes will be fresh water that will be pumped from the Alternate Water Supply Lake or Dead Dog Lake using similar water volumes per boreholes (see Figure 1-1 for lake locations). Water lines will be heated to ensure water does not freeze in the lines. Drill muds (if required) will be used to advance terrestrial and marine boreholes. All drill mud/cuttings will be pumped back into the borehole at completion.

2.2 Schedule

The Geotechnical Program will occur in March or April of 2021.

2.3 Equipment and Personnel

Drilling will be undertaken using a portable rotary drill rig mounted onto skids. A wooden shack to surround the drill rig will be built to protect the drill crew from the elements. The drill shack will be pulled onto terrestrial and marine boreholes using heavy equipment such as a front-end loader. Marine holes will use the level ice as a floating platform to support the drilling equipment.

The drilling methodology includes wash / mud rotary drilling combined with Standard Penetration (SPT) testing to obtain soil samples. Rock cores will be collected using triple tube diamond drilling techniques.

It is anticipated that each borehole will take approximately 24 hours to complete, comprising two, 12-hour shifts. Each 12-hour shift will include a driller and drilling assistant, a geotechnical engineer, a local wildlife monitor and local assistant. A marine mammal observer (MMO) will also be available as required while drilling over water at the SCH. Field decisions will be made at the time to confirm if the MMO and wildlife monitor can be the same individual. The intention of the MMO will be to watch for and monitor seal activity, while the intention of the wildlife monitor is to watch for and monitor wildlife that may pose a risk to field personnel.

3 Permit Status

Permits obtained for the 2019 Field Program are summarized in Table 3-1.

For the 2021 Geotechnical Program, additional permits or approvals will be required from the Nunavut Water Board (NWB), Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC), and DFO – Fish and Fish Habitat Protection Program (FFHPP). Compliance with the *Fisheries Act* will be met through the application of DFO's Measures to Protect Fish and Fish Habitat website (DFO 2019) and a compliance document will be generated to confirm requirements (Advisian 2020). Therefore engagement with DFO-FFHPP is not required as the project will not result in the harmful alteration, disruption or destruction (HADD) of fish or fish habitat.

Table 3-1 Existing Program Permits

Regulatory Authority	Permit/File No	Permit Type	Required in 2021
NRI	02 058 19N-M	Research License	Yes
NPC	149159	Conformity Determination	Yes
NIRB	19YN031	Screening Decision Report	Yes
GN-Department of Culture & Heritage	No. 2019-51A – Arctic Bay	Class 2 Territory Archaeologist Permit	No
DFO	S-19/20-1018-NU	License to Fish for Scientific Purposes	No

Table 3-2 Additional Program Permits

Regulatory Authority	Permit Type	Associated Activity
NWB	Type B	Water withdrawal and drill fluids disposal
CIRNAC	Class A	Drilling (Heli-portable rotary drill rig outfitted with a 150 mm drill head)
DFO	DFO compliance verification by a QEP	Drilling and water withdrawal

4 Geotechnical Program Effects

Geotechnical Program activities with the potential to have environmental effects on fish and fish habitat include:

- Drilling (including circulation of drill muds and water withdrawal)
- Contact of equipment with the seabed (drill head)
- Fuel storage and refuelling, including spills

Potential environmental effects relating to fish and fish habitat include the following, all of which were potential effects in the 2019 Field Program:

- Disturbance or injury to fish or marine mammals due to underwater sound
- Water quality degradation due to sediment disturbance

- Modification of fish habitat and effects to fish health due to changes in water quality, substrate changes or sedimentation
- Destruction of fish habitat

While the scope for the Geotechnical Program is different from previous Programs, the effects are similar to those summarized in Table 10-1 of Advisian (2019) for the 2019 NPC and NIRB applications and NIRB screening. Mitigation measures applied in 2019 were appropriate and effective to minimize and mitigate negative environmental effects. Theses mitigation measures will be applied for the 2021 Geotechnical Program. Further to this, best management practices (BMPs) will be incorporated to minimize the potential for accidental spills of fuel or drilling muds.

