10 WILDLIFE

10.1 Introduction

10.1.1 Focus

Wildlife in the Mackenzie Delta and the Mackenzie Valley are of critical value to northern residents and other Canadians. Many aspects of the culture and identity of people in northern communities are vitally connected to the wildlife and habitats that the lands and waters support. Country food is prominent in the subsistence economy, with replacement values in the hundreds of millions of dollars per year.

Northern residents and other Canadians are concerned about the potential effects of development on wildlife and wildlife habitat. This assessment evaluates potential effects of the proposed project on wildlife by assessing wildlife habitat availability, wildlife movement and potential wildlife mortality. Project activities likely to have an effect are:

- vegetation clearing
- noise
- improved access into previously remote areas
- interaction of wildlife with humans

Project effects on wildlife will likely vary among the different regions. The near-shore anchor fields can interact with the marine environment and waterfowl, the gathering pipelines and associated facilities and many infrastructure sites are mostly in tundra, and the main part of the pipeline corridor extends into the boreal forest. These three main areas focus on wildlife species that are representative and important in their areas.

10.1.2 Summary of Findings

10.1.2.1 Wildlife Valued Components

The wildlife assessment investigated project effects on the following valued components (VCs):

- in the Beaufort marine area – beluga whale, bowhead whale, polar bear and ringed seal
- in the tundra – barren-ground caribou, grizzly bear, snow goose, greater white-fronted goose, tundra swan, scaup, peregrine falcon, whimbrel and Arctic tern
- in the boreal forest of the pipeline corridor – barren-ground and woodland caribou, moose, grizzly bear, marten, lynx, beaver, amphibians, snow goose, scaup, peregrine falcon, lesser yellow legs, Arctic tern and boreal chickadee

These species were selected because of their importance in the subsistence economy or because they are listed as species of conservation concern or as species of particular ecological relevance.

10.1.2.2 Effects on Wildlife

Community members raised various concerns about wildlife. Depending on the area or season of project activity, wildlife could be exposed to habitat change, noise, movement barriers or changes in human and predator access. The construction and operation of the anchor fields, gathering pipelines and associated facilities, pipeline corridor and the infrastructure sites will affect, to varying degrees, habitat availability, movement patterns and mortality of some wildlife. Vegetation clearing and sensory disturbance during construction will result in a change in habitat availability for wildlife. The amount of preferred habitat available now, and how much will be disturbed, was mapped and measured for each VC. Effects during construction are predicted to be strongest when noise from equipment, aircraft, barge activity and people disturb wildlife and its movements. In the near-shore areas, barge activity during construction could interact with beluga whales and other marine mammals. The main effects along the right-of-way during operations will be improved travel and better access by hunters to previously remote areas and wildlife. Noise from facilities and flares might also affect wildlife during operations. Above-ground pipelines, which could affect wildlife movements, will generally be limited to flow lines.

Generally, with effective implementation of mitigation measures, the most severe potential effects on wildlife are of moderate magnitude, which indicates that changes in habitat availability, movement or mortality will only affect part of the population. This might result in changes to the distribution of wildlife at a local level, but it will not affect productivity or viability at the population level.

Barren-Ground Caribou

Habitat availability for barren-ground caribou could change because of:

- vegetation clearing
- sensory disturbance
- altered human and predator access
- changes in vegetation health

Movements of the Cape Bathurst caribou herd, particularly near Parsons Lake in winter, will likely be affected by construction. The potential effects near Parsons Lake are of moderate magnitude because some of the population might avoid the vicinity of the lake during construction, but the effects will not change the productivity of the herd. These effects might last through construction and operations.

Grizzly Bear

Grizzly bears will likely have less available habitat because of surface disturbance and borrow material removal during construction. Denning areas and seasonal food sources, such as roots, plants and ground squirrel colonies, might be lost, but losses will probably be limited to small areas affecting individual bears. Noise will also be limited primarily to small areas for short periods and is not likely to affect grizzly bear movements at the regional level. Infrastructure, such as roads, barge landings, camps, fuel storage areas, airstrips and pipe and equipment storage and stockpiling areas, could be physical barriers, but grizzly bear movements should not be affected because infrastructure is limited to a relatively small part of a bear's home range. Better access to bear habitat could increase hunting pressure and human and bear interactions, including attraction of bears to facilities and infrastructure sites. The largest potential effect is of moderate magnitude and medium-term or long-term duration.

Woodland Caribou

Woodland caribou habitat is relatively abundant, and there is no evidence that food and cover are in short supply, although habitat along the pipeline right-of-way will change and caribou might be displaced. Woodland caribou might also be displaced from habitat by noise, although they might return once people stop using the areas, indicating that woodland caribou might be disturbed more when the project is under construction than during operations. Clearing black spruce forests and disturbing peatland would affect woodland caribou on a small scale, and roadsides might attract caribou and increase vehicle-caused deaths. Hunters and predators could affect woodland caribou through increased access before natural vegetation regrows. Therefore, new access roads might increase hunting and predation pressures. The largest potential effect is of moderate magnitude and long-term duration.

Moose

Moose use habitat along the edges of waterways. Although clearing vegetation in forested areas will produce more browse for moose, clearing areas along rivers and streams will affect moose habitat availability and might affect how moose move along these corridors and use them for overwintering. Moose might be displaced from habitat by construction noise, but once people leave disturbed sites, moose will often return to use them. Effects on moose habitat during operations should be less than during construction because fewer people will be working along the right-of-way and because the shrub communities cleared during construction will regrow and provide forage for moose. Access roads and rights-of-way could increase hunting pressure, particularly in remote riparian areas used by moose in winter. The largest potential effect is of moderate magnitude and long-term duration.

Marten

Clearing vegetation to build the pipeline will affect marten with home ranges close to the proposed pipeline route. Marten might temporarily leave areas near construction worksites. However, once people stop or limit their use of an area, marten will readily use suitable habitat that is next to rights-of-way. Edge habitat beside rights-of-way might support abundant small mammals, providing important prey for marten. Better access to marten habitat could lead to increased trapping of marten and predation by other animals. The largest potential effect is of low magnitude and long-term duration.

Lynx

The pipeline corridor is good lynx and hare habitat, and removing forest could change lynx habitat. However, although habitat might be lost along a right-of-way, lynx will return to areas next to the right-of-way once human activity is reduced. The right-of-way will be a corridor for trappers, predators and animals that compete with lynx for space and food. The largest potential effect is of low magnitude and long-term duration.

Beaver

Beaver could be affected by the clearing of deciduous vegetation near lakes, streams and rivers, though regeneration of cleared areas could produce good forage habitat for beavers. Beaver are not usually affected much by human disturbance but could be trapped or preyed upon more if access is improved, especially near Thunder River and Little Chicago in the Gwich'in Settlement Area. The largest potential effect is of moderate magnitude and long-term duration.

Amphibians

Noise can disturb amphibians, but effects would be localized and site specific. Clearing marshy and damp woody areas along the right-of-way might affect habitat availability and could cause some mortality. The largest potential effect is moderate in magnitude and long term in duration.

Greater White-Fronted Goose

Most potential project interactions with greater white-fronted geese will be on the outer Mackenzie Delta near Niglintgak and Taglu. Few greater white-fronted geese use the Parsons Lake area or the gathering pipeline route away from the outer delta. Nesting and feeding areas for relatively few geese will be affected by vegetation clearing at these sites. Aircraft and boat-related disturbance will encompass a larger area and might affect critical areas on the coast of the outer delta where greater white-fronted geese concentrate during brood rearing and moulting. Potential effects on habitat availability following mitigation measures

are low. The project is not expected to affect greater white-fronted goose movement or mortality.

Snow Goose

Potential effects on snow goose habitat availability in the production area include:

- disturbance of nesting, brood-rearing and moulting snow geese at the Kendall Island Bird Sanctuary (KIBS) and nearby areas along the coast of the outer Mackenzie Delta from June to August
- disturbance of fall-staging snow geese on the outer delta in late August and September

Habitat will be directly lost and altered at and near project features, well away from the snow goose nesting colony. Effects of habitat loss and avoidance are likely to have a low to no effect, be local in extent and to occur during all project phases.

If project aircraft avoid disturbing staging and breeding snow geese, the effects of habitat loss and avoidance on habitat availability are likely low or of no effect and local in extent. The project is not expected to affect snow goose movement or mortality.

