7.0 LOCATION

AEC's seismic program will be conducted on EL 384 and EL 385, the two exploration licenses held by AEC in the Mackenzie Delta area of the Northwest Territories. The area covered by the seismic program will extend from Latitude 68° 45'N to 69° 35'N and from Longitude 133° 25'W to 134° 35'W. The seismic program will therefore extend onto the Inuvik 1 and Inuvik 2 blocks on the Mackenzie Delta, onto a small segment of the Tuk 2 block just south of Kugmallit Bay, and to Richards Island (Figure 1). Tuktoyaktuk is the closest community to the project area, approximately 22 km from the nearest seismic line. Inuvik is approximately 42 km from the project at its nearest point.

8.0 TRADITIONAL AND OTHER LAND USES

Land use in the region includes subsistence trapping, hunting and fishing, as well as tourism related recreation. Traditional land and continuing subsistence use by the Inuvialuit of the region is documented within Community Conservation Plans for each community in the Inuvialuit Settlement Region (ISR). The proposed project falls within the Tuktoyaktuk, Inuvik and Aklavik Conservation Planning Areas as defined by the respective Community Conservation Plans (TICCP, IICCP and AICCP 2000). The community conservation plans identify four management categories of lands (B through E). The project falls within all of these categories. The descriptions are as follows:

Category B: Lands and waters where there are cultural or renewable resources of some significance and sensitivity but where terms and conditions associated with permits and leases shall assure the conservation of these resources.

Category C: Lands and waters where cultural or renewable resources are of particular significance and sensitivity during specific times of the year. These areas shall be managed so as to guarantee the conservation of the resources.

Category D: Lands and waters where cultural or renewable resources are of particular significance and sensitivity throughout the year. As with Category C areas, these lands and waters shall be managed so as to guarantee the conservation of resources.

Category E: Lands and waters where cultural and renewable resources are of extreme significance and sensitivity. There shall be no development in these lands or waters. These areas shall be managed to guarantee absolutely no damage or disruption. This category offers the highest degree of protection, short of legal designation.

The proposed seismic program lies within areas defined as Special Management Areas, where the Inuvialuit outline recommended land use practices, and where timing of the program must be considered in relation to local harvesting of natural resources. Special Management Areas within or near the project area are listed in Table 3 and described in relation to the proposed project.

TABLE 3

SPECIAL MANAGEMENT AREAS WITHIN OR NEAR THE PROJECT AREA

Site Number And Protective Status Category	Name	Location Description	Location In Relation To Project
305C	Spring Fish Harvesting	Southern portion of Kugmallit Bay and Northwestern Tuktoyaktuk Peninsula.	Overlaps program at North Point and Kugmallit Bay.
307C	Summer Fish Harvesting	Kendell Island Bird Sanctuary, North Point of Richards Island and Northwestern Tuktoyaktuk Peninsula.	Overlaps program at North Point and Kugmallit Bay.
310C	Fall Fish Harvesting	Kendell Island Bird Sanctuary, southern portion of Kugmallit Bay and Northwestern Tuktoyaktuk Peninsula.	Overlaps program at North Point and Kugmallit Bay.
313C	Winter Seal & Polar Bear Harvesting	Entire offshore within the Tuktoyaktuk planning area.	Borders northern part of program.
315C	Winter Caribou Harvesting	Richards Island, south to the northern part of Sitidgi Lake; Anderson River to mouth of Mason River, including Tuktoyaktuk Peninsula.	Overlaps eastern portion of program.
316C	Winter Fish Harvesting	Various sites within Tuktoyaktuk planning area including Liverpool Bay.	Overlaps southeast portion of program.
322C	Grizzly Bear Denning Areas	Coastal areas including Richards Island and Tuktoyaktuk Peninsula.	Overlaps program north of Tunanuk.
323C	Mainland Coastal Polar Bear Dens	Northeast portion of the Tuktoyaktuk Peninsula, Kay Point to Summer Island, and northern portion of Cape Bathurst and Baillie Islands.	Overlaps program on North Point.
701B	Bluenose-west Winter Range	Starting at the southern ISR boundary, up to Tunanuk, northeast to include the western portioin of the Tuktoyaktuk Peninsula, southeast to include the Anderson River, and south to the ISR boundary.	Overlaps program southeast of Swimming Point.
702B	Caribou Hills	Upland area west of Parson's Lake and paralleling East Channel of Mackenzie River.	Overlaps southwest portion of program.
711E	Beluga Management Zone 1(a)	Kitigaaryuit Bay.	Overlaps program within Kitigaaryuit Bay

TABLE 3 Cont'd

Site Number And Protective Status Category	Name	Location Description	Location In Relation To Project
712C	Beluga Management Zone 2	Includes the Mackenzie shelf waters shallower than 20 m that are not included in Zone 1. Extends from Baillie Islands in the east to Kay Point on the Yukon coast to the west.	Overlaps program offshore
714DE	Kugmallit Bay	Extends from Pullen Island in the north, southward through portions of Richards Island, surrounding Beluga Management Zone 1A with a buffer zone in Mackenzie Bay.	Overlaps program at North Point as well as Kugmallit Bay.
715CE	Key Migratory Bird Habitat	Includes Shallow Bay, Olivier and Ellice Islands, Perry Island and part of Richards Island.	Overlaps program east of Kendall Island at West Point.
718D	Central Mackenzie Delta	Lands and waters defined by eastern edge of Mackenzie Bay, bordered to the south by Reindeer Channel, with the eastern border as Main Channel, with an extension along the East Channel.	Overlaps program on East Channel.
719C	Inner Mackenzie Delta	The boundary is marked by the western edge of the Mackenzie Delta, along Shallow Bay, with the northern border being Reindeer Channel, the eastern border being the East Channel, and the southern border being the ISR boundary line.	Overlaps program within Caribou Hills.
729D	Kitigaaryuit	The village and adjacent graveyards site at the south end of an island which lies at the mouth of the east branch of the Mackenzie River, on the east side of Kugmallit Bay. The peninsula is 1.5 km in length. The village is located south of the isthmus.	Overlaps program at mouth of Mackenzie River on the east side of Kugmallit Bay.

Site 702B – Caribou Hills is located on private 7(1)(a) lands within the ISR. It is an important site due to the unusual transition zone between alluvial taiga and low tundra habitats, the unique successional characteristics of the plant life and the use of the area for subsistence harvesting and berry picking (IICCP 2000). The main concern of the community working group is that land use activities will have a negative impact on this sensitive site (IICCP 2000).

Site No. 714DE - Kugmallit Bay is located on private 7(1)(a) lands and Crown lands within the ISR. It is a high traffic zone for marine species including beluga whales and is also used as a subsistence harvesting area throughout the summer months (TICCP 2000).

