High Lake Project, 2005 Baseline Programs: Summary of Work Plans

Prepared for
Wolfden Resources Inc.

Submitted by
Gartner Lee Limited

June 30, 2005

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Reference
GLL 41007

Gartner Lee

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1. Introduction

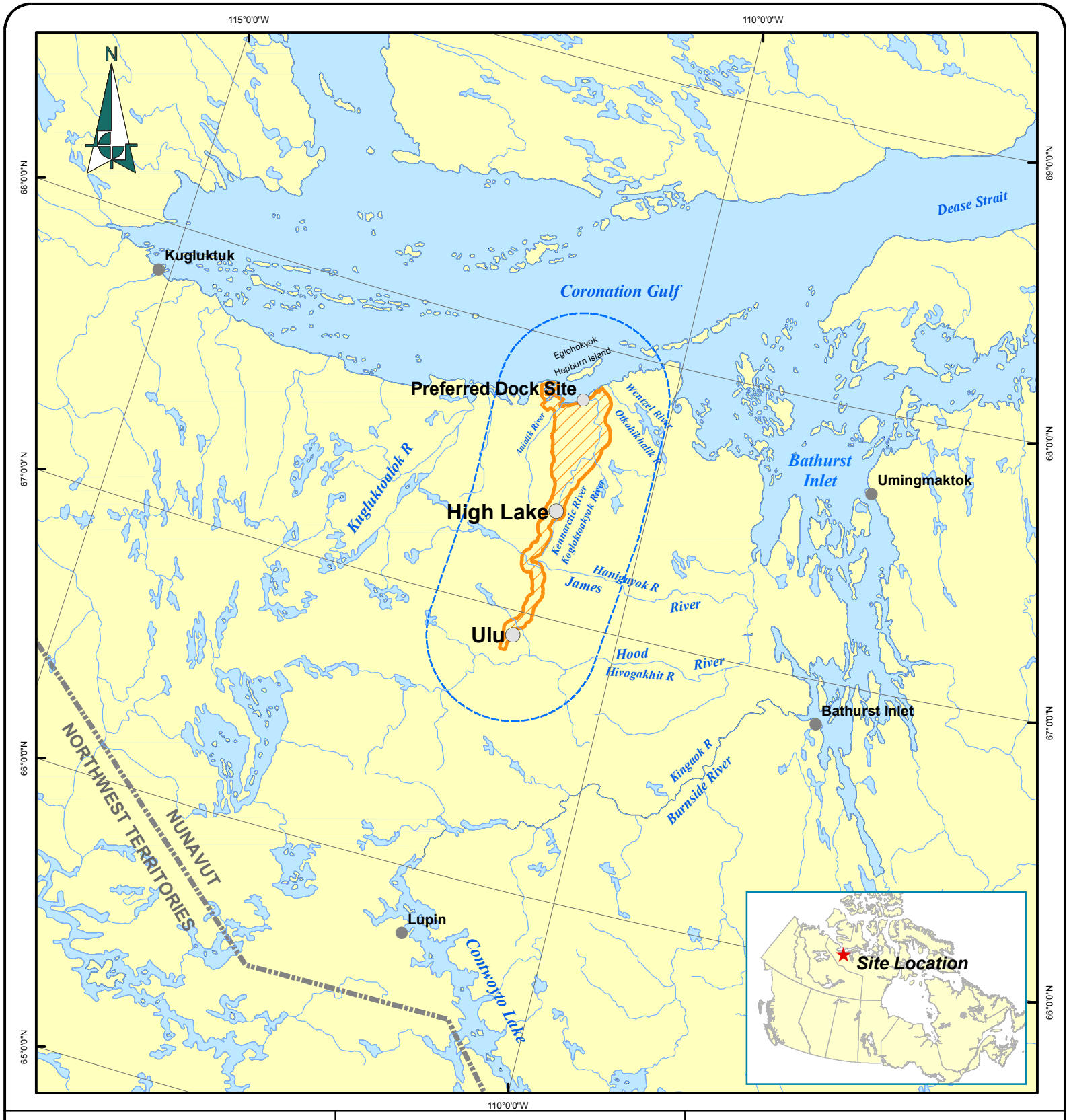
Wolfden Resources Inc. ("Wolfden") is a Canadian exploration and mining company and has the mineral rights for the High Lake property and the Ulu property in western Nunavut. Wolfden plans to develop these properties into operating mines, and ship the ore concentrates to markets from a dock at Grays Bay on the Coronation Gulf. Road transportation corridors are planned to link the Ulu and High Lake sites and the High Lake site and the dock facility. This mining project is collectively known as the High Lake Project. Figure 1 shows the location of the High Lake Project.

The intent of this document is to provide government, communities, Inuit Organizations and other interested parties with a preliminary summary of the 2005 environmental, socio-economic, and geotechnical baseline programs that are being designed to support the High Lake Project. The Strategic Plan for the High Lake Project commits Wolfden to share work plans for baseline programs. As the Project evolves and as the understanding of the baseline conditions grows, the plan may require modification.

The work plans described herein focus on the field data collection aspect of the baseline programs.

2. Summary Description of the High Lake Project

- Wolfden's plan is to extract mineral bearing rock, also called ore, from both the High Lake and Ulu sites, and to build a mill at the High Lake site to process the ore. Ore from Ulu will be transported to High Lake by winter road. Another road will be built between High Lake and a dock and loading facility at Grays Bay. From the dock and loading facility, ships will transport the metal concentrates to markets and bring supplies in.
- The Ulu site has a gold deposit and it will be mined underground. The Ulu site is located on Inuit-owned Land.
- The High Lake site has three areas of ore containing copper, gold, silver and zinc. The rock will be mined in open pit (above-ground) and the deeper ore will be mined underground. The High Lake site is primarily located on Inuit-owned Land.
- Tailings are the waste left behind after the process of separating the metal concentrate from the ore. Tailings will be placed in the bottom of High Lake. To date, no fish have been found in this lake, as its natural chemistry is not suitable for fish. Studies are being conducted to confirm this.
- Wolfden would like to start construction of the mine in early 2008 and is spending the next few years collecting information on the natural and human environments, including traditional knowledge, for the environmental assessment and regulatory approvals. Based on current information, the mine life is expected to be about 15 to 17 years. Wolfden expects to employ roughly 200 people during operation of the two mine sites. Efforts will be made to hire locally, whenever practical.