Tundra Swan

Tundra swan habitat availability will be affected most by sensory disturbance during construction. Disturbance of flightless moulting birds, especially of broods and the large flocks that gather on the coast of the outer delta, are of particular concern. Aircraft and barge and boat traffic will likely cause the most disturbance. Direct habitat loss will likely be small relative to the area used by breeding tundra swans in the production area, so only a few nesting pairs and feeding individuals might be affected.

Effects on tundra swan habitat availability are low in magnitude, local in extent and occur mostly during construction. The project is not expected to affect tundra swan movement or mortality.

Scaup

Potential effects on greater and lesser scaup habitat availability will include:

- disturbance of flocks of flightless, moulting scaup from late June to mid-August
- disturbance of broods in July

Disturbances could cause several thousand scaup to avoid favoured moulting and brood-rearing areas. Aircraft, barge and boat disturbances are expected to be greatest during construction. Direct loss of habitat will be minimal. Vegetation clearing could result in the loss of small areas of nesting habitat for a few scaup. Potential effects will be reduced by mitigation measures focused on aircraft avoiding flocks of flightless, moulting scaup.

Direct habitat loss and alteration are not considered likely to reduce use of the pipeline corridor by scaup. Suitable habitat is plentiful along the pipeline corridor for nesting scaup, although favoured waterbodies for moulting might be fewer, and vegetation clearing could result in the loss of small areas of nesting habitat for a few scaup.

Effects of the project on scaup habitat availability are likely to be low in magnitude, local in extent and occur mostly during construction and decommissioning. The project is not expected to affect scaup movement or mortality.

Peregrine Falcon

Project interactions with peregrine falcon nest sites will be avoided wherever possible. This reduces much of the potential for effects. Some foraging areas might be disturbed, but the disturbance is expected to be periodic and of short duration. For example, some peregrines might be dispersed to other areas by aircraft overflights.

Effects of the project on peregrine falcon habitat availability are likely to be low and local in extent. The project is not expected to affect peregrine falcon movement or mortality.

Whimbrel

Potential effects of the project on whimbrel habitat availability in the production area will include:

- direct loss of nesting and feeding habitat resulting from vegetation clearing
- disturbance of nesting and feeding areas by aircraft and human activities

These effects are likely to reduce habitat availability for only a few whimbrel near the project facilities. Habitat loss will not reduce whimbrel populations because suitable whimbrel habitat is widespread in the outer delta and at Parsons Lake. Aircraft and human disturbance will be greatest during construction.

Potential effects of the project on whimbrel habitat availability will be low in magnitude and local in extent. The project is not expected to affect whimbrel movement or mortality.

Lesser Yellowlegs

Lesser yellowlegs nesting and feeding habitat could be lost from vegetation clearing, and the disturbance of nesting and feeding areas by aircraft and human activities could affect habitat availability. These effects are likely to reduce habitat availability for only a few birds near the project features. The loss of available habitat will not reduce lesser yellowlegs populations because suitable habitat for lesser yellowlegs is widespread along the pipeline corridor. Aircraft and human disturbance are expected to be greatest during construction.

Potential effects on lesser yellowlegs habitat availability will be low in magnitude and local in extent. The project is not expected to affect lesser yellowlegs movement or mortality.

Arctic Tern

Potential effects on Arctic tern habitat availability include:

- destruction and disturbance of nesting colonies from June to August
- disturbance of favoured feeding areas from June to August

Arctic terns nest and forage throughout much of the production area. They are less abundant along the pipeline corridor. The proximity of nesting colonies and productive feeding areas to project features is not known. Loss or disturbance of feeding habitat near the anchor fields might affect some Arctic tern. If Arctic tern colonies are near the production facilities or surrounding disturbance, there is a potential for adverse effects on the local population. Vegetation clearing and disturbance could disrupt nesting or cause Arctic tern to abandon nesting colonies. Residual effects will be reduced by mitigation measures focused on avoiding Arctic tern nesting colonies.

Potential effects of habitat loss and avoidance will be low in magnitude and local in extent, as are effects on movement and mortality.

Boreal Chickadee

Boreal chickadee habitat availability could be affected by:

- direct loss of nesting and feeding habitat resulting from clearing of mature forest

- avoidance of otherwise suitable areas because human activities and pipeline facility noise have disturbed nesting and feeding areas

These effects are likely to reduce habitat availability for only a few birds along the pipeline corridor, and the loss of habitat availability will not reduce boreal chickadee populations because suitable habitat is widespread in the Mackenzie

Valley. The potential effects on boreal chickadee habitat availability are low in magnitude and local in extent, but it will be decades before suitable habitat regenerates in cleared areas. The project is not expected to affect boreal chickadee movement or mortality.

Marine Mammals

The final design, depth of the water and draft of the gas conditioning facility barge for the Niglintgak barge-based option will determine whether dredging is required to allow the barge to pass unhindered to Kumak Channel. Details of the potential dredging program have yet to be developed. If it is required, dredging will be done in Kugmallit and Kittigazuit bays and at select locations in the delta channels. Barge activity during construction could interact with beluga whales and other marine mammals in near-shore areas. Marine mammal habitat availability, for the barge-based option, could be affected directly by physical disturbance and indirectly by altering the way marine mammals use their habitat. The duration of direct habitat disturbance or alteration by shallow dredging in Kugmallit Bay and Kittigazuit Bay will be temporary and likely less than one or two years, with effects that will probably be masked by larger-scale natural processes. The extent of temporary direct habitat disturbance in the Kugmallit Bay area will be less than 1% of the available equivalent habitat in the Kugmallit Bay beluga whale concentration area. Potential dredging to level the channel bottom at Niglintgak where the barge will be grounded will have no direct effect on marine mammals or their habitat because this part of Kumak Channel is seldom, if ever, used by marine mammals.

Based on several studies, on anecdotal observation of marine mammal behaviour, and on consideration of the duration, location and nature of the proposed disturbance relative to marine mammal habitats, potential indirect marine mammal habitat loss will be short term and will affect relatively few animals.

Potential dredging, barge transport and facility operations at Niglintgak will have minor adverse effects on marine mammal movements. The few vessels travelling in the Beaufort Sea and Kugmallit Bay area will cause only brief and minor disturbance to seals and whales and will not interfere with essential seasonal movements. The affected area does not cross any confined marine mammal travel routes, and the affected area in the southernmost part of the Kugmallit Bay concentration area is generally used much less by beluga whales during the period when the work is proposed. The proposed facility is remote from any marine mammal movement corridors. It is unlikely that vessels will collide with marine mammals, so the probability of mortality is low.

Temporary increases in chemicals associated with sediments suspended by dredging are expected to be at low to moderate levels. Exposure potential and biological uptake are not likely to affect marine mammals.

10.1.3 Traditional Knowledge

Volume 1, Section 3, Traditional Knowledge (TK), outlines the status of the TK studies that communities near the project are undertaking. Because these studies are in progress, existing published TK information was used in this EIS. This information has been applied in all phases of the wildlife impact assessment process, including:

- baseline description of species and habitats and use of survey methods
- selection of VCs
- development of habitat models
- effect magnitude definitions that reflect harvest practices and level of subsistence use
- effect assessment, which incorporates observations by local people and their concerns about industry developments
- mitigation measures, which reflect community concerns, their visions of resource use, and their observations on past industry developments
- monitoring framework, which awaits community input

The TK reports applied in this assessment are listed by region in Section 10.7, Regional Summaries.

10.2 Assessment Approach

10.2.1 Key Issues

Key issues in this assessment were identified through:

- input from communities, including regional workshops and community-level meetings
- meetings with management agencies and resource managers
- review of previous effects assessments in the Northwest Territories and of regulators' decision documents
- review of published information
- professional experience

Because of these efforts, the following overarching wildlife issues were identified:

- potential change in the distribution and relative abundance of wildlife because of the proposed project
- change in habitat because of project construction
- noise disturbance of wildlife during construction and, to a lesser extent, during operations, resulting in wildlife being potentially displaced from their habitat
- blockage of local or seasonal wildlife movements during construction and operations
- habitat fragmentation
- disturbance of residences. A residence is defined in the Species at Risk Act, as a dwelling place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating.
- increased wildlife mortality because of:
    - increased hunting and trapping resulting from access to previously remote areas

- conflicts with humans, particularly resulting from attraction of wildlife to facility and infrastructure sites

- deterioration in health because of project emissions

See Volume 1, Section 4, Public Participation, for a list of the wildlife issues raised in the community consultation sessions.