Site No. 715CE (the E portion being inside the sanctuary) – Mackenzie River Delta Key Migratory Bird Habitat is located on private 7(1)(a) lands and Crown lands and waters within the ISR. The site is important nesting and breeding habitat for birds from May to September and is an important denning area for grizzly bears from October to May (site No. 322C). Polar bears will also den in the area from November to April (site No. 323C). Subsistence harvesting of waterfowl and beluga whales occurs during the summer months (IICCP 2000). Community concerns include the possibility that development will have a negative impact on the birds, beluga whales and traditional lifestyles (IICCP 2000).

Site No. 718D - Central Mackenzie Estuary is on both private 7(1)(a) lands and Crown lands within the ISR. This site is important for its concentration of beluga whales, use as an overwintering and nursery area for a variety of fish, extensive use by feeding anadromous coregonids (whitefish), and function as a transition area between Shallow and Kugmallit bays (IICCP 2000).

Site No. 719C – Inner Mackenzie Delta is located on private 7(1)(a) lands within the ISR. The site is important due to its habitat for fish, waterfowl, moose and furbearers. It is also used by the people of Aklavik for trapping and hunting muskrats during the spring and setting fish nets at all times of the year. Also found in the area are many historical, cultural and archaeological sites (IICCP 2000).

Site No. 729 – Kitigaaryuit is located on private lands within the ISR. Kitigaaryuit is a semi-permanent settlement that has played an important role in the Inuvialuit culture for hundreds of years. It represents a significant archaeological site in the western arctic and was established as a National Historic Site in 1978 (IICCP 2000).

The habitats of many wildlife species harvested by the Inuvialuit are located within the general area of the project. The main community concern within the project area is that industrial

development will have a major impact on sensitive wildlife habitat that the local users have traditionally utilized for subsistence harvesting (IICCP 2000).

Site No. 701B – Bluenose-west caribou winter range is located on private 7(1)(a) and 7(1)(b) lands and Crown lands within the ISR. This site is important as the herd is relied upon for harvesting by various Inuvialuit communities (within the winter caribou harvesting area (site No. 315C)) as well as aboriginal communities outside the ISR boundary. The community working group of Tuktoyaktuk is concerned that potential oil and gas activities within the ISR and neighbouring settlement areas will cause the herd to change its migration route due to a degradation of habitat (TICCP 2000).

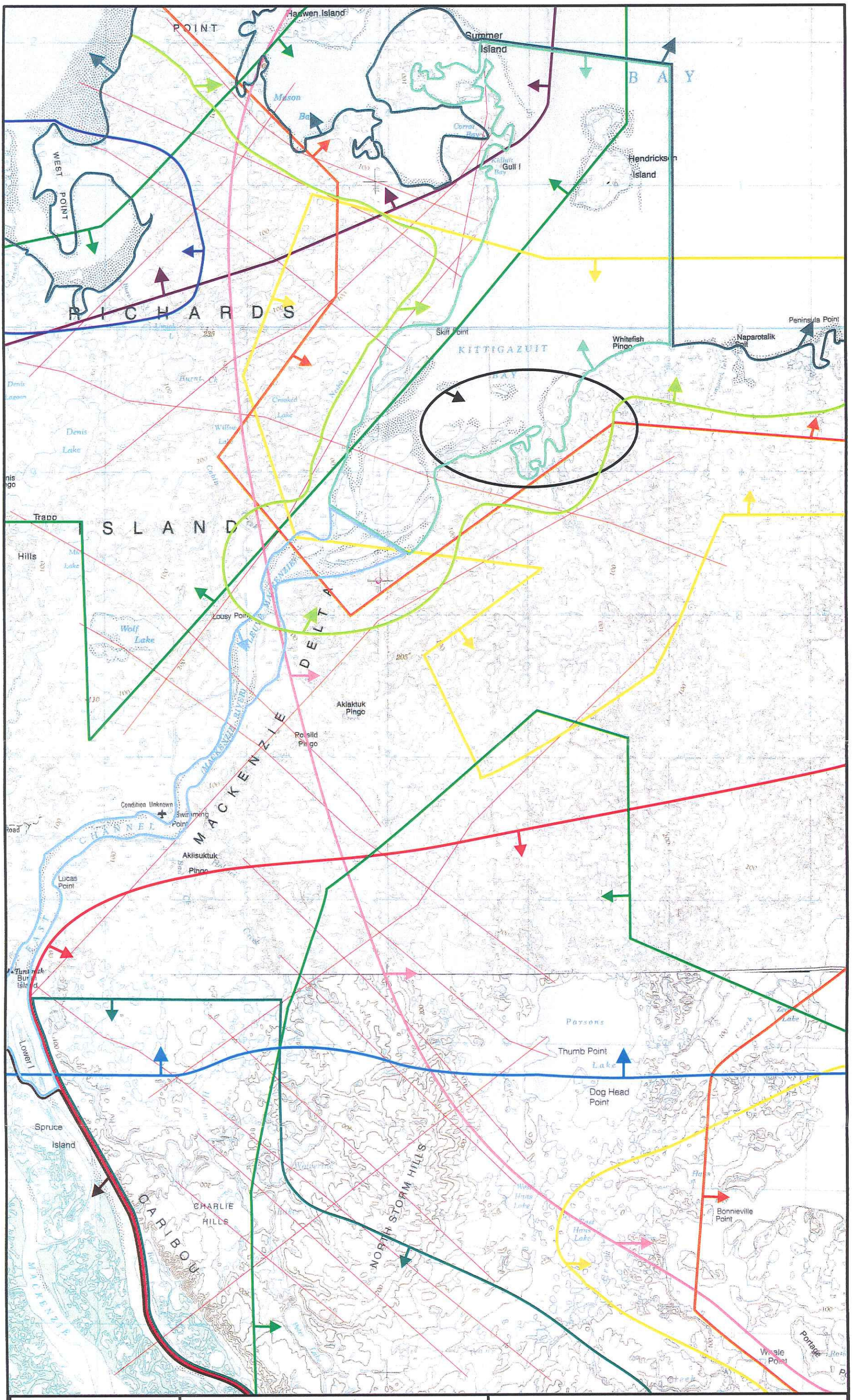
Site No. 305 – Spring Fish Harvesting, No. 307C – Summer Fish Harvesting, No. 310C – Fall Fish Harvesting, and No. 316C – Winter Fish Harvesting are each located on private 7(1)(a) and 7(1)(b) lands and Crown lands within the ISR. These sites are important for subsistence harvesting throughout the year.