4.1 Fish

The Geotechnical Program is being performed during the late winter/early spring when the bay is frozen over and ice is approaching its maximum thickness. Whales and many species of fish (e.g. Arctic char, Arctic cod) will not be present in the waters fronting the Hamlet at that time. Direct mortality to fish is not considered likely given the small footprint of the drill heads. Underwater sounds from the Geotechnical Program are not expected to cause fish mortality (see Section 4.2). Fish entrainment is not expected, however, water intakes for drilling in both marine and fresh water environments will be in compliance with the Standards and Codes of Practice (SCOPs) by utilizing end-of-pipe fish screens (DFO 2020). Water withdrawal is expected to be <50 m^3/day which will not impact water levels for fish bearing water courses.

4.2 Disturbance, injury or mortality to fish or marine mammals due to underwater sound

Negative effects to fish and marine mammals are not expected, and sound thresholds are unlikely to exceed DFO's recommendations (marine mammals: 160 dB re 1µPa root mean squared [rms] at extent of Exclusion Zone [EZ]; fish: Peak rms of 206 dB re1 µP, SELcum of 186 dB re µPa^2s within 10 m of the sound source). The acoustic effect of drilling in the underwater marine environment is not well understood, as available data are limited. Research conducted in Western Australia during geotechnical site investigations yielded source levels at 1 metre of 142 – 145 dB re1µPa rms during drilling and SPT 151–160 dB re1µPa^2s (Erbe & McPherson 2017). A similar drilling program in northern British Columbia, where Advisian conducted compliance monitoring, had an acoustic range of 121.32 – 148.89 dB re1µPa rms with sound pressures ranging from 1.16 – 27.82 Pa (pre-August 2019 *Fisheries Act* required 30 kPa @ 10 m from sound source for fish). These results are not directly transferable to the Geotechnical Program due to site specific variables that influence the sound, such as substrate type, mechanical equipment specifications, water temperature, salinity and an iced ocean. However, it does provide some indication that exceedances are not expected to occur.

The sensitivity of marine fish to anthropogenic underwater sound is primarily driven by the presence or absence within a particular species of a swim bladder. Species with no swim bladder (e.g. sculpin) are the least sensitive to underwater noise (J. R. Nedwell et al. 2004). Fish with swim bladders will have variable sensitivities to underwater noise, and species who use the swim bladder for hearing, and thus have a close connection between the swim bladder and the ear, are the most sensitive (Halvorsen et al. 2012; J. Nedwell et al. 2006; Popper et al. 2006). Sculpin will be the primary species of interest for an iced ocean coastal environment and are less likely to be vulnerable to sound influencing activities.

This, in combination with drilling occurring during the iced season, is indicative that sound negative effects to fish and marine mammals are not expected.

4.3 Water and Sediment Quality Degradation

Effects to fish health due to sediment mobilization are not expected. The footprint of the drill head is minimal.

4.4 Fish Habitat

Negative effects to fish habitat will be temporary and only due to the footprint of the drill head (diameter is 150 mm). As the program is being conducted in the iced-in season there is no other footprint impact.

Mobilization of sediment is not considered to be extensive as the drill head footprint is relatively small.

4.5 Modification and Destruction of Fish Habitat

Permanent loss of fish habitat will not occur as the effects to fish habitat from the Geotechnical Program are temporary and negligible.

4.6 Risk of spills and environmental pollution

Measures are in place to manage accidental spills which have been designed to be on compliance with the Spill Planning and Reporting Regulations in Nunavut. Spill response measures will be designed to be implemented for the prevention and management of spills to a worst-case scenario size that could occur as a result of the Program.

Hazardous products associated with the Program that have a potential to be leaked or spilled are provided in Table 4-1.