10.2.2 Valued Components

10.2.2.1 Selection Process

Wildlife VCs were selected for assessment from a list of candidate species that either had a regulatory status designation, economic or public profile value to northern communities, a particular ecological importance, or a combination of these. Information sources used in the selection process are referenced in Volume 3, Section 10, Wildlife, with particular attention to TK information referenced in Section 10.7, Regional Summaries (also see Section 10.2.1, Key Issues).

Species with a regulatory status designation are those that either the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or the Government of the Northwest Territories (GNWT) has ranked as sensitive to disturbance. They also include species listed under the Species at Risk Act (SARA) and, for species in Alberta, species listed by Alberta Environment (AENV) (see Table 10-1 for bird species at risk and Table 10-2 for other wildlife species at risk).

Species of socio-economic importance include those identified as important subsistence species by community members during the community engagement sessions (Volume 1, Section 4, Public Participation). Such VCs could indicate potential project effects on resource use, including effects on hunting, trapping and the outfitting industry.

The following were considered species of particular ecological importance:

- umbrella species, whose distribution and habitat requirements are well understood and representative of the requirements of other species (Kerr 1997; Lambeck 1997)

- keystone species, whose loss from an ecosystem would change other species populations or ecosystem processes, and which have a disproportionately large effect on other species in a community

- species that play a critical role in food webs

Table 10-1: Status of Bird Species at Risk in Canada in the Project Area

Common Name	Status			
	RWED	AENV	COSEWIC	SARA
Pied-billed grebe	Sensitive	Sensitive	–	–
Horned grebe	Secure	Sensitive	–	–
American bittern	Sensitive	Sensitive	–	–
Trumpeter swan	Sensitive	At Risk	Not at Risk	–
Northern pintail	Sensitive	Secure	–	–
Long-tailed duck	Sensitive	–	–	–
Lesser scaup	Sensitive	Secure	–	–
Common eider	Sensitive	Accidental/vagrant	–	–
King eider	Sensitive	Accidental/vagrant	–	–
Surf scoter	Sensitive	Secure	–	–
Black scoter	Sensitive	Accidental/vagrant	–	–
White-winged scoter	Sensitive	Sensitive	–	–
Osprey	Secure	Sensitive	–	–
Bald eagle	Secure	Sensitive	Not at Risk	–
Northern goshawk	Secure	Sensitive	Not at Risk	–
Swainson's hawk	Undetermined	Sensitive	–	–
Broad-winged hawk	–	Sensitive	–	–
Golden eagle	Sensitive	Sensitive	Not at Risk	–
Peregrine falcon (anatum)	At Risk	At Risk	Threatened	Schedule 1 – Threatened
Peregrine falcon (tundra)	May Be At Risk	–	Special Concern	Schedule 3 – Special Concern
Rock ptarmigan	Sensitive	–	–	–
Sharp-tailed grouse	Secure	Sensitive	–	–
American coot	Sensitive	Secure	Not at Risk	–
Sandhill crane	Secure	Sensitive	–	–
Black-bellied plover	Sensitive	Secure	–	–
American golden-plover	Sensitive	Secure	–	–
Semipalmated plover	Sensitive	Secure	–	–
Lesser yellowlegs	Sensitive	Secure	–	–
Upland sandpiper	Undetermined	Sensitive	–	–
Whimbrel	Sensitive	Secure	–	–
Eskimo curlew	At Risk	Extirpated/Extinct	Endangered	Schedule 1 – Endangered
Sanderling	Sensitive	Secure	–	–
Semipalmated sandpiper	Sensitive	Secure	–	–
Least sandpiper	Sensitive	Secure	–	–
Buff-breasted sandpiper	Sensitive	Secure	–	–
Short-billed dowitcher	Not assessed	Sensitive	–	–

Table 10-1: Status of Bird Species at Risk in Canada in the Project Area (cont'd)

Common Name	Status			
	RWED	AENV	COSEWIC	SARA
Long-billed dowitcher	Sensitive	Secure	–	–
Common snipe	Sensitive	Secure	–	–
Red-necked phalarope	Sensitive	Secure	–	–
Red phalarope	Sensitive	Accidental/vagrant	–	–
Caspian tern	Sensitive	Sensitive	Not at Risk	–
Black tern	Sensitive	Sensitive	Not at Risk	–
Great gray owl	Secure	Sensitive	Not at Risk	–
Short-eared owl	Sensitive	May Be At Risk	Special Concern	Schedule 3 – Special Concern
Black-backed woodpecker	Secure	Sensitive	–	–
Pileated woodpecker	Secure	Sensitive	–	–
Olive-sided flycatcher	Sensitive	Secure	–	–
Bank swallow	Sensitive	Secure	–	–
Barn swallow	Sensitive	Secure	–	–
Boreal chickadee	Sensitive	Secure	–	–
Gray-headed chickadee	May Be At Risk	–	–	–
American pipit	Sensitive	Secure	–	–
Cape May warbler	Undetermined	Sensitive	–	–
Black-throated green warbler	–	Sensitive	–	–
Bay-breasted warbler	Undetermined	Sensitive	–	–
Blackpoll warbler	Sensitive	Secure	–	–
Canada warbler	Undetermined	Sensitive	–	–
Western tanager	Secure	Sensitive	–	–
American tree sparrow	Sensitive	Secure	–	–
White-throated sparrow	Sensitive	Secure	–	–
Harris' sparrow	Sensitive	Secure	–	–
Rusty blackbird	Sensitive	Secure	–	–

NOTE:
– = not listed
RWED = Resources, Wildlife and Economic Development
AENV = Alberta Environment
COSEWIC = Committee on the Status of Endangered Wildlife in Canada
SARA = Species At Risk Act

SOURCES:
Alberta Environment (2000); COSEWIC (2004); Environment Canada (2004a); Environment Canada (2004b); GNWT (2004)

Table 10-2: Status of Wildlife Species at Risk in Canada in the Project Area

Common Name	Status			
	RWED	AENV	COSEWIC	SARA
Terrestrial Mammals				
Canada lynx	Secure	Sensitive	Not at Risk	–
Collared pika	Sensitive	–	–	–
Fisher	May Be At Risk	Sensitive	–	–
Grizzly bear (northwestern population)	Sensitive	May Be At Risk	Special Concern	Schedule 3 – Special Concern*
Little brown bat	Sensitive	Secure	–	–
Northern flying squirrel	Sensitive	Secure	–	–
Northern long-eared bat	Undetermined	May Be At Risk	–	–
River otter	Sensitive	Secure	–	–
Wolverine	Secure	May Be At Risk	Special Concern	Schedule 3 – Special Concern*
Wood bison	At Risk	At Risk	Threatened	Schedule 1 – Threatened
Woodland caribou (boreal population)	Sensitive	At Risk	Threatened	Schedule 1 – Threatened
Marine Mammals				
Bowhead whale (Western Arctic population)	Sensitive	–	Endangered	Schedule 2 – Endangered
Polar bear	Sensitive	–	Special Concern	Schedule 3 – Special Concern*
Amphibians				
Canadian toad	May Be At Risk	May Be At Risk	Not at Risk	–
Boreal chorus frog	Sensitive	Secure	–	–
Reptiles				
Red-sided garter snake	May Be At Risk	Sensitive	–	–

NOTES:

* Status is to be reassigned, i.e., potentially added to Schedule 1, pending results of public consultation, that ends June 14, 2004, stakeholder consultation and final Ministerial approval (Environment Canada 2004a)

– = not listed

RWED = Resources, Wildlife and Economic Development
AENV = Alberta Environment
COSEWIC = Committee on the Status of Endangered Wildlife in Canada
SARA = Species At Risk Act

SOURCES:

Alberta Environment (2000); COSEWIC (2004); Environment Canada (2004a); Environment Canada (2004b); GNWT (2004).

Umbrella species, keystone species and species with a critical role in food webs are usually of special management concern, meaning management might plan to conserve, monitor or harvest these species.

The suite of selected VCs represents a diversity of species, habitats and ecosystems in accordance with recent recommendations on using a suite of indicators as a conservation tool (Carignan and Villard 2002; Roberge and Angelstam 2004). Endemic and unique species were considered under the selection process.

The final list of wildlife VCs selected for the project includes large mammals and some furbearers, waterfowl, birds of prey and other birds of ecological relevance. Marine mammal species were included as VCs for the assessment of the barge-based gas conditioning facility option at Niglintgak.