Site No. 711E – Beluga Management Zone 1(a) and No. 712C – Beluga Management Zone 2 are both located on Crown lands and waters within the ISR. This is a high area of concentrated activities for the Beaufort Sea population of beluga whales including calving, rearing calves, moulting and socializing. It is also used as a subsistence harvesting area throughout the summer months and is designated as a Protected Area according to the Inuvialuit Renewable Resources Conservation and Management Plan (IICCP 2000). When the proposed seismic program is being completed the beluga population will be wintering in the Beaufort Sea. Also on the coast and located on Crown waters is site No. 313C – Winter Seal and Polar Bear Harvesting. This area just borders the program location but is important to the local communities for subsistence hunting.

The denning areas for both site No. 322C and No. 323C are located in the northern portion of the proposed program. Site No. 322C (Grizzly Denning Habitat) is located on Crown lands within the ISR. Site No. 323C (Mainland Coastal Polar Bear Denning Habitat) is located on private 7(1)(a) lands as well as Crown lands within the ISR. Both of these sites include many critical sites for denning bears and can easily be disturbed by industrial activity (IICCP 2000).

Community concerns within the project area are that industrial development will have a major impact on sensitive wildlife habitat that the local users have traditionally utilized for subsistence harvesting. These local users believe that hydrocarbon exploration, production, shipping and barging operations will have a major impact on the fish resources (IICCP 2000),

Since the AEC seismic program will be conducted during the winter months, impacts to fish and wildlife will be minimized. AEC will undertake consultation with local Hunters and Trappers Committees in order to make individuals aware of ongoing exploration activities that may impact their traditional activities. Special management areas within or near the vicinity of the project area are shown in Figure 4.



Inuvialuit Environmental Inc.

Legend

Seismic Lines	316C	702B	715CE
305C	322C	711E	718D
307C	323C	712C	719C
315C	701B	714DE	729D

Special Management Areas Within or Near the Vicinity of the Project Area

Scale 1:250,000 (0 – 5km)

699-00

August 2000

Figure 4

9.0 DEVELOPMENT TIMETABLE

The proposed seismic program will be conducted in winter 2000-early 2001, and it is expected to take approximately three to four months to complete. Veritas is currently planning to begin the program in January 2001 and expects to finish the program in late April. The dates proposed reflect the possibility of mobilizing some equipment to the program site by barges in early September. The bulk of equipment and camp associated items will be mobilized once the ice thickness will accommodate travel on the ice road from Inuvik to Tuktoyaktuk. Table 4 provides the proposed schedule for the winter 2000/2001 seismic program.

TABLE 4

DEVELOPMENT SCHEDULE

Project Activity	Estimated Time Frame
Planning	August – ongoing
Pre-survey Scouting	August – September 2000
Mobilization	November 2000
Mobile Camp Set-up	December 2000 – January 2001
Survey Control	January – February 2001
Survey	January – February 2001
Recording	January – April 2001
Final Clean-up	April – May 2001

* Time lines given in the above table are approximate and subject to change depending upon variables such as weather or ice thickness on proposed routes of travel.

10.0 NEW TECHNOLOGY

10.1 Vehicle Guidance and Tracking System

All vehicles used during the program will be equipped with a Vehicle Guidance Tracking System (VGTS). The VGTS is a remote system that is capable of displaying the locations of all vehicles being utilized on the program at any one time. The system makes it possible to keep vehicles on course during extreme weather, and reduces the potential for lost vehicles or crew members. The central tracking device will be located in the camp office and each unit will have an individual transmitter. The central tracking device records the data of each vehicle on a daily basis, allowing management to monitor vehicle movement during the operation.

In addition, areas of concern for safety or environmental reasons can be input into the database of the tracking system, thus alerting vehicle operators of the sites during operations. The use of

the VGTS will ensure that crew members stay on identified access routes and avoid sensitive areas while operating in the project area.

10.2 Dyna - Nav System

The dyna-nav system is utilized by the helicopter while laying-out lines for seismic recording. This tracking system enables the pilot to fly to a predetermined location to deploy or retrieve equipment. Where weather and daylight permits helicopter support, this system improves efficiency of daily operations while minimizing the vehicle travel required on seismic lines.

11.0 ENVIRONMENTAL OVERVIEW

11.1 Physiography and Bedrock Geology

The proposed seismic program lies within the Tuktoyaktuk Coastal Plain Ecoregion within the Southern Arctic Ecozone, with the exception of the most southwestern lines and access routes, which cross Caribou Hills and traverse into the Mackenzie Delta Ecoregion of the Taiga Plains Ecozone (ESWG 1995).

Glacial features dominate within the Southern Arctic ecozone. The terrain consists largely of broadly rolling uplands and lowlands underlain by Precambrian granitic bedrock (ESWG 1995). Discontinuous morainal deposits mantle much of the area, except near the coasts where fine-textured marine sediments cover the surface. Outwash aprons of crudely sorted sand and gravel occur less frequently, and raised beach ridges along the shores of phantom preglacial lakes (ESWG 1995). The resulting undulating terrain is studded with innumerable lakes and ponds.

The Tuktoyaktuk Coastal Plain ecoregion covers the outer Mackenzie River delta and Tuktoyaktuk Peninsula bordering the Beaufort Sea. Much of the ecoregion is composed of distinctive delta landforms at the mouth of the Mackenzie River. These include wetlands, active alluvial channels, and estuarine deposits. Characteristic wetlands, which cover 25–50% of the area, are lowland polygon fens, both the low- and high-centre varieties (ESWG 1995). Innumerable lakes and pingos, some very large, form unique and outstanding features of the landscape on the peninsula (Plate 1). The region is underlain by continuous permafrost with high ice content in the form of ice wedges and pingos (ESWG 1995).

The Taiga Plains feature typically subdued relief consisting of broad lowlands and plateaus incised by major rivers, the largest of which show elevation differences of several hundred metres (Plates 2 and 3).

Plate 1: Example of pingo and fen landscape found on the northern portion of AEC's seismic program.

Plate 2: View of upland tundra east of Mackenzie River where the bulk of AEC's proposed seismic program will be conducted.

Plate 3: Photo of upland tundra in the area of AEC's proposed seismic program.

The nearly level to gently rolling plain is underlain by horizontal sedimentary rock, limestone, shale and sandstone and covered with organic deposits, or to a lesser degree, with undulating to hummocky morainal and lacustrine deposits (ESWG 1995). Alluvial deposits are common along the major river systems, including braided networks of abandoned channels.

The Mackenzie Delta ecoregion is composed of the southern two-thirds of the distinctive Mackenzie River Delta. The delta is a complex area of peat-covered deltas and fluvial marine deposits. The present delta is remarkable for its multitude of lakes and channels. Wetlands extend over 50% of the ecoregion, and are characteristically polygonal peat plateau bogs with ribbed fens (ESWG 1995).