Table 4-1 Potential Hazardous Products to be used during the Program

Type	Quantity	Use
Gasoline	100 Litres	Mobile equipment, remote generators, heaters
Diesel	10,000 Litres	Drill Rig
Polypus	400 Litres	Drill Rig
Hydraulic oil	280 Litres	Drill Rig
10/40 oil	120 Litres	Drill Rig
Gun Grease	48 Litres	Drill Rig
Methyl hydrate	20 Litres	Drill Rig
Transmission Fluid	20 Litres	Drill Rig
80/90 Gear oil	80 Litres	Drill Rig
Antifreeze	120 Litres	Drill Rig

5 Environmental Compliance

The measures as outlined in the NIRB SDR will be followed and a copy of the SDR will be on site (NIRB 2019), in addition to the compliance requirements that will be dictated through NWB, CIRNAC and DFO-FFHPP. A Program Environmental Management Plan (EMP) has been developed which will be provided to the contractor to confirm compliance measures are followed (Advisian 2020a). The onsite Advisian geotechnical lead will confirm all site personnel are aware of the regulatory conditions and will confirm that the measures are followed.

Measures are in the place for the program under the following categories:

- Fish and Fish Habitat
  - A local MMO will be hired to observe for and confirm the presence of seals (including the documentation of any changes in behaviour). As the Geotechnical Program is occurring in the iced season, they are the only marine mammal expected to be present. Polar bears may be present will not be impacted by underwater sound or other project activities.
- Wildlife Management
  - A wildlife monitor will be present at all stages of drilling for both the SCH and quarry locations, and field personnel will participate in wildlife training. Waste management measures will include appropriate storage strategies to not attract wildlife.
- Water quality and Management
  - Appropriate measures will be in place to confirm drill muds and additives do not enter marine or freshwater courses.
- Air Quality
  - Measures to minimize idling will be in place and equipment will be in good working order.
- Fuelling, Chemical Storage, spill prevention and emergency response
  - To mitigate environmental impacts, fuelling of the rig will occur in place (thus over water at the SCH and possibly near the community's alternate water source at the quarry) with appropriate measures to reduce the likelihood of a spill, including supplies to catch drips, leaks or small spills. The area of land within 31 km from the alternate water source is small and the likelihood of a spill in this region is low. However, in the event of any spill, the drill rig will have secondary containment, as well as a spill kit in the event of accidental fuel spills not captured within the secondary containment area. A spill contingency plan (SCP) will be in place, and this plan will be submitted to the NWB and CIRNAC either at the time of application or prior to the Geotechnical Program. The SCP can also be provided to NPC and NIRB, if required. Refuelling will be required to occur 'over water' for the SCH drilling and thus less than 30 m from a water course, however the secondary containment measures outlined above are sufficient to minimize risk to the aquatic and marine environments. NWB and CIRNAC will be made aware of this requirement during application submissions.
  - Reclamation
    - reclamation is not required given the location that the Program is being undertaken. However the SCH and quarry locations will be left in the same condition they were in prior to drilling. After the Program is complete, the area will be cleaned and restored. This includes the removal of all equipment; the plugging and capping of drill holes and waste clean-up.

6 Consultation

Consultation during the feasibility phase of the Project included four separate community visits from 2018 to 2020 to conduct meetings with the Hamlet, design workshops with the Ikajutit Hunters and Trappers Association (HTA), and Inuit knowledge (Inuit Qaujimajatuqangit [IQ]) workshops with local elders and active hunters. A public open house was also conducted in February 2020. Proposed field activities and anticipated impacts were discussed during each meeting conducted in the feasibility phase.

A joint meeting on September 22, 2020 was conducted in Arctic Bay to provide the community an overview of the detailed design phase of the Project, the preferred harbour layout, the proposed field and construction activities, and to discuss anticipated impacts and mitigation measures. The joint meeting was attended by Hamlet mayor and council, the Ikajutit HTA, Qikiqtani Inuit Association (QIA), local community representatives, and the Arctic Bay Nauttiqsuqtit (the Guardians). Drop-in introductory meetings were also held with residents along the shoreline and quarry haul route, the RCMP, Northern Store, and the Co-op. These meetings were conducted to provide residents with a brief introduction of the Project, listen to any concerns or questions and commit to further consultations with directly impacted residents in February 2021. As in the feasibility phase, proposed field activities, including the Geotechnical Program, were presented and discussed with the community. No concerns were expressed by the community regarding the proposed Drilling Program or other field activities.