The project transects three general biophysical areas, or regions. Because of the unique characteristics of each region, project impacts were assessed separately for each region. Different sets of wildlife species that are representative and important to each area were also assessed. The three areas are:

- marine – the Niglintgak barge-based gas conditioning facility option potentially interacts with marine mammals and migratory birds (see Table 10-3)

- tundra – the production area, anchor fields, the gathering pipelines and associated facilities, and infrastructure sites in the Inuvialuit Settlement Region are situated primarily in tundra (see Table 10-4)

- boreal forest – the main part of the pipeline corridor and its associated infrastructure are situated in the boreal forest (see Table 10-5)

Table 10-3: Marine Mammal Valued Components

Valued Component		Regulatory Status	Ecological Importance	Socio-Economic Importance[1]	Conservation Concern
Latin Name	**Common Name**				
Delphinapterus leucus	Beluga whale	–	●	●	●
Balaena mysticetus	Bowhead whale	●	●	●	●
Ursus maritimus	Polar bear	●	●	●	●
Phoca hispida	Ringed seal	–	●	●	●

NOTES:
1 The socio-economic factors in selecting VCs included subsistence harvest and guiding and outfitting interests
● indicates item was a factor in selecting VC
– indicates item was not a factor in selecting VC

Table 10-4: Wildlife Valued Components – Production Area

Valued Component		Regulatory Status	Ecological Importance	Socio-Economic Importance[1]	Conservation Concern
Latin Name	Common Name				
Rangifer tarandus groenlandicus	Barren-ground caribou	–	●	●	●
Ursus arctos	Grizzly bear	●	●	●	●
Anser albifrons	Greater white-fronted goose	–	●	●	●
Chen caerulescens	Snow goose	–	●	●	●
Cygnus columbianus	Tundra swan	–	●	–	●
Aythya marila and Aythya affinis	Scaup (greater and lesser)	●	●	●	●
Falco peregrinus	Peregrine falcon	●	●	–	●
Numenius phaeopus	Whimbrel	●	●	–	●
Sterna paradisaea	Arctic tern	–	●	–	●

NOTES:
1 The socio-economic factors in selecting VCs included subsistence harvest, other hunting and other recreational and guiding and outfitting interests
● indicates item was a factor in selecting VC
– indicates item was not a factor in selecting VC

Table 10-5: Wildlife Valued Components – Pipeline Corridor

Valued Component		Regulatory Status	Ecological Importance	Socio-Economic Importance[1]	Conservation Concern
Latin Name	Common Name				
Rangifer tarandus groenlandicus	Barren-ground caribou	–	●	●	●
Rangifer tarandus caribou	Woodland caribou	●	●	●	●
Alces alces	Moose	–	●	●	●
Ursus arctos	Grizzly bear	●	●	●	●
Martes americana	Marten	–	●	●	–
Lynx canadensis	Lynx	–	●	●	–
Castor canadensis	Beaver	–	●	●	–
N/A	Amphibian community	●	●	–	–
Chen caerulescens	Snow goose	–	●	●	●
Aythya marila and Aythya affinis	Scaup (greater and lesser)	●	●	●	●
Falco peregrinus	Peregrine falcon	●	●	–	●
Tringa flavipes	Lesser yellowlegs	●	●	–	–
Sterna paradisaea	Arctic tern	–	●	–	–
Poecile hudsonicus	Boreal chickadee	●	●	–	–

NOTES:
N/A = not applicable
1 The socio-economic factors in selecting VCs included subsistence harvest, other hunting and other recreational and guiding and outfitting interests
● indicates item was a factor in selecting VC
– indicates item was not a factor in selecting VC

10.2.2.2 Other Species

Several other wildlife species occur in the study area but were not included as VCs either because:

- they have low potential to be affected by the project because of marginal range in the project area, e.g., gray-headed chickadee, muskox and wood bison

- the mitigation measures designed to protect their habitat or populations would be developed under the umbrella of another VC already selected. For example, protection of the wide-ranging barren-ground caribou and grizzly bear would also mitigate potential effects on species such as muskox and wolverine. Key habitat requirements and biology of some birds were similar to other selected species, e.g., brant, long-tailed duck and scoters, or they were a priori considered unlikely to be affected at a biologically meaningful level, e.g., glaucous gull and American tree sparrow

For reference, and for comparison with the final VCs, a regional baseline overview was prepared for several species not selected as VCs, including wolverine, grey wolf and muskox. This information and the detailed overviews for the VCs selected for this assessment are presented in Volume 3, Section 10, Wildlife.

10.2.2.3 Overview of Selected Valued Components

10.2.2.4 Niglintgak Barge-Based Gas Conditioning Facility

The assessment of effects of the barge-based gas conditioning facility focused on marine mammals because effects on terrestrial wildlife will be less than predicted for the land-based gas conditioning facility option.

Beluga Whale

The beluga whale is important to the subsistence economy in the Inuvialuit Settlement Region. The species is hunted primarily by whalers from Inuvik, Tuktoyaktuk, Aklavik and Paulatuk, and the products from the hunt are shared among all Inuvialuit communities. In addition to the value of beluga whale as food, the annual harvest is an important Inuvialuit cultural tradition. The number of beluga whales taken annually by the Inuvialuit averaged 120 from 1987 to 1998 (Joint Secretariat 2003). Beluga whales are also important to neighbouring Inupiat communities in Alaska where the average annual take is about 68 (Angliss and Lodge 2003). Ecologically, the beluga whale is at the top of the marine food chain, is abundant and preys on a diverse array of fish and invertebrates. The proposed potential dredging and barge transport will take place in areas seasonally frequented by beluga whales and beluga whale hunters.

Bowhead Whale

The bowhead whale is classified as endangered in Canada (COSEWIC 2004, Government of Canada 2002) and sensitive in the Northwest Territories (see Table 10-2, shown previously). The population of the western Arctic bowhead whale stock, estimated at about 8,200, represents more than 90% of the world's population (Community of Tuktoyaktuk et al. 2000). Commercial hunting of bowhead whales from the late 1800s to the early 1900s greatly reduced the population. Bowhead whales are now being managed for recovery. There is a substantial subsistence harvest by Alaskan Inupiat and a small but culturally important harvest by the Inuvialuit in Aklavik in some years (Freeman et al. 1992). Inupiat harvest about 60 bowhead whales annually by permit for subsistence. Inuvialuit from Aklavik harvested one in 1991 and another in 1996 (Community of Aklavik et al. 2000). The species also has value for tourism, particularly when it frequents near-shore waters near Herschel Island and along the Yukon coast. The proposed barge-based gas conditioning facility involves barge transport in waters sometimes used by bowhead whales.

Polar Bear

The polar bear is listed as a species of special concern in Canada (COSEWIC 2004) and as sensitive in the Northwest Territories (GNWT 2004) (see Table 10-2, shown previously). The Southern Beaufort Sea Polar Bear Agreement between the Inuvialuit and Inupiat recognizes the importance of the polar bear in the Beaufort Sea region. The species is highly valued for Inuvialuit guided hunts and for traditional subsistence use. Polar bears are not likely to be encountered during barge transport and potential dredging. Whereas most polar bears winter on the sea ice, a few, mostly females and their young, will use coastal areas for denning. Pregnant females and females accompanied by young can be sensitive to disturbance.

Ringed Seals

The ringed seal is one of the more abundant marine mammal species in the project area. The species is an important component of the arctic marine ecosystem and is the primary prey of polar bears. Ringed seals are also an important subsistence resource for the Inuvialuit. A few ringed seals are expected along the barge transportation route because of their dispersed pattern of occurrence in summer.

10.2.2.5 Land-Based Facilities

Barren-Ground Caribou

The barren-ground caribou was selected as a VC primarily because of its socio-economic importance in the Northwest Territories and its potential vulnerability to human activity and land use changes.

Based on its distribution and on consultations with communities and resource managers (Nagy 2003, personal communication), the barren-ground caribou is a species of key concern in the Inuvialuit Settlement Region. Existing pressures on the barren-ground caribou population include:

- industrial development
- subsistence hunting
- predation
- potential competition with reindeer (Community of Aklavik et al. 2000)

Woodland Caribou

Woodland caribou are strongly associated with old-growth forests and are sensitive to natural or human-induced changes in this habitat type. The woodland caribou was selected as a VC because of concern over its status in the Northwest Territories and in Alberta and because of its socio-economic and ecological importance.

Based on its known distribution and on consultations with communities and resource managers, the woodland caribou is a species of concern throughout the region crossed by the proposed pipeline. It is considered the main wildlife management concern in the Gwich'in Settlement Area and Sahtu Settlement Area (Nagy 2003, personal communication; Popko 2003, personal communication), and in Alberta it is a species of primary land use management concern (Dzus 2001).