11.2 Soils

Organic and Turbic Cryosols developed on level to rolling organic, morainal, alluvial, fluvioglacial, and marine deposits are the dominant soils of the Tuktoyaktuk Peninsula ecoregion (ESWG 1995). These soils are underlain by a continuous layer of permafrost, unlike the soils of the Mackenzie Delta ecoregion, which are underlain by a discontinuous layer of permafrost. The dominant soils of the Mackenzie Delta ecoregion are Regosolic Static and Gleysolic Static

11.5 Vegetation

Permafrost detracts from soil productivity by chilling the soil and creating waterlogged conditions in the thawed active layer near the soil surface. Plant communities found in the vicinity of the project are relatively simple and are dominated by a few species that are well adapted to poor soil conditions and the harsh climate.

The predominant vegetation in the vicinity of the project consists of a ground cover of dwarf birch, willow, ericaceous shrubs, cottongrass, lichen, and moss (Plate 4). Poorly drained sites usually support tussocks of sedge, cottongrass, and sphagnum moss. Floodplain vegetation consists of primarily black spruce, northern willow, horsetail and water sedge (Gill 1971). Wetlands occur over 50% of the delta and are characteristically polygonal peat plateau bogs with ribbed fens.

Plate 4: Typical vegetation found in the area of the proposed seismic program.

Eleven plant species of national significance are found in the delta (McJannet et al. 1995). However, due to the fact that the proposed project takes place in the winter these species will likely not be affected. Plants of national significance that may occur in the area are listed in Table 5.

TABLE 5

VEGETATIVE SPECIES OF SIGNIFICANCE FOUND IN THE VICINITY OF THE PROPOSED PROJECT

Common Name	Latin Name	Phytogeography	Habitat	Ncr[1]
Pussytoes	*Antennaria friesiana*	Arctic-alpine	Alpine ridges and snowbeds.	N3T1
Mustard	*Braya pilosa*	Arctic	Sandy seashores.	NX
Fescue	*Festuca lenensis*	Arctic-alpine	Dry tundra.	N1
Junegrass	*Koeleria asiatica*	Arctic-alpine	Shale scree slopes and dry tundra.	N1
Pondweed	*Potamogeton subsibiricus*	Aquatic	Still waters.	N2
Goose grass	*Puccinellia poacea*	Arctic	Riverbanks, flood plains and tidal flats.	N1
Buttercup	*Ranunculus pallasii*	Arctic-alpine	Coasts and estuaries	N2
Buttercup	*Ranunculus turneri*	Arctic-alpine	Subalpine meadows.	N2
Willow	*Salix chamissonis*	Arctic-alpine	Tundra	N2
Willow	*Salix ovalifolia* var. *arctolitoralis*	Arctic	Sand beaches and terraces.	N2T2
Mustard	*Smelowski calycina* var. *media*	Arctic-alpine	Stony slopes and lakeshores.	N3T2

Notes:

1. The Nature Conservancy Ranks
   - Canada Rank (N): national status
   - Taxon Subrank (T): applied if a taxon is a subspecies or variety
   - The degree to which a species is imperiled is rated on a scale of 1 – 5 (from extremely rare to abundant), with X indicating the species is extirpated or extinct.

11.6 Wildlife

The islands and flood enriched shores of the Mackenzie River are favourite habitats for many wildlife species including black and grizzly bear, polar bear, seal, muskrat, caribou, beluga, wolf, snowshoe and arctic hare, red fox, beaver, mink, ermine and arctic ground squirrel. The proposed seismic program lies within grizzly bear denning area. Inuvialuit environmental and wildlife monitors will be used to assess potential wildlife conflicts as the project progresses.

Grizzly bears reside year round in the project area, although at low density. They have been designated the status of "Special Concern" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) due to their dwindling populations as a result of hunting and habitat degradation (COSEWIC 2000). Between the years of 1973 to 1978 approximately four bears per 1000 km^2 were observed within the Richards Island/Tuktoyaktuk Peninsula region (WMAB 1998). Most local grizzly denning occurs on south and west facing lake/channel banks between sea level and 100 m above sea level within the bear's home range. Grizzlies will enter their dens beginning in late September and will remain there until late April/early May (WMAB 1998). Locations of previous dens have been obtained from RWED that will enable the seismic crew to ascertain areas of potential denning sensitivity. The Inuvialuit environmental monitor will identify any grizzly bear dens in the vicinity of the project.

Polar bears may occur in the project vicinity. They have also been designated the status of "Special Concern" by COSEWIC due to their dwindling populations as a result of hunting (COSEWIC 2000). The Canadian population has approximately 15,000 animals, of which roughly 1,200 reside in the Beaufort Sea and on the mainland coast from Alaska to the Northwest Territories (Carpenter 1989).

The muskrat is a semi-aquatic rodent whose habitat includes the fresh water marshes, marshy areas of lakes, and slow-moving streams of the Mackenzie River Delta. They winter in lakes between one and two metres deep ensuring that there is adequate supply of submerged aquatic plants available for forage (CWS 2000). Muskrats extend their foraging distance under ice by creating push-ups, which are hollow mounds of vegetation that rise above the surface of the ice and are subsequently covered by snow. These are used as feeding stations and can be located up to 90 metres away from the muskrat's main burrow (CWS 2000). Muskrat harvesting occurs during the proposed seismic program.

The project area overlaps the Bluenose-west caribou herd winter harvesting area. Various Inuvialuit communities rely upon this herd for subsistence use and it is a common concern that oil and gas activities as well as an increase in tourism might have a negative impact on the herd.

Currently the population of the Cape Bathurst/Bluenose-west herd is between 14,000 and 19,000 and can be found on the Tuktoyaktuk Peninsula between September and April (TICCP 2000).

A wolf research program was undertaken by RWED in the western arctic from 1987-1993. These studies indicate that wolves may occur throughout the project area, but are more common in the Caribou Hills, southwest of the project area (Clarkson et. al 1992).

Beaver, mink and ermine are found in habitat associated with the channels and watercourses of the delta. Foxes may also occur in the area. Ground squirrels inhabit dry upland ridges, while lemmings and voles occupy more heavily vegetated tundra and delta habitats.

Common bird species include the common redpoll, gray jay, common raven, red-throated loon, northern shrike, and fox sparrow. Raptors include the bald eagle, peregrine falcon, and osprey. The Mackenzie Valley forms one of North America's most traveled migratory corridors for waterfowl (ducks, geese, and swans) breeding along the Arctic coast. The delta is important as a spring and fall staging area for migrating waterfowl. In spring, the largest concentrations occur along the Middle Channel during mid to late May (TICCP 2000). The Kendall Island Bird Sanctuary, located west of the project area is an area of high use for breeding by geese and other waterfowl during the spring and summer. However, these species are not likely to be found in the project area during the time proposed as they migrate south for winter. There are no recently recorded nest sites for the peregrine falcon or bald eagle in the vicinity of the project, but these and other raptor species may nest in the area.