Legend

- High Lake Project Area
- Preliminary Regional Study Area (Terrestrial)

Kilometres

0 10 20 40 60 80 100

1:2,000,000

Projection:
Lambert Conformal Conic

Reviewed By: GF
Prepared By: EM
Date Issued: June 28, 2005
Project No.: 41007
File Name:
Proj_local.mxd

WOLFDEN Resources Inc.

Project: High Lake
Location: High Lake, Nunavut
Client: Wolfden Resources Ltd.

LOCATION MAP

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Figure No.
1

A preliminary analysis of potential issues indicated potential impacts associated to some level with the following activities associated with the High Lake Project:

- barge transportation / tugs;
- shipping using a western route
- general cargo transfer;
- fuel transfer;
- bulk supply transfer;
- concentrate transfer;
- garbage disposal and recovery;
- demolition;
- geotechnical drilling;
- construction-related drilling;
- blasting;
- excavation and fill placement for construction for buildings, airstrip, roads;
- building construction;
- open pit and underground mining;
- site clearing;
- offshore construction;
- general equipment operation;
- power generation;
- burning;
- landfilling;
- snow removal and piling;
- recreational activities (indirect);
- road traffic;
- berming and lining for fuel tank farm;
- waste rock removal and storage;
- waste rock transportation
- ore processing;
- air traffic (fly in fly out);
- tailings management.

3. Approach

Wolfden believes that early and effective consultation with communities, government and Inuit organizations is important to the overall success of the High Lake Project. The information gained from meetings and consultations held with these interested parties to date has been used to refine baseline program work plans. Comments received on this work plan document will also be incorporated into our baseline program, to the extent possible.

Communications and collaboration between the engineering, environmental and socio-economic teams at an early stage is a high priority in this project. For example, two environmental-engineering coordination workshops were held recently (May and June 2005) with the intent on providing input to the engineers, particularly with respect to maximizing mitigation of potential impacts by avoidance or through project design. Feedback from the engineers in these workshops, have also been used to refine and focus the baseline program work plans.

Wolfden recognizes the value that local knowledge can bring to the field programs. Local Inuit were employed to assist with the biophysical and geotechnical programs in 2004, and will continue to be involved in these programs in 2005.

4. Biophysical Programs

4.1 Preliminary Study Area

Preliminary Regional (RSA) and Local Study Areas (LSA) were selected to provide the base of the impacts assessment for short-term, long-term, combined and cumulative effects. RSAs may vary from discipline to discipline. At the moment, the terrestrial-based disciplines share the same RSA, which is currently defined as the area within a 30 km radius from the proposed dock and mine site and centred on the transportation corridor. The RSA for the water-related disciplines is based on potentially affected drainage basins. It may be adjusted to reflect watershed boundaries as needed by the hydrology and water quality and fisheries team.

For the purposes of our work to date, the preliminary LSA is defined to include the footprint of the proposed mine sites, dock facility, and the road corridor between Ulu and the dock, plus a 1 km (approximate) buffer around the footprint (this varies slightly for some disciplines). The study area associated with the shipping component of the project includes areas linking the dock to existing shipping routes.

4.2 Spring and Summer Field Program Objectives

The remainder of this section outlines the biophysical field data collection programs planned from March to September 2005. Prior to the preparation of these work plans, relevant reports, studies, and maps available in the public domain and relevant to similar mining projects in the area were reviewed, including previous work conducted at Ulu or High Lake. Results from the 2004 field programs were considered. The content of these studies were used as guides to foresee regulatory requirements likely to apply to the High Lake Project, identify gaps in data, and provide information, either at the local or regional scale. The amount of data available for review varies among disciplines.

The objective of the biophysical field program is to collect sufficient information to assess potential impacts resulting from the High Lake Project. Details of the High Lake Project and the areas potentially affected by the project have evolved since 2004, for example the road corridor alignment and dock site area have been further refined. This will allow the field team to further focus field data collection in 2005.

4.3 Permits & Licences

The following permits and licences were obtained for the purposes of the 2005 biophysical field program:

Permit/Licence	Organization	Effective Dates
Biophysical Scientific Research Licence	Nunavut Research Institute	January 21, 2005 – December 31, 2005
Nunavut Territory Archaeologist Permit	Department of Culture, Language, Elders and Youth, Government of Nunavut	Application is being processed.
Nunavut Wildlife Research Permit	Department of Environment, Government of Nunavut	July 20, 2005 – July 5, 2006
Marine and Freshwater Fisheries Permits	Department of Fisheries and Oceans, Government of Canada	Application is being processed.

4.4 Air Quality, Climate and Noise

4.4.1 Introduction

Mining activities include a variety of sources of both air emissions and noise that need to be addressed. Air quality can be influenced by gaseous and particulate discharges to the atmosphere from the following sources:

- Mine development and operation (blasting, fleet exhaust);
- Mine and camp generator exhausts;
- Particulate emissions associated with milling operations (crushing, concentration dryer);
- Fugitive dust emissions from a variety of sources including construction, transportation and mine operation activities;
- Fugitive dusts from ore, concentrate and tailings storage areas;
- Camp incinerator;
- Space heater exhausts (maintenance, mill and camp buildings); and
- Airstrip and dock activities.