Existing pressures on the regional woodland caribou population include:

- habitat loss and alteration because of fire and industrial development
- increased access and potential overhunting
- disease and predation (Telfer and Kelsall 1984)

Moose

Moose is the largest browse-dependent herbivore in the region, relying on edge and riparian and shrubby vegetation communities. Moose was selected as a VC for the pipeline component of the project primarily because of its subsistence and recreational value to the people of the region.

Consultations with communities and resource managers indicated that the moose is a species of concern throughout the region crossed by the proposed pipeline (Nagy 2003, personal communication; Popko 2003, personal communication). Moose have been a major focus of wildlife management in the region, including the planning for previously proposed resource developments. Because of this focus, population levels, seasonal distribution and habitat use are relatively well understood for most of the regions, except the Gwich'in Settlement Area where

there is limited understanding about how habitat and snow depth influence moose population dynamics (Marshal and Nagy 1999).

Existing pressures on moose in the region include:

- recreational and traditional hunting, primarily near communities
- predation
- disturbance and displacement by oil and gas exploration
- natural fluctuations in habitat availability resulting from forest fires (Popko 2003, personal communication)

Grizzly Bear

Grizzly bear in the Northwest Territories occur primarily in open alpine or tundra habitats, but can also be found in forested areas (GNWT 2004). The grizzly bear was selected as a VC because of concerns about its status in the Northwest Territories and because of its vulnerability to the effects of human activity and northern development. Grizzly bear are also an umbrella for other carnivore species, such as wolverine, wolf and Arctic fox that might be attracted to industrial project sites.

Grizzly bear are difficult to study, and information on distribution and abundance varies in reliability. Existing pressures on the regional population include:

- recreational, subsistence and guided hunting
- disturbance and displacement by land use activities, including increased access

Marten

The marten is an economically important furbearer associated with old-growth forest, but it can also be found in other habitats that have abundant red-backed voles, its main prey species. The marten was selected as a VC because of its importance as a fur species.

Information on marten population trends and abundance is limited (Poole 1990). Existing pressures on the regional population include:

- localized trapping particularly during cyclical lows and in response to increased pelt values
- loss of habitat to development

Lynx

The lynx was selected as a VC because of its economic and ecological importance. It also represents other species that might be affected by industrial development.

Lynx are difficult to study, in part because they are cyclic. There is an identified need for more information on the factors that affect its distribution and relative abundance (Community of Aklavik et al. 2000). Existing pressures on the regional lynx population include:

- trapping
- habitat change from a variety of factors, including forest fire

Beaver

Beaver are capable of influencing water levels, and they depend on the availability of suitable wetlands with adjacent woody vegetation. The beaver was selected as a VC because of its socio-economic importance and its role as a keystone species in the region's ecology.

Threats to beaver populations in the proposed development area include:

- forestry
- forest fire
- water pollution
- water level fluctuations
- trapping
- disease (GNWT 2004)

Amphibian Community

Amphibians were selected as a VC primarily because of their sensitivity to change of wetlands and because some species are considered to be at risk.

Threats to amphibian populations include:

- logging
- fire
- disturbance or loss of aquatic and riparian habitat
- drought
- fluctuating winter temperatures
- freezing rain
- low snow cover
- disease
- wetland drainage

Greater White-Fronted Goose

The greater white-fronted goose was selected because of its socio-economic and ecological importance and because it is a major species in the KIBS. It is not a listed species of conservation concern. The greater white-fronted goose is hunted in spring. Almost 20% of the spring harvest of geese and swans in the Inuvialuit Settlement Region from 1987 to 1990 were white-fronted geese (Bromley 1996). The KIBS was established partly because it supports important populations of waterbirds, including white-fronted geese. In contrast to the colonially nesting snow goose (see following section), greater white-fronted geese are widely distributed when nesting and thus are more likely to interact with the project than snow geese. During the sensitive brood-rearing and moulting periods, these geese congregate along the coast of the outer delta. Disturbance of those congregations could potentially affect local populations. Greater white-fronted geese also serve as an umbrella species, representing other geese and waterfowl that occur on the outer delta, e.g., Canada goose and brant.

Snow Goose

A nesting colony of several thousand snow geese resides on islands near the KIBS on the coast of the outer Mackenzie Delta. This is one of few nesting colonies in the western Canadian Arctic and is the primary reason this species was selected as a VC. Other reasons include its socio-economic value for subsistence hunting, ecological sensitivities, including being flightless during moult and occurring in large congregations, and its status as an umbrella species representing spring congregations of other waterfowl. Snow goose populations are considered secure in the Northwest Territories (GNWT 2004), and the continental population has increased dramatically in recent years (Mowbray et al. 2000).

The snow goose and greater white-fronted goose overlap to some extent as VCs. The snow goose is included because it nests colonially, whereas the white-fronted goose has a scattered nesting distribution. Therefore, the local snow goose nesting population is more susceptible to effects if the colony is disturbed. The snow goose is even more important than white-fronted geese in the spring subsistence hunt (Bromley 1996). Virtually the entire western Arctic snow goose population might migrate through the Mackenzie Valley (Alexander et al. 1991). The snow goose is an umbrella species, so it covers potential effects on other waterfowl that stage in spring in large numbers at the same sites along the Mackenzie River.

Tundra Swan

The tundra swan is also a key waterfowl species, especially in the production area. It was selected as a VC for several reasons. It is an abundant nesting species, and the Mackenzie Delta is probably the most important breeding area in Canada for tundra swans (Canadian Wildlife Service 2000). The population that nests on the Mackenzie Delta is part of the eastern population that winters along the

Atlantic coast, mostly from New Jersey to South Carolina. Tundra swans are also part of the subsistence hunt and are sensitive during brood rearing and moult when they congregate and are flightless.

Nesting tundra swans are common and widespread. Tundra swans thus serve to address potential effects on large waterfowl species regarding development in the anchor fields and along the gathering pipelines.

Almost all of the tundra swans nesting in the Beaufort Sea region migrate through the Mackenzie Valley (Richardson and Johnson 1981; Johnson and Herter 1989). They stage in large numbers along with snow geese on river islands in the middle Mackenzie River (Alexander et al. 1991). Effects on spring congregations of tundra swans are addressed via snow geese.

Scaup

Two scaup species were included in the assessment: greater scaup and lesser scaup. These species were selected because:

- the North American populations of both scaup species are in decline (Allen et al. 1999), and populations of lesser scaup in the Northwest Territories are designated sensitive (GNWT 2004)
- scaup make up a large proportion of the duck population in the production area and along the pipeline corridor, so could be considered key species
- scaup, like other waterfowl, are sensitive during brood rearing and moulting, when they often congregate and are flightless
- they represent other duck species of concern, such as scoters and long-tailed duck

Greater scaup are a VC in the production area and lesser scaup are a VC along the pipeline corridor.

Peregrine Falcon

The peregrine falcon was selected because it is designated at a high level of conservation concern by COSEWIC (2004), i.e., the *tundrius* subspecies is of special concern and the *anatum* subspecies is threatened, and because it represents other cliff-nesting raptors, such as the golden eagle. The *anatum* subspecies is listed at risk, and the *tundrius* subspecies may be at risk in the Northwest Territories (GNWT 2004). Peregrine falcons are sensitive to disturbance during nesting when they are restricted to a few specialized nest sites. They are also high-level predators at the top of the food chain.

Whimbrel

Shorebirds are a key avian group in northern regions, both in species richness and in populations. This is especially true in tundra regions. Whimbrel are tundra-nesting shorebirds. The species was selected as a VC to represent tundra-nesting shorebird species of concern, such as the Hudsonian godwit and the American golden-plover, and because shorebirds are a dominant feature of the tundra avian community. Several species of shorebirds occur in the KIBS, which is an area of concern to the Canadian Wildlife Service. Populations of whimbrel are considered sensitive in the Northwest Territories (GNWT 2004).

Lesser Yellowlegs

The lesser yellowlegs was included as a VC as a representative boreal-nesting shorebird. It is one of a group of boreal-nesting shorebirds of concern to the Canadian Wildlife Service and is designated sensitive in the Northwest Territories (GNWT 2004). The lesser yellowlegs is a VC in the pipeline corridor. It does not occur regularly in tundra regions.