A number of species are found in the area that are important to local subsistence harvesters as well as recreational users. Vertebrate species of concern potentially found in the project area are listed in Table 6.

TABLE 6

VERTEBRATE SPECIES OF CONCERN FOUND IN THE VICINITY OF THE PROPOSED PROJECT

Species [1]	Latin Name	Habitat	COSEWIC [2]
MAMMALS			
Caribou[3]	*Rangifer tarandus*	Hornaday, Brock and Horton Rivers area for calving, winter habitat northeast of Inuvik.	Not listed
Grizzly bear	*Ursus arctos*	Prefers open areas of alpine tundra, subalpine mountains or subarctic tundra. Richards Island, Kugaluk River, delta.	Special Concern
Polar bear	*Ursus maritimus*	Southern broken edge of the arctic ice pack. Less use of delta region during summer and fall.	Special Concern
Wolf	*Canis lupus arctos*	Treeline-tundra transition zone. Bluenose caribou wintering range. Caribou Hills.	Indeterminate
Wolverine	*Gulo gulo*	On tundra between treeline and arctic coasts. North Slope, Cache Creek, Sheep Creek, Big Fish River, Foothills west of Aklavik. Relatively few in delta.	Special Concern
BIRDS			
Yellow billed loon[3]	*Gavia adamsii*	Arctic tundra on large lakes or in backwater areas of flooded rivers. Winter in the Gulf of Alaska.	Not listed
Red-throated loon[3]	*Gavia stellata*	Coastal and tundra ponds during summer; large lakes, bays, estuaries, and ocean during migration and winter.	Not listed
Bald eagle[3]	*Haliaeetus leucocephalus*	Lakes, rivers, marches, seacoasts. Willow River, Fish Creek, First Creek, Mackenzie delta.	Not listed
Golden eagle[3]	*Aquila chrysaetos*	Mountain forests and open grasslands; can be found in any habitat during migration. Willow River, Fish Creek, First Creek, Mackenzie delta.	Not listed
Peregrine falcon	*Falco peregrinus tundrius*	Nests on cliffs or buildings, and hunts over open tundra habitats.	Special Concern
Gyrfalcon[3]	*Falco rusticolus*	Arctic tundra and rocky cliffs near water. Nests in cliffs and occasionally trees.	Not listed
Eskimo curlew[4]	*Numenuis borealis*	Formerly bred in the tundra and woodland transition zones of the Mackenzie District. Present day habitat is unknown.	Endangered
Short-eared owl	*Asio flammeus*	The owl prefers extensive stretches of relatively open habitat. It is primarily a bird of marshland and deep grass fields. It likes to hunt and roost in abandoned pastures, fields, hay meadows, grain stubble, airports, young conifer plantations and marshes in the winter. It frequents prairies, grassy plains or tundra in the summer.	Special Concern

Notes:

1. Bird species are included only if they are known to be confirmed, possible or probable breeders within a particular subregion that the proposed project impacts.

2. Committee on the Status of Endangered Wildlife in Canada 2000.

   Endangered = A species facing imminent extirpation or extinction.
   Special Concern = A vulnerable species because of characteristics that make it particularly sensitive to human activities or natural events.
   Indeterminate = A species for which there is insufficient scientific data to support status designation.

3. Species are included due to their listing in Community Conservation Plans as species of interest or declining in population.

4. Species not observed for approximately 100 years. Thought to be extinct.

11.7 Hydrology and Fish

The Mackenzie River Delta is a dynamic complex of lakes, islands, braided channels and oxbows. The hydrological regime is the primary factor controlling vegetation and wildlife habitat in the area. It is an estuarine delta with poorly developed levees, formed largely from sediments transported by the Mackenzie River over the last 13,000 years. The southwest sector also receives sediment from the Peel and Rat rivers. The major channels appear largely unchanged in the last century. The present delta is flat and dotted with numerous lakes, ponds and river channels, but also contains land varying from stable forested areas to tidal flats (MRBC 1981).

The southwest portion of the delta is greatly influenced by the Peel River, which enters the delta directly. However, the dominant influence is the Mackenzie River that asserts itself across the delta farther downstream. Ice covers the waters of the delta for approximately eight months of the year and can be up to 2.5 m thick in the main stem of the Mackenzie River. Ice break-up usually begins in April, and ice movement occurs before peak spring water levels. Water levels fall during late summer and into fall. The basic hydrology of the delta is a complex interaction of aggrading and degrading forces, with spring break-up the major hydrological event each year (MRBC 1981).

A large number of fish species occur within the freshwater and marine environments of the mainland western Arctic. The impacts of oil and gas development activities are of particular concern to these aquatic environments and their inhabitants (IICCP, TCCP 2000). Fish species of concern are listed in Table 7 along with their spawning habitats and spawning times.

TABLE 7

FISH SPECIES FOUND IN THE VICINITY OF THE PROPOSED PROJECT

Species [1]	Latin Name	Habitat	Spawning Period	COSEWIC [2]
FRESHWATER				
Burbot	*Lota lota*	Mouths of creeks. Winter and spring may be abundant in fresh or brackish waters of Kugmallit Bay's coastal embayment.	January – March	Not listed
Arctic char	*Salvelinus alpinus*	Fish Hole, Rat River, Big Fish River, Fish Creek, Babbage River, Peel River, Shingle Point, occasionally travel the Mackenzie near Inuvik and Aklavik.	August, early September	Not listed
Flathead chub	*Platygobio gracilis*	Shallow sandy bars in smaller tributary streams, survives well in turbid water.	Summer	Not listed
Lake chub	*Couesius plumbeus*	Most of Canada west of Hudson Bay. Cool streams, lakes, ponds. Moves into deeper water during the summer.	Late March – early May	Not listed
Arctic cisco	*Coregonus autumnalis*	Mackenzie River and estuary, tributaries to the Mackenzie (spawning habitat - inland lakes).	Fall	Not listed
Least cisco	*Coregonus sardinella*	Mackenzie River and estuary, tributaries to the Mackenzie (spawning habitat), inland lakes. Inner Shallow Bay / Niakunak Bay and Kugmallit Bay are important overwintering and nursery areas.	Early October	Not listed
Finescale dace	*Chrosomus neogaeus*	Bog ponds, streams, and lakes. Mackenzie River drainage.	April to June	Not listed
Longnose dace	*Rhinichthys cataractae*	Prefers small streams, generally in riffles of gravel and boulders. Often found in turbulent waters. Also the wave lashed shores of very large lakes and often found in trout streams.	April and May	Not listed
Inconnu	*Stenodus leucichthys*	Mackenzie River and estuary (rearing habitat). Turbid lakes on Richard Island throughout summer, Mallik and Mason Bays.	Late September – early October	Not listed
Arctic grayling	*Thymallus arcticus*	Kugalak River, coastal rivers of North Slope. Occasionally Richards Island.	Spring	Not listed
Lake trout	*Salvelinus namaycush*	Outer delta lakes (including minor channels) with high oxygen levels, a good connection to adjacent water bodies, small to moderate volumes available and poor to moderate water quality.	Fall	Not listed
Northern pike	*Esox lucius*	Tributaries, creeks and shallow lakes in Mackenzie delta.	Early spring	Not listed
Deepwater sculpin	*Myoxocephalus thompsoni*	Habitat preferences are not known. Spawning areas are not known.	May and June	Threatened
Slimy sculpin	*Cottus cognatus*	Coldwater streams. Stream bottom.	Late April and May	Not listed