The primary air quality issues will likely focus on exhaust emissions (e.g., mine fleet, generators, space heaters, transportation vehicles, and incinerator) and on dust emissions (e.g., wind borne fugitive dust).

Similarly, there are a number of noise sources associated with mining operations including the following activities:

- Open pit operation (equipment operation, blasting);
- Milling operations (crushing, etc.);
- Power generation;
- Increased land, water and air traffic; and
- Facility construction.

As the project description evolves, emission estimates will be developed for all significant sources of atmospheric discharges and noise. These estimates will form the basis for assessment of air quality and noise impacts based on the application of site-specific air quality dispersion models and noise propagation models.

Air quality and noise impacts are likely to be localized around the primary emission sources. The largest sources (e.g., mine operation and milling) will be fixed and located at the mine sites. However, it is also important to consider potential impacts along mine access and haul roads and the airstrip and dock facility. For these reasons, the RSA for air quality and noise assessment has initially been established as a 10 km by 10 km grid centred around the High Lake and Ulu sites and at the dock facility. In addition, an area extending a distance of 1 km on either side of the transportation corridor will also be included. There are no communities or residents (permanent or temporary) located in close proximity to the proposed mine sites that would influence the size of the RSA. However, this study area will be revised as necessary, based on an air dispersion model, to ensure all potentially impacted lands are incorporated.

The air quality assessment requires an understanding of transport, dispersion, transformation, and deposition process and relies on meteorological data for development and application of site-specific dispersion models. Similarly, the assessment of potential noise impacts is also dependent on an understanding of existing noise levels and the noise generating properties of the various activities.

Little to no site-specific meteorological, air quality or noise data exists for the proposed High Lake site. Limited data are available from regional sources and can be used to generally characterize the local environment. Environment Canada, Atmospheric Environment Services, operates a number of meteorological stations in the north, providing long-term information on regional temperature, wind and precipitation. In addition, some short-term data are available from other recent projects including the Doris North, Jericho, and Ekati projects.

Site-specific meteorological data is required to run dispersion models used for the air quality assessment. Meteorological information is also important in assessing sound propagation and potential noise impacts associated with facility operation. However, since the proposed mine site is located in a remote area and not influenced by other regional emission sources, existing local air quality and noise levels can be inferred from existing data available from other remote northern locations. For this reason, the 2004

scope of work included establishing meteorological stations for collection of baseline climate data at High Lake and at Ulu and regular downloading of the data.

4.4.2 Field Data Collection Program

The air quality and noise impact assessments will rely on characterization of emission rates from project sources and modeling of expected air quality concentrations and noise levels associated with project activities. Collection of meteorological parameters necessary to support the modeling exercise was initiated in 2004 and will continue in 2005 at regular intervals. A minimum of one year of meteorological data is required to run the dispersion model(s).

The scope of the meteorological monitoring program was developed in consultation with discipline leaders in the areas of air quality and hydrology. Based on this work, the parameters included in the monitoring program include:

- Wind direction and speed;
- Air temperature;
- Relative humidity and barometric pressure;
- Solar radiation; and
- Total precipitation.

4.5 Terrain

4.5.1 Introduction

A solid understanding of the surface and bedrock geology is essential for site selection of mine facilities and routes. The geological maps will be the interface between engineering, construction and design teams, and the environmental teams. This is particularly important in permafrost-affected areas, where poor handling of the ice-rich sediments or slopes may cause long-term disturbances and thus affect the integrity of the surface and put at risk valuable ecological or cultural sites.

4.5.2 Field Data Collection Program

Surface geology maps at the 1:30,000 scale were prepared in 2004 and will be ground-truthed in 2005. Map unit descriptions include soils associated with landforms, at the soil subgroup level. Site inspections will be documented on field forms and added to the terrain database. Data collection will take place in July 2005. Fieldwork will focus on the area between High Lake and the dock site. The surface geology maps will be in the ecological land classification (see Section 4.6). In addition, some map units or terrain units are strongly linked to heritage and archaeological sites, sites with high habitat value, such as canine denning sites or wetlands, and terrain with multiple land use potential such as eskers.

Subsurface data obtained from the 2004 geotechnical drilling programs and geophysical surveys will be incorporated into the mapping and map unit description in late summer 2005.

4.6 Vegetation

4.6.1 Introduction

The proponent is expected to provide textual and mapped information on the environment, including local vegetation and plant communities, and rare plants or plant communities. This provides the necessary baseline information from which project-related impacts can be assessed (e.g., loss or alteration on vegetation productivity, ecosystem or habitat loss or alteration, loss or alteration of rare or highly valued plan or plant communities, including wetlands). Ecological land classification is used to describe the vegetation, landforms and soils in an integrated manner. This is used to discuss ecosystem biodiversity and wildlife habitat characterization for landforms.

4.6.2 Field Data Collection Program

Fieldwork related to the mapping and description of vegetation map units was completed in 2004 and map preparation based on this work, was completed in Spring 2005.

Fieldwork in 2005 will focus on the area between High Lake and the dock site. We are using the *Vegetation Classification for the West Kitikmeot/Slave Study Society Region* (Matthews, Epp and Smith, 2001) for the basis of our regional mapping. A portion of the RSA, however, is not currently covered by this document. Therefore visual inspections (based on satellite imagery) of this portion of the RSA are required to complete the vegetation classification of the RSA. The vegetation program is currently planned to commence in early July.

4.7 Hydrogeology

4.7.1 Introduction

Information on shallow and deep groundwater conditions in the vicinity of the proposed High Lake and Ulu mines is required for the environmental assessment as well as for mine design. Mine dewatering may affect local and regional groundwater levels and flow directions. Management and treatment of mine inflow water can be a significant technical and cost issue for mine design and operations. Mine inflow water quality, during operations and after closure may affect local and regional groundwater quality or surface water quality.