Arctic Tern

The Arctic tern was selected as a VC because it nests colonially. Local populations can be affected if nesting colonies are disturbed. The Arctic tern is also an umbrella species for other colonially nesting waterbirds, such as the glaucous gull. Arctic terns forage in aquatic habitats, where they are high-level predators, so they are sensitive to effects on aquatic systems. The Arctic tern is a VC in both the production area and the pipeline corridor, although they are most abundant in the production area.

Boreal Chickadee

Populations of several passerine species, such as blackpoll warbler, American tree sparrow and rusty blackbird, are designated of conservation concern in the Northwest Territories (GNWT 2004). The boreal chickadee was selected as a VC to represent the passerines. Boreal chickadee populations are designated sensitive in the Northwest Territories (GNWT 2004). The boreal chickadee was also selected because it resides all year throughout the treed parts of the Mackenzie Valley.

10.2.3 Key Questions and Effect Pathway Diagrams

To focus the assessment effort, key questions were identified that reflect the issues raised for wildlife. The wildlife issues identified earlier can be addressed using three key questions:

1. How will the project affect wildlife habitat availability?
2. How will the project affect wildlife movements?
3. How will the project affect wildlife mortality?

Table 10-6 shows the relationship between key questions, issues and VCs. An effect pathway diagram was developed to show the various paths by which project activities could affect VCs. These effect pathway diagrams are provided at the beginning of each key question section (see Section 10.3, Effects on Wildlife Habitat Availability, Section 10.4, Effects on Wildlife Movements, and Section 10.5, Effects on Wildlife Mortality).

Table 10-6: Key Questions, Key Issues and Potentially Affected Valued Components

Key Question	Related Key Issue	Potentially Affected VCs
How will the project affect wildlife habitat availability?	• change in habitat because of project construction • noise disturbance of wildlife during construction and, to a lesser degree, during operations, resulting in wildlife being displaced from their habitat • disturbance of residences sensu, the definition in the Species at Risk Act, which defines a residence as a dwelling place, such as a den or nest	All VCs listed in Tables 10-1, 10-2 and 10-3, shown previously
How will the project affect wildlife movement?	• potential change in the distribution of wildlife because of the proposed project • blockage of local or seasonal movements of wildlife • fragmentation of habitat	Terrestrial and marine mammals
How will the project affect wildlife mortality?	• increased hunting and trapping because of access to previously remote areas • conflicts with humans • deterioration of health because of air emissions	Particularly hunted species including caribou, moose and waterfowl. Furbearers could be affected if trapping increases. Carnivores could be affected through conflicts with humans

10.2.4 Effect Descriptions

The potential effects of the project on wildlife VCs are described with four attributes: direction, magnitude, geographic extent and duration (see Table 10-7). The combination of these effect attributes is used to determine if a potential effect is significant.

10.2.4.1 Direction

Direction describes the ultimate long-term trend of the effect. For wildlife VCs, an effect can be adverse, neutral or positive. The direction of the wildlife effect is considered from an ecological perspective, not from the perspective of humans. For example, an increase in the beaver population is rated positive although humans might perceive it as detrimental because a larger beaver population can increase the chances of flooding along roadways.

Table 10-7: Definitions of Effect Attributes

Attribute	Definition
Direction	
Adverse	Impact[1] will cause an adverse change in a measurable parameter [2] relative to baseline conditions or trends
Neutral	Impact will cause no change in a measurable parameter relative to baseline conditions or trends
Positive	Impact will cause a positive change in a measurable parameter relative to baseline conditions or trends
Magnitude	
No effect	No change in the VC
Low	An individual or group within a population[3] found in a localized area, such as in the LSAs or RSAs, might be affected
Moderate	A part of a regional population within the LSAs or RSAs might be affected, changing the abundance or distribution of the VC and affecting opportunities for hunting, trapping or viewing wildlife as currently practiced
High	An entire population within the LSAs or RSAs might be affected, changing abundance or distribution to such an extent that the population would not likely return to its previous level resulting in reduced population viability and unsustainable harvest compared with current practice
Geographic Extent	
Local	Terrestrial: The effect on the VC is measurable within the LSA Marine: The effect will be limited to within about 10 km of the proposed activity
Regional	Terrestrial: The effect on the VC is measurable within the RSA Marine: The effect will extent beyond 10 km of the proposed activity to the Canadian Beaufort Sea region
Beyond regional	Terrestrial: The effect on the VC is measurable beyond the RSA
Duration	
Short term	Effect is limited to less than one year
Medium term	Effect lasts for more than one year, but less than four years, e.g., many effects that occur throughout construction
Long term	Effect lasts longer than four years, but VC will recover not more than 30 years after project decommissioning
Far future	Effect extends more than 30 years after decommissioning, e.g., loss of habitat that cannot be restored

NOTES:
LSA = local study area
RSA = regional study area
1 Impacts include vegetation clearing, sensory disturbance, air emissions, physical barriers, attraction to facilities and rights-of-way and altered human and predator access
2 Parameters measured in the effects assessment include habitat availability, wildlife movements and wildlife mortality
3 Population is defined as a group of individuals of the same species occupying a particular geographic area. A population can be separated from other populations of the same species by unfavourable habitat or by behaviour. Individuals within populations interact with each other more often than individuals between populations

10.2.4.2 Magnitude

Magnitude describes the severity or intensity of an effect.

10.2.4.3 Geographic Extent

Geographic extent describes the physical area within which an effect occurs. It can be local, regional or beyond regional.

10.2.4.4 Duration

Duration refers to the time a VC will need to recover from an impact. Recovery is defined as a return to the conditions existing before the project.

10.2.5 Study Areas and Boundaries

The following study areas have been designed for wildlife VCs:

- one local study area (LSA)
- three regional study areas (RSAs)

Effects in these areas are assessed for each of the project components, with specific reference to the four ecological zones described in Section 9, Vegetation. The ecological zones are (see Figure 10-1):

- Tundra Ecological Zone – includes Niglintgak, Taglu and Parsons Lake
- Transition Forest Ecological Zone – extends from the Gwich'in Settlement Area and Inuvialuit Settlement Region boundary, which is in tundra, to the pipeline crossing of the Travaillant River north of Woodbridge Lake, which is the northern extent of closed forests
- North Taiga Plains Ecological Zone – extends from the Travaillant River to the pipeline crossing of the Great Bear River near Tulita, which is the northern extent of jack pine forests
- South Taiga Plains Ecological Zone – extends from the Great Bear River to the NOVA Gas Transmission Ltd. (NGTL) interconnect facility of the pipeline corridor

10.2.5.1 Local Study Area

The wildlife LSA encompasses the production area and the pipeline corridor. It includes a 1-km-wide buffer area around each of the project footprints.
Figure 10-2 shows the wildlife LSA and RSA in the production area. Note that the scale in the figure for the pipeline corridor is too small to show the LSA.

Figure 10.1 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

Figure 10.2 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

10.2.5.2 Regional Study Area – Beaufort Marine Area

Only an RSA was used in the marine mammal assessment for the barge option. The RSA for marine mammals (see Figure 10-3) is designed to capture the potential regional and cumulative effects of the Niglintgak barge-based gas conditioning facility option on marine mammal VCs. The RSA encompasses:

- the footprint of the barge-based gas conditioning facility option, which includes the potential dredging area, the barge transport corridor, and the Niglintgak field
- the Mackenzie estuary and delta
- about half the Tuktoyaktuk Peninsula
- the normal open water zone for the southern Beaufort Sea out to the 50 m depth contour

The corridor in which the barge is expected to travel is about 20 km wide. The study area specifically includes:

- beluga whale summer concentration areas, i.e., Beluga Management Zone 1A protected areas
- bowhead whale migratory routes
- open-water summering areas for much of the southern Beaufort Sea ringed seal populations
- occasional denning areas for polar bears near Niglintgak

10.2.5.3 Regional Study Area – Production Area

The RSA in the production area includes the footprint of the anchor fields and gathering pipelines and associated facilities and about a 40-km buffer beyond the footprint boundary (see Figure 10-2, shown previously). The 40-km buffer corresponds to the estimated average annual home range of female grizzly bears on Richards Island and the Tuktoyaktuk Peninsula (Nagy and Branigan 1998) and also includes known wintering areas of the Cape Bathurst barren-ground caribou herd (Wright et al. 2002). This RSA was designed to capture potential regional and cumulative effects on wildlife VCs.