TABLE 7 Cont'd

Species [1]	Latin Name	Habitat	Spawning Period	COSEWIC [2]
Spoonhead sculpin	*Cottus ricei*	Turbid rivers or deep areas of lakes.	Fall	Not listed
Pond smelt	*Hypomesus olidus*	Arctic and Pacific drainages from Rae River (Coronation Gulf) and Great Bear Lake in Northwest Territories, Canada to Copper River in Alaska Seines of Shallow Bay near mouth of west channel.	Late spring – early summer.	Not listed
Rainbow smelt	*Osmerus mordax*	Found only along mainland coast from Bathurst Inlet westward.	Spring	Not listed
Ninespine stickleback	*Pungitius pungitius*	Shallow vegetated areas of lakes, ponds, and pools of sluggish streams. Sometimes in open water over sand. Seining locations Shallow Bay, Kendall Island, Swan Channel and East Channel.	Spring	Not listed
Longnose sucker	*Catostomus catostomus*	Arctic mainland in lakes and occasionally in the brackish water of estuaries.	Spring	Not listed
White sucker	*Catostomus commersoni*	Lakes, small rivers and streams.	Late April to June	Not listed
Trout-perch	*Percopsis omiscomaycus*	Stream habitats with high water quality, deep pools and bottoms consisting of sand and gravel. Lake populations avoid mud-filled bays.	May through August	Not listed
Walleye	*Stizostedion vitreum*	Intermediate to large cool lakes, rivers, and streams. Prefers large shallow lakes with high turbidity.	April to late June	Not listed
Broad whitefish	*Coregonus nasus*	Several overwintering areas in East Channel and Whitefish Bay. Tuktoyaktuk Harbour, Mason Bay, Mallik Bay, Shallow Bay, streams of Tuktoyaktuk Peninsula, spawning throughout the Mackenzie system.	October, November	Not listed
Round whitefish	*Prosopium cylindraceum*	Inhabits shallow areas of lakes and clear streams, rarely entering brackish water. Most often found in clear fast flowing water. Outer Mackenzie delta.		Not listed
SALTWATER				
Capelin	*Mallotus villosus*	Cold deep waters.	June / July	Not listed
Arctic char	*Salvelinus alpinus*	Fish Hole, Rat River, Big Fish River, Fish Creek, Babbage River, Peel River, Shingle Point, occasionally travel the Mackenzie near Inuvik and Aklavik.	Fall	Not listed
Arctic cod	*Boreogadus saida*	Within Mackenzie estuary.		Not listed
Greenland cod	*Gadus ogac*	Cold temperatures usually inshore regions. Arctic coast of Canada.		Not listed
Saffron cod	*Elegiums navaga*	Saline bays and offshore.		Not listed
Tom cod	*Microgadus proximus*			Not listed
Starry flounder	*Platichthys stellatus*	West coast of Tuktoyaktuk Peninsula and Mallik Bay.	February - April	Not listed
Blue herring	*Clupea spp.*	Mackenzie River and estuary, tributaries to the Mackenzie, inland lakes.	Late June	Not listed
Sand lance	*Amodytes sp.*	Shallow intertidal with sandy bottoms.	December - March	Not listed

TABLE 7 Cont'd

Species [1]	Latin Name	Habitat	Spawning Period	COSEWIC [2]
Chum salmon	*Oncorhynchus keta*	Pacific and Arctic oceans, spawning in rivers from the Mackenzie westward.	Fall	Not listed
Pink salmon	*Oncorhynchus gorbusha*	Pacific and Arctic oceans, spawning in rivers from the Mackenzie westward.	Fall	Not listed
Fourhorn sculpin	*Myoxocephalus quadricornis*	Lakes and streams of the Arctic archipelago.	May and June	Special Concern

Notes:

1. Fish species are included only if they are known to be confirmed, possible or probable breeders within a particular subregion that the proposed project impacts.

2. Committee on the Status of Endangered Wildlife in Canada 2000.

   Threatened = A species likely to become endangered if limiting factors are not reversed.
   Special Concern = A vulnerable species because of characteristics that make it particularly sensitive to human activities or natural event

11.8 Cultural and Historic Resources

Cultural and heritage resources include the physical traces of culture and societies as well as the current resources utilized by local people. Heritage sites recognized by Federal agencies are also considered. These sites include archaeological sites, historic structure sites, traditional trails, campsites, berry picking areas, sacred or medicinal plant picking areas, burials, ceremonial sites, traditional hunting grounds and places associated with traditional names or legends.

The project is situated within the Mackenzie Delta, portions of which have seen previous survey efforts. A records search was completed for mapped locations of heritage resource sites on file at the Canadian Museum of Civilisation for locations of known archaeological and historical resource sites in the project area. Palaeontological finds of Quaternary age have also been recorded in the delta and are not on file with the Canadian Museum of Civilisation but are considered a heritage resource (FMA 2000). There are 80 recorded site locations within the project area as specified in Figure 1. These recorded site locations currently on file are listed in Table 8 and are shown in Figure 5.