Groundwater conditions at the High Lake and Ulu sites are affected by the presence of permafrost and the depth of the mines. The proximity to large lakes (where the permafrost may be thinner or absent) also

needs to be considered. The scope of the hydrogeological field-testing program is dependent upon information from the geotechnical permafrost program and mine design program.

Shallow groundwater only occurs within the upper active zone, which is about 2 m from surface and only occurs during the summer time. Between 2 m and > 400 m, the ground is permanently frozen; therefore, we do not expect groundwater will be a significant issue at the proposed Ulu mine and High Lake open pits, because the deep groundwater zone will not be encountered. However, the proposed underground mine at the west zone will extend to about 800 m, and therefore will encounter deep unfrozen groundwater zones.

4.7.2 Field Data Collection Program

In 2004, a desktop study was conducted and summarized the regional hydrogeological conditions in the vicinity of the High Lake Project area. In 2005, a field program will be carried out in conjunction with deep exploration wells that are being drilled in the west zone deposit.

The main components of the proposed 2005 hydrogeological summer field program are as follows:

- Determine the hydraulic conductivity of the bedrock below the bottom of the permafrost in the West Zone using single packer tests conducted at 50 metre intervals during the drilling of two exploration boreholes to 800 m;
- Determine the groundwater levels/pressures in the bedrock below the bottom of the permafrost in the West Zone by installing vibrating wire piezometers at the bottom of two deep exploration boreholes. During installation of the vibrating wire piezometers we will also conduct temperature logging to assist in the identification of permeable fracture zones with active groundwater flow;
- Attempt to obtain baseline groundwater samples from the bedrock below the bottom of the permafrost in the West Zone by airlifting through a 25mm diameter PVC pipe installed in the two exploration boreholes.

The primary objective of the fieldwork is to obtain data on baseline groundwater conditions and characterize the hydrogeological properties of the bedrock. This is required to assess the potential volume of groundwater inflows into the West Zone underground mine and to determine whether these inflows will constitute a significant environmental or operational issue.

Saline water is often associated with deep-water in the Canadian Shield. Wolfden and its consulting team is at the moment researching the potential sampling methods to collect groundwater samples from deep boreholes in permafrost. Deep groundwater sampling may have to be deferred until boreholes can be drilled from the proposed underground mine.

Fieldwork is planned for summer 2005 and will focus on providing site-specific information relating to deep groundwater elevations and bedrock hydraulic conductivity (permeability) in support of determining groundwater influx into the proposed West Zone underground mine, which will be about 800 m deep, well below the bottom of the permafrost (400 m to 550 m deep).

4.8 Hydrology

4.8.1 Introduction

Mines can affect the aquatic systems of an area in many ways. The most common include the direct footprint of the mine and associated infrastructure, the use of water, the creation of wastewater and other wastes that are deposited in the environment. Studies are required to characterize the surface water hydrology in the project area, the location of particularly critical or sensitive areas and the linkages between water (quality and quantity) and the aquatic resources.

The local study area has been defined as any sub-watershed that contains a proposed component of mine infrastructure including camps, mills and airstrips. The Kennarctic River located upstream of the inlet of the High Lake outlet creek and downstream for 8 to 10 km to below the inlet of drainage from the potential airstrip location is part of the local study area. The mouth of the Kennarctic in Grays Bay and the potential dock location are also included in the local study area.

4.8.2 Field Data Collection Program

The hydrology program outlined herein deals with the spring/summer/fall period for both the High Lake and Ulu areas, and near the proposed dock site and proposed road corridor. The program will primarily involve snow surveys and ice thickness survey, water level recording and flow metering. Each of the gauged sites will be photographed at the time of each visit.

Identified field tasks were initiated in late May and will be completed in September 2005. The major field tasks include:

- Snow and ice thickness surveys;
- Download gauge data and service gauges;
- Meter flows at all gauged sites at minimum of three times during the first two weeks of July. Because lake outflow channels run shallow and are boulder-covered, conventional flow meters will not work, so it is proposed to use a mini-velocity meter like the one identified the 2004 work plan. A conventional Price-type velocity meter would be used to measure discharge on the Kennarctic River. This effort may require a boat fitted with a boat frame;
- Photograph all primary streams from the air and all gauge sites;
- Meter flows (when there is flow) during August and once in each of September described above;
- Remove gauges near end of September.

Data from the above field tasks will be used to:

- Compute metered discharges;
- Tabulate recorded water levels;
- Estimate daily discharges and plot hydrographs; and

- Plot cross sections and ground profile.

As with 2004 work, the fisheries and water quality studies will be carefully coordinated with the hydrology program. For example, stream gauging sites will be coordinated with water quality sample sites.

4.9 Fresh and Marine Water and Sediment Quality

4.9.1 Introduction

The most common factors to consider include the direct footprint of the mine and associated infrastructure, the use of water, the creation of wastewater and other wastes that are deposited in the environment. The proposed studies are required to identify the water and sediment quality in the project area, the location of particularly critical or sensitive areas and the linkages between water (quality and quantity) and the aquatic resources.

The local study area has been defined as any sub-watershed that contains a proposed component of mine infrastructure including camps, mills and airstrips. The Kennarctic River from just upstream of the inlet of the High Lake outlet creek and downstream for 8 to 10 km to below the inlet of drainage from the potential airstrip location is part of the local study area. The mouth of the Kennarctic in Grays Bay and the potential dock location are also included in the local study area.

4.9.2 Field Data Collection Program

In 2004, a detailed study of the water and sediment quality around the proposed High Lake and Ulu mine sites was carried out, and paired with data to be collected in 2005, this will provide sufficient detail to support the design engineers in planning the layout of the mine and the environmental impact statement (EIS) for the mine. The 2005 work plan for the mine sites uses existing information (including results of the 2003 and 2004 season).