Figure 10.3 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

10.2.5.4 Regional Study Area – Pipeline Corridor

The wildlife RSA along the pipeline corridor is a 30-km-wide corridor on either side of the pipeline centreline (see Figure 10-4). It was selected to cover the typical home range of a woodland caribou (Stuart-Smith et al. 1997; Bradshaw et al. 1995), as this is the extent to which regional and cumulative effects on caribou and other mammals might occur. This area also includes the following locations identified during community consultations as areas in which seasonal movement of woodland caribou occurs:

- low-lying areas around Wrigley and Ebbutt Hills
- summer ranges of the McConnell Range and the Horn Plateau

10.2.6 Analytical Approach

10.2.6.1 Field Survey

Four types of terrestrial mammal surveys were conducted from 2002 to 2004:

- winter track surveys
- aerial ungulate surveys
- pellet group surveys
- aerial and, in 2003, ground den surveys

In conducting the four mammal surveys, biologists used systematic techniques and recorded incidental observations of other species to supplement data from systematic surveys. Survey types and intensity varied among mammal groups and differed between areas along the pipeline corridor. Surveys specifically targeting semi-aquatic furbearers were not conducted.

Bird surveys were conducted during the nesting period in mid to late June 2001 and during spring migration from mid-May to early June 2002. Surveys were conducted:

- in the outer Mackenzie Delta, including Niglintgak and Taglu
- in the Parsons Lake area
- along the proposed laterals
- along the proposed pipeline corridor from northern Alberta to Inuvik
- along the Mackenzie River from Fort Simpson to Inuvik
- in several special areas near the proposed pipeline corridor, e.g., Brackett Lake, MacKay Creek and Travaillant Lake

Figure 10.4 has been removed for the purposes of reducing file size and can be viewed as a graphic separately. This document can be accessed through the link in the Table of Contents reference web page.

The survey types employed were aerial surveys, ground-truthing surveys and point count surveys.

See Volume 3, Section 10.2, Methods, for detailed descriptions of survey methods and survey effort.

10.2.6.2 Habitat Modelling

The results of modelling for terrestrial VCs during construction and operations incorporate the loss of habitat from vegetation clearing under project footprints and the zones of influence stemming from sensory disturbances, which is based on visual and noise sources. Project-specific information on noise was obtained from the analyses in Section 3, Noise, and was complemented by information from available studies on wildlife responses to noise disturbance. Consequently, life habitat availability models reflect both direct changes in habitat availability and changes in habitat effectiveness.

All mitigation measures are assumed to have been implemented for both the modelling output values and subsequent project effects assessments.

The main results are presented for *effective* habitat throughout the assessment. Effective habitat comprises the primary habitats that can be used by VCs for food and cover, including those habitats ranked as very high, high and moderate quality based on model results.

All models assume that construction is continuous in duration and that it lasts the entire length of the component feature. For these reasons, the modelled amount of habitat change is an overestimate for any given moment in time. Much of the reduction of habitat is based on potential sensory disturbance. The actual amount of habitat loss from sensory disturbance will depend on location, geographic extent, duration and intensity of activities during the project.

Disturbance modelling can result in shifts in habitat values such that the reduction in one category would result in an increase in other categories. Such cases occurred particularly when a high category was reduced in its value because of sensory disturbance, creating an increase of habitat amount in the lower category.

10.2.6.3 Marine Mammal Assessment Approach

The marine mammal assessment relied on:

- initial consultation and collaboration with community hunters and resource managers
- review of relevant biological and impact assessment literature
- application of professional experience
- consultation with other specialists

The assessment drew on several investigations in the Beaufort Sea region and elsewhere over the past two decades in anticipation of petroleum development. These studies were designed to fill gaps in knowledge about marine mammal population size, distribution, feeding habits and habitat use in the Beaufort Sea region (BEMP 1985, 1987a, 1987b; BREAM 1992). Several investigations about marine mammal behavioural response to industrial activity in the Beaufort Sea region have also been done (Fraker et al. 1978; Koski et al. 1989; Norton and Harwood 1986; Richardson 1985; Richardson et al. 1990, 1995a).

10.2.6.4 Wildlife Assessment Approach

Baseline as Foundation

The foundation of the wildlife assessment is the quantifiable information in Volume 3, Section 10, Wildlife. To the extent possible, baseline information provides confidence limits and other statistical means to evaluate strength of the information. Evaluation of baseline information helps validate habitat models and model outputs. Both baseline information and model outputs are complemented by scientific, peer-reviewed reports, other literature and local knowledge.

Effect Prediction and Interpretation

Effect predictions focus on interpreted effects on populations. For example, the alteration of habitat is interpreted in terms of potential effects on a proportion of a population and, consequently, effects on hunting, trapping and viewing wildlife. Similarly, project impacts are interpreted in terms of effects on movements of individuals of a population and the subsequent effects on distribution. Mortality that could be caused by the project is interpreted in much the same way.

Prediction Confidence

The question of habitat availability has the strongest foundation of quantifiable data. Hence, prediction confidence can be better evaluated than in the questions on movement and mortality. As to movement, some large scale movements and migrations of wildlife VCs are known and effects of the project on them are predicted based on past industry experience in similar environments. However, detailed knowledge on local movements is currently limited, affecting the strength of the predictions. As information on local mortality rates is low, mortality impacts can only be inferred from regional information and past industry experience.

Mitigation and Monitoring

Mitigation measures have been designed to reduce potential effects (see Volume 7, Environmental Management). Effects and compliance monitoring has been designed as a systematic and transparent framework for communities and regulators to consider for resource management. As part of the monitoring framework, baseline data has been collected so that future information related to project effects can be compared with current baselines.

10.3 Effects on Wildlife Habitat Availability

This section considers the potential effects of the project on the availability of wildlife habitat. Habitat availability (HA) is a combination of habitat suitability (HS) and habitat effectiveness (HE), where HA = HS*HE. Habitat suitability is the amount of available habitat with some value for a particular species; for example, the number of hectares of lichen-bearing coniferous forest that woodland caribou can use. Habitat effectiveness is the ability of a habitat to support wildlife, as influenced by human activities. Habitat availability can change if either the suitability or effectiveness of habitats changes because of development. These values are incorporated into wildlife habitat models to quantify the amount and quality of wildlife habitats available before, during and after the project.

10.3.1 Effect Pathways

The following pathways are discussed for the terrestrial and marine study areas.

10.3.1.1 Effect Pathways for the Terrestrial Valued Components

The effect pathway diagram (see Figure 10-5) shows that changes to habitat availability in the production area can result from:

- direct loss or alteration of habitat caused by vegetation clearing
- displacement of animals from habitat because of sensory disturbance
- displacement of animals from habitat because of altered human and predator access
- local change in vegetation health because of exposure to air emissions

The possibility of the project affecting each wildlife VC is reviewed following. The wildlife VCs are listed in Section 10.2.2, Valued Components. General project mitigation measures are outlined in Volume 7, Environmental Management.