TABLE 8

PREVIOUSLY RECORDED HISTORICAL SITES IN THE VICINITY OF THE PROPOSED WINTER SEISMIC PROGRAM

Site	Type	N.T.S Map Reference	Location	Association	Distance To Project (Km)
NeTs 1	P Isolated Find	107B/11E	8WNM 3164 2530	Ridge	< 7
NeTs 2	P Artifact Scatter / Burial	107B/11E	8WNM 3228 2420	Ridge	< 9
NeTs 3	P Campsite	107B/11E	8WNM 3256 2383	Knoll	< 9
NgTs 1	H Burial	107C/3E	8WNM 2905 7136	East Bank	< 3
NgTt 1	TU Village	107C/3W	8WNM 150 561	Tunanuk Point	< 4
NgTt 2	P Village	107C/3W	8WNM 150 544	Nennorai Point	< 3
NgTt 4	P/H ?	107C/3E	8WNM 2603 670	Mouth/South Bank	< 2
NgTt 5	P Campsite	107C/3W	8WNM 1380 6890	Kame	< 9
NgTt 6	P Artifact Scatter	107C/3W	8WNM 1409 6893	Saddle/Kames	< 9
NgTt 7	H? Cairn	107C/3W	8WNM 1462 6910	Hill/Shore	~ 8
NgTt 8	P Isolated Find	107C/3W	8WNM 1339 7005	Upland/Lake Shore	< 9
NgTt 9	? Burials	107C/3E	8WNM 2623 6636	Knolls	< 500 m
NgTt 10	? Artifact Scatter	107C/3E	8WNM 2121 6881	Knoll	< 8
NgTt 11	P Artifact Scatter	107C/3W	8WNM 1345 5494	Left Bank	~ 3
NgTt 12	? Burial	107C/3W	8WNM 1416 5697	Terrace	< 5
NgTu 1	H Burials/house	107C/3W	8WNM 130 5473	Bluff	< 3
NgTu 6	H Cabin	107C/3W	8WNM 1034 5874	Kame	< 7
NhTp 4	P House	107C/7E	8WNM 7088 8868	North Bank/Creek	< 9
NhTp 5	?	107C/7E	8WNM 7105 8901	North Shore/Lake	< 9
NhTq 1	? Isolated Find	107C/7	8WNM 5520 8909	Knoll/Lake	< 2
NhTr 1	P Village	107C/7W	8WNM 4329 8537	Radio Creek	< 4
NhTr 2	P Isolated Find	107C/7W	8WNM 4375 8575	Sand Bluffs	< 4
NhTr 3	H Campsite	107C/2W	8WNM 4597 8008	Hill/Lake	< 3
NhTr 4	P Artifact Scatter	107C/2W	8WNM 4554 7969	Hill/Lake	< 3
NhTr 5	P Isolated Find	107C/7W	8WNN 4431 8371	Hill	< 2
NhTr 6	? Campsite	107C/7W	8WNM 4725 9141	Shore/Small Lake	< 3
NhTr 7	TU ?	107C/7W	8WNM 4748 9144	Shore/Small Lake	< 3
NhTr 8	TU Campsite	107C/7W	8WNM 4389 9038	Bank	< 1
NhTr 10	TU Campsite	107C/7W	8WNM 4355 8861	Hill/Shore	< 1
NhTr 11	P Isolated Find	107C/7W	8WNM 4390 8912	Hill/Shore	< 500 m
NhTr 12	H Village	107C/7W	8WNM 4391 8646	North Bank	< 3
NhTr 13	H Loran Station	107C/7W	8WNM 4442 8622	Radio Creek	< 3
NhTs 1	P Village/burials	107C/3E	8WNM 304 8014	Lousy Point/Bluffs	< 3
NhTs 2	P Village	107C/6E	8WNM 3545 8529	Cache Point	< 4
NhTs 3	P Artifact Scatter	107C/6E	8WNM 3399 8604	Ridge	< 2
NhTs 4	P House ?	107C/6E	8WNM 3645 8974	Bank	< 2
NhTs 5	? Stone Feature	107C/6E	8WNM 360 900	Terrace/West Bank	< 2
NhTs 6	P Stone Feature	107C/6E	8WNM 345 880	Terrace/West Bank	< 2
NhTs 7	? Burial	107C/3E	8WNM 8235 7546	Terrace	< 2

TABLE 8 Cont'd

NhTs 8	? Burial	107C/6E	8WNM 3440 8573	Cabin Creek	< 2
NhTs 9	? Burial	107C/3E	8WNM 3020 7363	East Bank	< 1
NhTs 10	P Artifact Scatter	107C	8WNM 3386 8825	Lake Shore	< 1
NhTs 11	P Isolated Find	107C	8WNM 3283 8794	East Shore	< 1
NhTt 1	? Artifact Scatter	107C/3W	8WNM 1566 7699	Ridge/North Shore	< 4
NhTt 2	P Artifact Scatter	107C/3W	8WNM 1593 7492	Ridge/East Shore	< 6
NhTt 3	P Artifact Scatter	107C/3W	8WNM 1594 7474	Ridge/East Shore	< 6
NhTt 4	TU Campsite	107C/3W	8WNM 2398 7684	Terrace/East Shore	<2
NiTq 1	H?	107C/7E	8WNM 540 970	Whitefish Station	< 8
NiTq 2	? Isolated Find	107C/7E	8WNM 6288 9385	Shores	< 9
NiTq 3	H Structure	107C/7E	8WNM 6279 9407	West Bank	< 5
NiTq 4	H cabin	107C/7E	8WNM 6329 9756	Left Bank	< 8
NiTr 1	P Village/burials	107C/7W	8WNM 5083 9311	Sandspit	< 4
NiTr 2	P Village/burials	107C/7W	8WNM 5119 9288	Coast	< 6
NiTr3	P House	107C/7W	8WNM 5118 9380	Coast	< 6
NiTr 6	P House	107C/7W	8WNN 4244 0041	Bluff/Stream	< 3
NiTr 7	P Campsite	107C/7W	8WNN 4117 0038	Hill/Shore	< 500 m
NiTr 8	? Burial	107C/7W	8WNN 4412 0093	Coast	~ 3
NiTr 9	? Burial	107C/7W	8WNN 4432 0203	Coast	< 1
NiTr 10	P Artifact Scatter	107C	8WNM 3974 9843	Coast	< 500 m
NiTr 11	P Artifact Scatter	107C/6E	8WNN 4425 0926	Lake Shore	< 1
NiTs 1	H Village/burial	107C/6E	8WNM 3763 9302	Gopuk Point	< 2
NiTs 2	P Village/burials	107C/6E	8WNM 3721 9267	Gopuk Point	< 2
NiTs 3	P Village/burials	107C/6E	8WNM 3606 9202	East Channel	< 1
NiTs 4	P House ?	107C/6E	8WNM 3878 9763	Small Lake	< 500 m
NiTs 5	P Burials	107C/6E	8WNM 3711 9291	Tributary/Hill	< 2
NiTs 6	P Artifact Scatter	107C	8WNM 3712 9299	Gopuk/Hill	< 2
NiTs 7	P Isolated Find	107C	8WNM 3958 9533	East Channel	< 2
NiTs 8	P Isolated Find	107C	8WNM 3714 9794	Tributary	< 500 m
NiTs 9	P Stone Feature	107C	8WNM 3566 9634	Nesbit Lake	< 3
NiTs 10	P Artifact Scatter	107C	8WNN 2749 0782	Lake Shore	< 500 m
NiTt 1	P Campsite	107C/6E	8WNN 255 065	Bluff/Lake	< 1
NiTt 2	P Artifact Scatter	107C	8WNN 2388 0533	Lake	< 1
NiTt 3	TU Campsite	107C	8WNN 2595 0773	Lake	< 100 m
NiTu 1	? Campsite	107C/6W	8WNM 070 975	Pingo	< 10
NjTr 1	P Village	107C/10W	8WNN 4836 1243	Kidluit Bay	< 3
NjTr 2	? Burials	107C/10W	8WNN 4024 1515	South Shore	< 8
NjTr 4	H Village	107C/10W	8WNN 4776 1293	North Shore	< 1
NjTr 5	P Artifact Scatter	107C	8WNN 4097 1642	Small Lake	~ 9
NjTr 6	P Campsite	107C	8WNN 3926 1272	Southwest Shore	~ 3
NjTr 7	P Campsite	107C	8WNN 4573 1097	Small Lake	< 500 m