As for the 2004 program, the 2005 program's objective of the water and sediment quality studies will be to collect sufficient additional baseline information to:

- Characterize the physical limnology of the lakes within the project area;
- Characterize the surface water quality within the project area including lakes, streams and rivers;
- Characterize the fresh water sediment quality within the project area including lakes, streams and rivers; and
- Characterize the water and sediment quality in the marine environment including the mouth of the Kennarctic River and the dock area.

The water quality studies will be carefully coordinated with the fisheries and hydrology programs. For example, stream and benthic sampling sites will be coordinated with sediment sampling and sample sites will also be coordinated.

The goal of this field program is to collect water and sediment quality data from as many areas as are likely to be affected by the proposed mine development based on current mine design. Therefore, the sampling program will focus on key sites in the proposed development area.

The general field program includes sampling at the following locations:

- Lakes (under ice and post ice off- at least once and possibly twice):
  - limnology – depth profiles of dissolved oxygen, conductivity, temperature and pH;
  - water quality samples at 2 depths for the parameters listed in Table 1 along with total chlorophyll and hydrogen sulphide; and
  - bottom sediment samples analyzed for the parameters listed in Table 2 (July).

- Rivers and streams , and dock site :
  - visual assessment of channel characteristics;
  - surface measurement of temperature, dissolved oxygen, pH and conductivity; and
  - water quality samples analyzed for the parameters listed in Table 1.

- Marine Sediment (July/August):
  - bottom composite sediment samples from proposed dock area and reference sites.

The field studies focus on High Lake area, specifically on those drainages that may be associated with mine infrastructure or receive drainage from areas that may have mine infrastructure.

The proposed lake sampling locations for the Ulu area are the same as those established in the 1996 investigation carried out by RL&L Environmental Services Ltd. where appropriate, with the addition of a few lakes.

Quality assurance/quality control protocols are a necessary component to any environmental sampling program. Three types of quality assurance sampling will be included in the proposed work plan: trip blanks, field blanks and replicate samples.

Table 1. Water Quality Analytical Parameters

Conventional Parameters		Major Ions	
Water Temperature		Sulphate	
Conductivity		Magnesium	T-Mg
Dissolved Oxygen		Calcium	T-Ca
Dissolved Oxygen		Sodium	T-Na
PH		Potassium	T-K
Alkalinity		Nutrients / Organics	
Total Inflection Point (Gran) Alkalinity		Ammonia Nitrogen (low level)	
Total Hardness		Total Kjeldahl Nitrogen	
Total Dissolved Solids		Nitrate + Nitrite	
Total Suspended Solids		Total Phosphate	
Turbidity		Ortho-phosphate	
ORP		Total Organic Carbon	
Cyanides		Dissolved Organic Carbon	
Total Cyanide			
Total Metals by ICP-MS		Dissolved Metals by ICP-MS	
Aluminum	T-Al	Aluminum	D-Al
Antimony	T-Sb	Antimony	D-Sb
Arsenic	T-As	Arsenic	D-As
Barium	T-Ba	Barium	D-Ba
Beryllium	T-Be	Beryllium	D-Be
Bismuth	T- Bi	Bismuth	D-Bi
Boron	T-Bo	Boron	D-Bo
Cadmium	T-Cd	Cadmium	D-Cd
Chromium	T-Cr	Chromium	D-Cr
Cobalt	T-Co	Cobalt	D-Co
Copper	T-Cu	Copper	D-Cu
Iron	T-Fe	Iron	D-Fe
Lead	T-Pb	Lead	D-Pb
Lithium	T-Li	Lithium	D-Li
Manganese	T-Mn	Manganese	D-Mn
Mercury	T-Hg	Mercury	D-Hg
Molybdenum	T-Mo	Molybdenum	D-Mo
Nickel	T-Ni	Nickel	D-Ni
Selenium	T-Se	Selenium	D-Se
Silver	T-Ag	Silver	D-Ag
Strontium	T-St	Strontium	D-St
Thallium	T-Tl	Thallium	D-Tl
Tin	T-Sn	Tin	D-Sn
Titanium	T-Ti	Titanium	D-Ti
Uranium	T-U	Uranium	D-U
Vanadium	T-V	Vanadium	D-V
Zinc	T-Zn	Zinc	D-Zn

Table 2. Sediment Quality Analytical Parameters

Conventional Parameters	
PH	
Moisture (%)	
Organic (%)	
Particulate Size	
Gravel (>2.00 mm)	
Sand (2.00 mm - 0.063 mm)	
Silt (0.063 mm – 4 μm)	
Clay (<4 μm)	
Total Metals by ICP-MS	
Aluminum	T-Al
Antimony	T-Sb
Arsenic	T-As
Barium	T-Ba
Beryllium	T-Be
Bismuth	T- Bi
Boron	T-Bo
Cadmium	T-Cd
Calcium	T-Ca
Chromium	T-Cr
Cobalt	T-Co
Copper	T-Cu
Iron	T-Fe
Lead	T-Pb
Lithium	T-Li
Magnesium	T-Mg
Manganese	T-Mn
Mercury	T-Hg
Molybdenum	T-Mo
Nickel	T-Ni
Potassium	T-K
Selenium	T-Se
Silver	T-Ag
Strontium	T-St
Thallium	T-Tl
Tin	T-Sn
Titanium	T-Ti
Uranium	T-U
Vanadium	T-V
Zinc	T-Zn

4.10 Marine Fish, Fish Habitat and Aquatics

4.10.1 Introduction

This program documents and provides baseline information including species type and presence, abundance and the general overall habitat. These data will allow for impact assessment, and to provide input to decision making with respect to the dock facility and ship navigation.

4.10.2 Field Data Collection Program

Preliminary data was collected in late summer 2004 at four potential dock sites. Now that a preferred site has been identified, the team will focus its efforts on that site.