7 Reporting

Annual reports will be submitted to the NRI (before December 31, 2021) the NWB (before March 31, 2022) and CIRNAC (confirmation date likely the same as NWB) after the 2021 Geotechnical Program. The NRI annual report will be available in both English and North Baffin Inuktitut.

8 Conclusion

The Project is an exciting one and will result in the construction of a SCH for the Hamlet of Arctic Bay. There are measures in place to manage potential effects to the environment for this small-scale drilling operation, and it is our opinion that the current SDR encompasses all compliance requirements.

The Project has been highly anticipated by the community for many years. It will improve existing boat launching and the overall safety of marine activities in Arctic Bay by providing a protected harbour for hunters and fishers, subsistence harvesters, outfitters, recreational users, and cruise ship tenders. The Project will also support the developing commercial fishing operations by providing access to a safe harbour and landing facility in the community.

9 Closure

We trust that this report satisfies your current requirements and provides suitable documentation for your records. If you have any questions or require further details, please contact the undersigned, Victoria Burdett-Coutts, at any time by email at Victoria.coutts@advisian.com or by phone either at 778-945-5501 (office) or, during the COVID-19 working from home requirements, at 778-839-2372 (mobile).

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10 References

Advisian. (2019). Lancaster Sound Four Harbours Feasibility Study: Application Information Requirements for Submissions to Nunavut Impact Review Board (NIRB). Prepared for the Government of Nunavut. *(Document No. 307071-01306-00-EN-LET-0006, Revision 0)*, June 2019.

Advisian. (2020). Regulatory Compliance for Arctic Bay Civil Engineering Services, Harbour Development Project (R.110729.001). Prepared for Public Services and Procurement Canada and DFO-SCH. *(Document No. 317071-00037-00-EN-TEN-0001, Revision 0)* September 23, 2020.

DFO. (2019). Measures to Protect Fish and Fish Habitat. Available at: http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures-eng.html. Accessed: September 2019.

DFO. (2020). Interim code of practice: End-of-pipe fish protection screens for small water intakes in freshwater. Fisheries and Oceans Canada. Available at: https://www.dfo-mpo.gc.ca/pnw-ppe/codes/screen-ecran-eng.html. Accessed: May 2020.

Erbe, & McPherson. (2017). Underwater Noise from Geotechnical Drilling and Standard Penetration Testing. J Acous. Soc. Amer. 142 (3) 281-285 Available at: https://asa.scitation.org/doi/abs/10.1121/1.5003328?af=R&.

Halvorsen, Casper, Matthews, Carlson, & Popper. (2012). Effects of exposure to pile-driving sounds on the lake sturgeon, Nile tilapia and hogchoker. *Proceedings of the Royal Society B: Biological Sciences, 279*(1748), 4705-4714. doi:10.1098/rspb.2012.1544

IIBA. (2019). Allurutiup Imanga National Marine Conservation Area. Inuit Impact and Benefit Agreement. August 1, 2019. Available at: https://www.qia.ca/wp-content/uploads/2019/09/2019-08-01_TINMCA-IIBA_FULLY-SIGNED-1.pdf Accessed: November 2019.

Nedwell, Edwards, Turnpenny, & Gordon. (2004). Fish and Marine Mammal Audiograms: A Summary of Available Information (Report No. 534R014): Subacoustech. 281p.

Nedwell, Turnpenny, Lovell, & Edwards. (2006). An Investigation into the Effects of Underwater Piling Noise on Salmonids. *The Journal of the Acoustical Society of America, 120*(5), 2550-2554.

NIRB. (2019). Screening Decision Report: Four Harbour Feasibility Study Program - Fisheries and Oceans Canada-Small Craft Harbour's (DFO). NIRB File No. 19YNO31. NPC File No: 149159. Dated 15 August 2019.

NPC. (2000). North Baffin Regional Land Use Plan. Available at: https://www.nunavut.ca/sites/default/files/north_baffin_regional_land_use_plan.pdf Accessed: October 2020.

Popper, Carlson, Hawkins, Southall, & Gentry. (2006). Interim Criteria for Injury of Fished Exposed to Pile Driving Operations: A White Paper. Prepared for Jones & Stokes and the California Department of Transportation. Sacramento, CA.