Notes: ? indicates timing or content of archaeological site is unknown

Cryosols with Organic Cryosols developed on level fluvioglacial, organic, and marine deposits (EWSG 1995). The organic soils found in the eskers of this ecozone are generally shallow, highly acidic, and nutrient-poor. The mineral soils are also poorly developed and often frozen (ESWG 1995).

Sensitive terrain areas encountered within the project area include the eroded banks of the Mackenzie River and associated channels as well as moderate to steep slopes adjacent to lakes.

11.3 Climate

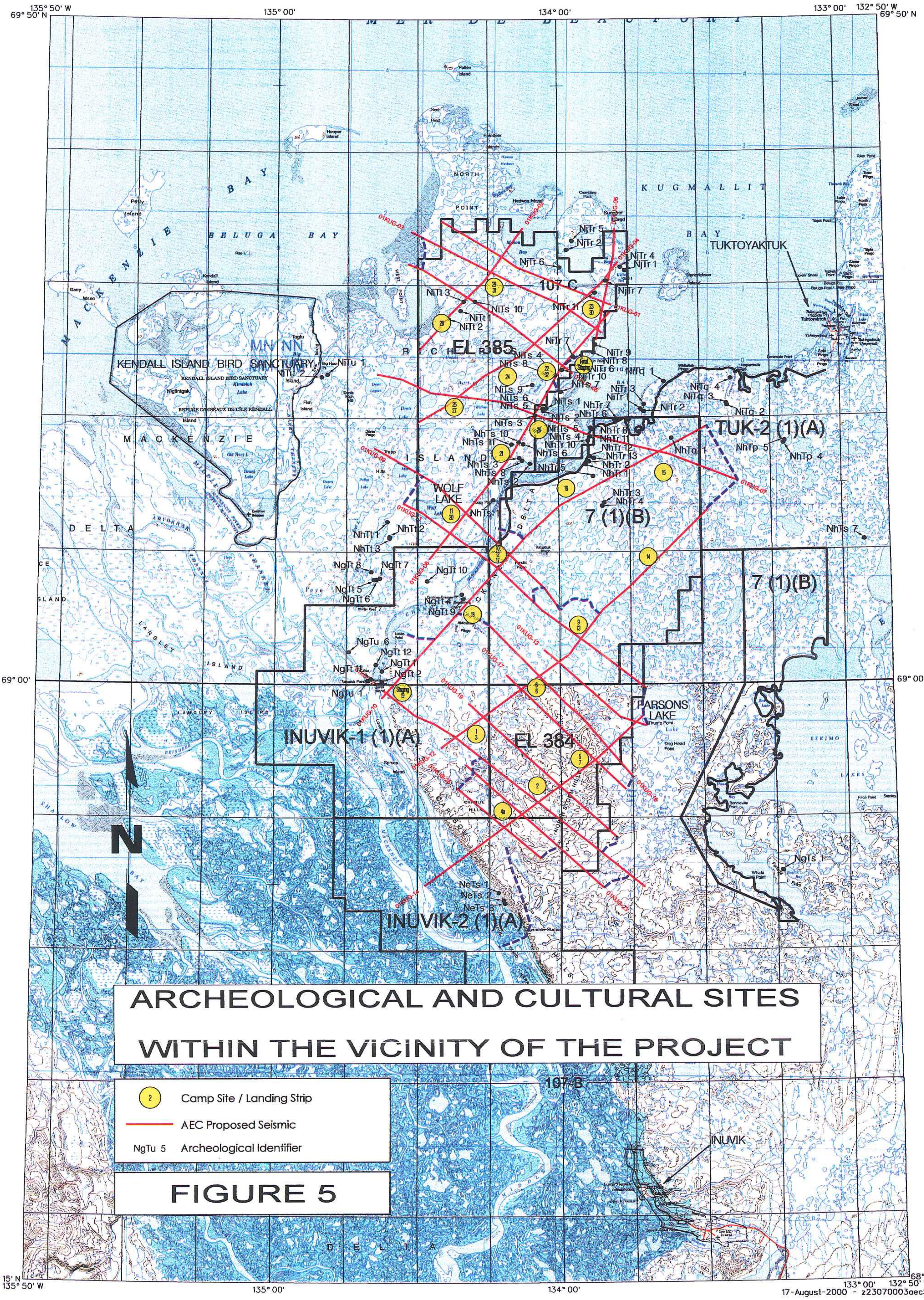
Both ecoregions traversed by the proposed project experience very cold winters and cool summers. The mean annual temperature is approximately -9.5°C to 11.5°C in the Mackenzie Delta region with a mean summer temperature ranging from 4.5°C to 8.5°C and a mean winter temperature of -26.5°C (ESWG 1995). Winters in this area tend to be quite long as there is a period of approximately 3 months during which the sun does not rise above the horizon. In this dark period the ground radiates heat into space, the air grows colder and denser, and the atmospheric pressure begins to build. Very cold conditions prevail and may last for several weeks at a time. When temperatures reach such lows, the ability of the air to contain moisture is limited and very little precipitation falls. The mean annual precipitation ranges from 200–275 mm (ESWG 1995).

Snow and freshwater ice persist for six to eight months of the year. When the sun begins to rise above the horizon (January), the increased amounts of heat dissipate the high-pressure centre and storms prevail. By June most of the snow has melted though lake ice may persist until July. During the seismic program, temperatures should average between -8°C and -36.4°C (RWED 1999).

11.4 Permafrost

Permafrost occurs continuously throughout the project area. This layer often lies just a few centimetres below the surface and acts as a dam that stops the downward flow of water. Consequently, even though there is little precipitation here, the soils are often waterlogged or frozen. These ice rich soils are common in areas maintained by extensive vegetation cover and are therefore susceptible to permafrost degradation. This can occur as a result of erosion. The top layer of vegetation provides a thermal barrier that acts as protection against permafrost degradation. Vehicle and equipment traffic, and soil excavation can disturb the surface layer and degrade the permafrost (UMA 1999). Under frozen conditions and considering the implementation of mitigative measures, permafrost should be protected.

AEC WEST LTD.



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