Data collected in 2004 will be complemented in 2005 with additional fisheries studies. These fisheries studies will include the netting of fish, the collection of benthic samples, and the collection of sediment and water samples taken at the area directly affected by the dock or other potential development near the dock. A team of divers will also videotape the underwater area to provide biologists with a better understanding and record of the existing marine ecology at the preferred dock site. In addition, clams may be sampled to document baseline health. This field program will take place in late July 2005.

4.11 Fresh Water Fish, Fish Habitat and Aquatics

4.11.1 Introduction

Aquatic studies are required to identify the aquatic resources in the project area, the location of particularly critical or sensitive areas and the linkages between water (quality and quantity) and the aquatic resources.

The local study area has been defined as any sub-watershed that contains a proposed component of mine infrastructure including camps, mills and airstrips. In 2004, stream segments connecting these lakes were also investigated. The Kennarctic River from just upstream of the confluence of the High Lake outlet creek and downstream for 8 to 10 km is part of the local study area.

4.11.2 Field Data Collection Program

The objective of the fisheries studies will be to collect sufficient baseline information:

- To identify species and life history characteristics of fish in the project area;
- To identify any threatened, rare or endangered species as required under the federal *Species at Risk Act* and their associated habitat requirements;

- To identify sensitive or critical habitats within the project area including the location and quantity of habitat used by each life stage and species (spawning, rearing and over wintering);
- To estimate the productivity/biomass of primary and secondary producers and fish in the lakes, streams and rivers in the project area;
- To characterize the health of the fish in the area, including the existing contaminant loadings (i.e., metals in fish tissue);
- To confirm drainage patterns – i.e., ground truth map information; and
- To begin to understand the migratory patterns of fish in the area (this will take more than one year).

All aquatic studies (e.g., fish, water quality, etc.) will be carefully coordinated. Stream and lake benthic sampling sites need to be coordinated with sediment sampling and the water quality and the fisheries biologists will agree on the criteria that will be used to select sites. Similarly, wetland assessments should be coordinated with aquatic studies.

Approximately 30 lakes were investigated in 2004. In 2005, detailed field studies will focus on the proposed High Lake and Ulu mine sites and associated mine infrastructure, the road corridor, and the water bodies identified as most likely to be directly affected by the project construction and operation. The studies will also gather general baseline information required to complete the "alternatives assessment" for tailings and waste rock disposal sites. The general field program in 2005 may include, depending on gaps identified in 2004:

Lakes: (for each lake)

- Limnology – bathymetric survey, dissolved oxygen and water temperature profiles, etc.;
- Phytoplankton;
- Zooplankton;
- Benthic; and
- Fish collection – gill netting, beach seining, angling and minnow traps will be used to capture fish. Samples will be collected for metals in fish tissue analysis

Rivers and Streams: (for each stream)

- Habitat – flow characteristics, channel type, substrate, quantity and quality of fish habitat, etc.;
- Periphyton;
- Drift Organisms – drift samplers;
- Benthic Sampling – serber or ponar sampler; and
- Fish – electrofishing, minnow traps, pole seines, collection of samples for metals in fish tissue analysis.

4.12 Marine Mammals

4.12.1 Introduction

Wolfden intends to develop a dock in Grays Bay, Coronation Gulf, and to ship ore concentrate from there to Europe, North America, or the Orient. At this moment, the western arctic shipping route is likely to be used. Shipping will be carried out only during the ice-free months of the year. Dock construction and stockpiling of ore concentrate at the dock may occur during the winter and spring when the landfast ice occurs in the area.

In summer, a number of marine mammal species occur in Coronation Gulf and along shipping routes to the east and the west. Noise from project activities, including the construction and operations phases, may disturb marine mammals.

A considerable amount of information is available on the distribution of marine mammals along parts of the shipping routes, from the Beaufort Sea to the west and Barrow Straight, Lancaster Sound, and Baffin Bay to the east. Much of the information is from studies carried out by LGL Limited in the eastern Arctic in the 1970s and in the Beaufort Sea from the 1980s to the present. Little or no information is available for the parts of the shipping route in between. Surveys in those areas are required as part of the impact assessment process.

Two of the six populations of beluga in the Canadian Arctic summer in the study area; the Beaufort Sea and high arctic stocks (Davis and Finley 1979; Finley *et al.* 1987). During the early open water period, belugas concentrate in large herds of several thousand animals in a few shallow estuaries (Finley 1976; Smith *et al.* 1985). A concentration of about 2,000 narwhal may summer in Peel Sound (Finley and Johnson 1977; Smith *et al.* 1985). A few bowheads from the Davis Strait stock occur in the Peel Sound/Franklin Strait area and in Barrow Strait (Davis and Koski 1980; Davis *et al.* 1980). Bowheads from the Bering Sea stock occupy areas off the Bathurst Peninsula and Amundsen Gulf early in the open-water period, and gradually extend their range westward to include areas off the Tuktoyaktuk Peninsula, usually by late July or early August (Davis *et al.* 1982). Pinnipeds that may be encountered are the ringed seal, bearded seal, walrus, and, in parts of the eastern shipping route, harp seals.

4.12.2 Field Data Collection Program

As noted above, there is considerable information available, including government studies and consultant's reports (mostly by LGL Limited) on marine mammal distribution in the Beaufort Sea and the eastern High Arctic.

In spring 2004, a seal survey was completed in the Grays Bay area. In September 2004, marine mammal surveys were conducted in areas along the potential shipping routes where there are few or no previous data available, both for the eastern and western shipping options. Those areas included Dolphin and Union Strait, Coronation Gulf, Dease Strait, Queen Maude Gulf, Victoria Strait, Rasmussen Basin and the

straits and passages to the south and east of King William Island, Larsen Sound, Franklin Strait, and Peel Sound.

No marine mammal surveys are planned for 2005.

4.13 Wildlife and Wildlife Habitat

4.13.1 Introduction

Data collection needs for this program includes:

- Local and regional occurrence of species and populations;
- Relative seasonal abundance and distribution of these species/populations;
- Seasonal range or habitat use, movements, and population status of these species; and
- Significant habitats for these species, such as eskers, denning sites and other valued habitat units.

The wildlife component of the EIS will require information related to wildlife populations and habitats within the direct footprint of the mine facilities, road corridors, and dock facilities, as well as in a wider regional area surrounding the proposed mine and dock facilities and roads.

The wildlife-related requirements to describe wildlife and habitat are expected to include:

- The local and regional occurrence of species/populations;
- The relative seasonal abundance and distribution of these species/populations;
- The health of these species/populations and their contaminant loadings;
- The seasonal range or habitat use, movements, and population status of these species;
- The migratory patterns and routes of these species and the corresponding sensitive periods when the routes cross habitats affected by the Project;
- Significant habitats for these species, such as eskers, calving and rearing areas, denning sites, and staging areas, and such special locations as licks, water crossings, and insect relief habitats;
- Wildlife management areas or similar areas for these species;
- Habitats of any rare or regionally unique species or species with federal, territorial, regional, or local designated status (e.g., vulnerable, threatened, endangered, extirpated, of special concern);
- Species that perform particularly significant ecological functions; and
- Any other issues relating to these species identified through public consultation.

Much of this information can be prepared using existing information such as government research, range maps, and local Traditional Knowledge; however, some on-site data collection is needed to provide specific information and confirm regional scale data.

4.13.2 Field Data Collection Program

A considerable amount of useful information is available for wildlife and wildlife habitat within the Kitikmeot region of Nunavut. Information sources include research conducted by government and other agencies `e.g., West Kitikmeot Slave Study, EMAN-North, peer-reviewed scientific literature, and baseline studies and environmental assessments for other projects within the region (e.g., Doris North Mine, Ulu Mine). These information sources have been explored and general results presented in existing Ulu and High Lake documents as well as results from the 2004 season have guided development of this work plan.

Field data collection for 2005, and for 2004, is designed to fill information gaps pertaining to the required description of the biological environment. In 2005, the wildlife field data collection will involve mostly aerial survey work as a continuation of the 2004 surveys and will provide information supporting the determination of the occurrence, relative seasonal abundance, distribution and status of species and populations and to provide information supporting the determination of the occurrence of significant habitats, such as seasonal habitat use, movement patterns, and denning sites. Information on migration routes through the study area is also required. The Environmental Assessment for Ulu (Echo Bay Mines Ltd. 1997) and 2004 field data identified habitats such as raptor nests near the proposed mine sites. In 2005, this area will be revisited to confirm these findings.

Ungulate Aerial Surveys

The objective of aerial surveys is to provide information supporting the determination of the occurrence, relative seasonal abundance, distribution and status of species and populations and to provide information supporting the determination of the occurrence of significant habitats, such as seasonal habitat use and movement patterns. Systematic transects will be flown throughout the local and regional study area. All wildlife observed along these transects will be recorded. Carnivore den sites will also be recorded.

Multiple surveys are required to document seasonal use of the study area by species such as caribou. The use of the area by the Dolphin Union herd in winter and late spring and by the Bathurst herd in early to mid summer were considered when designing the program. In 2005, aerial surveys to document use of the area by the Dolphin Union herd took place in late winter (March), and pre-calving, calving and post calving surveys for the Bathurst herd took place in May and June 2005.

Denning Surveys

One aerial survey for den sites within the LSA was completed in May 2005, in conjunction with ungulate aerial surveys.

Raptor Nest Surveys

In order to document distribution and characteristics of active breeding territories of all raptor species known to occur in the study area (i.e., Peregrine Falcon, Gyrfalcon, Golden Eagle and Rough-legged Hawk), an aerial survey was conducted in June 2005 to confirm and supplement data collected in July 2004. Information of historical nests will be gathered from ecological database available for the Nunavut Wildlife department.

Suitable habitats such as cliffs, bluffs, and canyons were assessed using air photos. Nests surveys were conducted at a speed of 30-130 km/h by two observers looking for any signs of active nests: adults flushed from cliff, actual platforms, whitewash, and orange lichen growth on rocks. A distance of 50 m from nests will be maintained at all times in order to avoid nest abandonment.

4.14 Archaeological Resources

4.14.1 Introduction

In Nunavut, the Nunavut Archaeological Sites Regulations governs the conduct of archaeological research and protect archaeological sites and artifacts. In order to protect archaeological sites, they must first be identified.

The work performed in 2004 involved four phases. The first phase consisted of background research on disciplines relevant to archaeological resources. The second phase involved the determination of archaeological potential based on past experience, background research and preliminary field reconnaissance. The third phase involved more intensive ground examination of locations in which exploration activity may occur and that are suggestive of moderate or greater archaeological potential. All ground reconnaissance was conducted under a Class 2 Nunavut Archaeologists Permit. The fourth phase involved compilation and analysis of relevant data and the production of a final, detailed archaeological permit report, which was submitted to the Chief Archaeologists office before March 31, 2005.

4.14.2 Field Data Collection Program

In general, the 2005 investigations will include the assessment of archaeological potential for the proposed road alignment between Ulu and High Lake and between High Lake and the docking site. More intensive archaeological investigation will be undertaken near the preferred dock site and at the High Lake site.

An aerial reconnaissance of those portions of the study area in which exploration or development might occur will be first conducted to determine the archaeological potential. Previously recorded sites close to identified project components will be re-visited and potential for impact will be evaluated. Detailed

ground reconnaissance of specific sites related to project footprint will be undertaken. At the preferred dock site, the team proposes to send an underwater team to videotape the areas near the dock site, and with the guidance of the archaeologist, to document any potential underwater sites.

Intensive archaeological inventory is currently proposed to be limited to the local study area unless ancillary facilities at some distance area identified prior to initiation of field investigations.

5. Geotechnical Engineering

5.1 Introduction

Geotechnical programs are planned to provide both pre-feasibility level engineering input and sufficient definition of design approaches, preferred siting, and issues for inclusion in environmental permitting submissions at the end of 2005. A summer program in 2005 is anticipated to provide additional geotechnical data for the selected tailings dam locations and other infrastructure sites at High Lake, and at the dock site. Reconnaissance and ground-truthing along the route alternatives will be conducted in summer 2005.

Primary objectives are to provide a basis for confirmation of sites for all surface facilities for the project including the dock, access road to High Lake, for open pit and underground mining, ore processing and support infrastructure at High Lake, access to Ulu from High Lake, and underground mining and surface infrastructure at Ulu. The information obtained will support both feasibility level engineering and the development of a project definition with sufficient certainty to support a credible impact assessment.

The work proposed in the summer of 2005 will confirm founding conditions at the dock site are suitable, and will provide additional field assessment of geotechnical and environmental factors for the overall site, which will allow the siting trade-off to be completed.

5.2 Field Data Collection Program

In 2004, a limited number of geotechnical boreholes were drilled at the dock site, High Lake and Ulu. In 2005 the geotechnical program will be more intensive at High Lake focusing on potential dam locations for the proposed tailings containment facility and the plant site area. Additional work will also be carried out at the dock site. No geotechnical work is currently planned for the Ulu site.

5.2.1 Dock Facility

The 2005 program at the proposed dock site consists of:

- Marine geophysics for bathymetry and bedrock surface (sub-bottom profiling) survey in the vicinity of the proposed dock structure; and
- Diving inspection of proposed dock structure footprint. The dives will be recorded using an underwater video camera relayed live to the surface monitor.

The area of interest extends from the shoreline out a distance of about 100 m, over a length of about 300 m parallel to shore, enclosing the proposed dock structure area. The dimensions of the area of interest are larger than the final dock structure because the objective of this survey is to identify the best location to site the structure.

5.2.2 High Lake

Geotechnical investigations at High Lake in summer 2005 are focussed in three areas:

- The proposed tailings containment facility (i.e., High Lake);
- The proposed water supply dam at Granite Lake; and
- The proposed plant/camp facility.

Approximately 30 holes (using Boyles 17 diamond drill) are planned to be drilled around these features, and most of the holes will likely be less than 20 m in length. Chilled brine will be used to obtain undisturbed samples of frozen ground. Thermistors will be installed in about seven holes. Any wastewater will be disposed of in accordance with the terms and conditions of the High Lake exploration water licence.

6. Socio-economic

6.1 Introduction

The purpose of this work program is to develop an understanding of the potential impacts to:

- Demographics;
- Land use and occupancy;
- Regional economics;
- Education and training;
- Human health; and
- Infrastructure and housing.

Identification and assessment of socio-economic impacts requires an understanding of:

1. The project;
2. The characteristics and socio-economic conditions of the local area; and
3. The possible type of interactions between the two (project and conditions).

The 2005 program will continue from the regional and local profiling that was started in 2004 in order to answer the following questions:

1. How does the project fit within the regional context?
   - Answers to this question will be used to identify issues related to cumulative effects, how the project relates to other developments, what the potential regional development catalytic impacts are, and identify initial Valued Socio-economic Components (VSECs) and indicators.
2. What is the community and regional capacity to respond to the project and what will the response be?
   - Answers to this question will be used to identify issues related to human resource development and training needs, absorptive capacity of communities, requirements for capacity development, and pacing/scale of the project. This task will also identify initial VSECs and indicators.
3. What are the aspirations and development objectives of the Kitikmeot communities and the region?
   - Answers to this question will be used to identify issues related to mitigation and modification of project design to better-fit socio-economic expectations related to everything from employment to regional development.

Finally, as in 2004, the socio-economic team will continue to work closely with the engineering team.

6.2 2005 Tasks

- **Seven (7) Community Profiles** – Finalize community profiles based on socio-economic information gathered to December 2004. The reports summarize available information about each community.
- **Regional Profile** – Finalize the regional perspectives report. This report covers the economic and fiscal issues for Kitikmeot Region, community information that is of concern to the overall Kitikmeot region and future development plans/potential. In addition to outlining future developments, a description will be provided of the present situation for each developments sector (i.e., for mining, transportation, tourism/parks, etc.).
- **Aspirations** –Summarize the desires and development objectives of the Kitikmeot.
- **Field Work** –Fieldwork for 2005 includes field research and meetings in Cambridge Bay, Kugluktuk, Taloyoak, Kugaaruk and Gjoa Haven; and with key socio-economic regulators in Iqaluit and Ottawa.

7. Inuit Qaujimajatuqangit

7.1 Introduction

The purpose of the program is to gain Inuit Qaujimajatuqangit (IQ) for the project area and to use this information to inform High Lake Project design and impact assessment.

The following tasks were undertaken in 2004:

- Literature review/other background research. Gathered information that has been previously collected for the region.
- Developed an IQ protocol with the Kitikmeot Inuit Association guiding the collection and ultimate use of any traditional knowledge collected.
- Developed an IQ collection program based on the protocol, interviews of other experts and community "expert" input. This was done as the first step to identifying elders to participate in the program.

7.2 2005 Tasks

Based on the preliminary IQ work in 2004, workshops in Cambridge Bay and Kugluktuk and one-on-one interviews were held in winter/spring 2005. These workshops were arranged in conjunction with the Kitikmeot Inuit Association. Additional information confirmation will be conducted with the elders. Site visits, coordinated with the archaeologist, may be arranged with select elders and select youth. Finally, based on the information collected and confirmed, the IQ report will be drafted for the EIS.

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