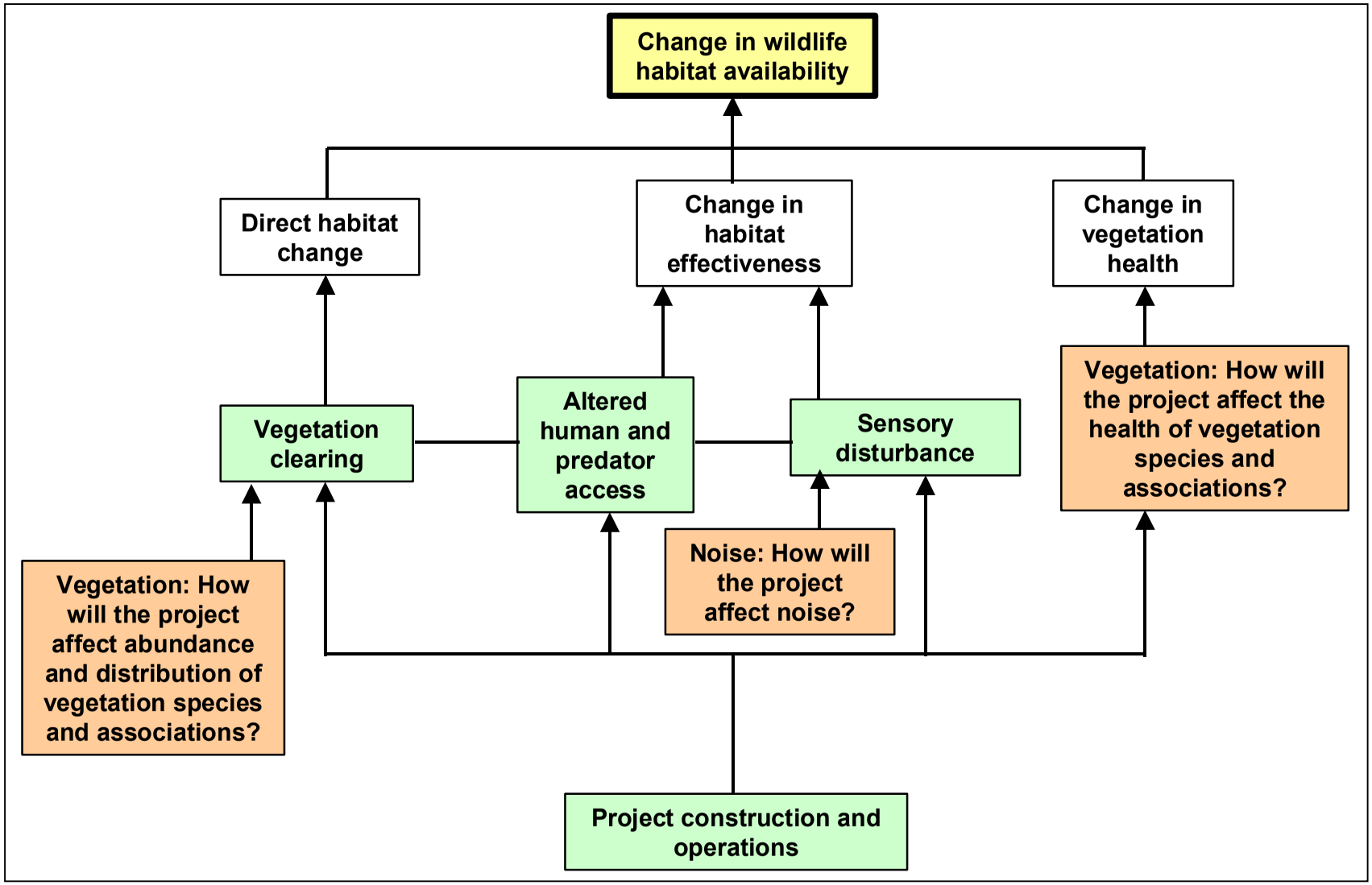

Figure 10-5: Terrestrial Mammal Effect Pathways – Habitat Availability

Vegetation Clearing

Vegetation clearing will occur primarily during construction. Although clearing will generally occur in winter, the effects of habitat changes will extend into other seasons. For example, vegetation clearing could affect:

- winter foraging habitat for caribou, e.g., lichen-rich areas
- foraging and denning habitat for barren-ground grizzly bears, e.g., gravel pits
- calving habitats for woodland caribou
- seasonal habitats for moose
- all-year habitats for marten, lynx, beaver and amphibians
- spring, summer and fall migrating, staging, nesting, moulting or brood-rearing habitats for birds

Habitats for each VC are identified and discussed in detail in Volume 3, Section 10, Wildlife.

Habitat Alteration Relative to Home Range

The area of habitat changed in the production area will be relatively small and local, so effects could be greater on species with small home ranges or territories, such as some birds, than for species with large home ranges, such as barren-ground caribou and barren-ground grizzly bears. The level of effect will also depend on the quality of habitats removed. For example, effects will be higher if preferred habitats, such as nesting colonies or key feeding areas for birds, denning and foraging areas for bears, if limiting, or lichen-rich winter-feeding areas for caribou are disturbed during construction. The importance of these areas for each VC in the arctic tundra has been well documented (Truett and Johnson 2000).

Along the pipeline corridor, habitat loss will be restricted to the long, narrow right-of-way, with an expected maximum width of 50 m and occasional extra width for temporary workspace, and at facility and infrastructure locations. At any given point along the corridor, the area of direct habitat loss will be small compared with regionally available habitats.

Habitat Alteration Relative to Regional Availability

Changes in preferred habitats during construction or reclamation could result in adverse effects if the availability of these habitats is limited within each species' home range or territory. For example:

- Riparian habitats along the Mackenzie Valley are preferred foraging habitats for moose, especially in winter (Prescott et al. 1973). Therefore, loss of riparian habitat could be a concern if the availability of this habitat is limited within moose home ranges. This possible impact needs to be weighed against the positive effects of increased forage availability along the right-of-way edge.

- Woodland and barren-ground caribou depend on lichen-bearing forests in winter, e.g., upland black spruce, treed and shrubby bogs and mixed-wood forest. Therefore, loss of these habitats along the pipeline corridor might also affect caribou if forage availability is limited within caribou winter ranges.

Other Effects of Habitat Change

Land subsidence might cause direct changes in habitat availability near gas reservoirs around Niglintgak and Taglu. As gas is withdrawn from the reservoirs, land currently subject to periodic flooding in and around Niglintgak and Taglu might become more susceptible to flooding for longer periods than in the past. This might affect the forage value of vegetation in these areas for birds and mammals. It is not expected that grizzly bear denning habitat will be affected because dens tend to be located on steep embankments and ridges that are not prone to flooding.

Changes in habitats can also cause energetic stresses to wildlife, particularly if critical or limiting habitats are removed, and energetic stresses can reduce productivity or increase mortality (Bergerud 1975; Bradshaw et al. 1998; Cronin et al. 1994). Alternatively, changes to energetics in some cases can be positive when projects cause net improvements in the quality of wildlife habitats.

Reclamation following vegetation clearing could also change wildlife habitat availability. Re-establishment of vegetation will likely involve reintroduction of native species and natural re-colonization. The success of reclamation in the Northwest Territories is unknown, although McKendrick (2000) reported varying success in Alaska's arctic tundra. According to McKendrick, success depended on the previous disturbance regime, site characteristics and plant species, and plant community characteristics. For example, lichens might take several decades to re-establish on disturbed sites, while grasses and shrubs might quickly recolonize. Some VCs such as bears and most birds might be able to quickly use reclaimed sites, whereas others, such as caribou, might not find preferred lichens for decades.

Changes in water quality could be a potential concern for Arctic terns and other birds that forage on fish and aquatic invertebrates. However, the project effects on water quality in lakes are predicted to be low or of no effect (see Section 6, Water Quality). This effect is not considered further in the following assessment.

Sensory Disturbance

Sensory disturbance is defined as any visual, auditory, tactile or olfactory stimulus that changes the attractiveness of an area to wildlife. Some wildlife, such as barren-ground grizzly bears, foxes and ravens, might be attracted by the scent of food or waste. Examples of terrestrial sensory disturbances most likely to occur include:

- human activity
- noise from well sites, e.g., flaring, compressor stations, other facilities, vehicles, helicopters, airplanes and barges
- movements of vehicles, helicopters, airplanes and barges
- odours from facilities and camps

Sensory disturbances can occur during all project phases. The highest levels will occur during construction, primarily in the winter. Winter construction will limit effects on wildlife, including bears, amphibians and small mammals, such as ground squirrels that are hibernating, beaver that are dormant and migratory species that will not be in the area in winter. Activities during operations and to a lesser extent during decommissioning and abandonment will also cause some disturbance, which could occur throughout the year and will be largely restricted to all-weather roads and specific facility and maintenance sites.

Reactions of wildlife to sensory disturbance might vary, depending on the outcome of previous encounters with people. For example, in areas near communities or existing rights-of-way where wildlife have frequently been trapped or hunted, wildlife might react adversely to project activities and avoid the rights-of-way during all project phases.

Wildlife might become habituated to disturbance. Habituation could result if a stimulus occurs repeatedly without adverse consequences (Geist 1978). For example, barren-ground caribou can become habituated to roads, aircraft overflights of the nonhunted population, compressor station noise and other disturbances (Bergerud 1974; Cronin et al. 1994; Roby 1978; Valkenburg and Davis 1983). Similarly, barren-ground grizzly bears can become habituated to human activity, especially if the energetic benefits, such as food availability, are greater than the costs (Archibald et al. 1987). Barren-ground grizzly bears have been frequently observed at garbage dumps, including those associated with oil field developments in Alaska's North Slope region (Shideler and Hechtel 2000). Wildlife might not habituate to disturbance in areas of heavy hunting pressure.

Signs that sensory disturbance has affected habitat effectiveness include:

- habitat avoidance
- changes in animal behaviour
- changes in wildlife movement patterns

Changes in movement patterns are reviewed in Section 10.4, Effects on Wildlife Movements.

The following section discusses potential effects of sensory disturbance for selected VCs.

Caribou

Examples of habitat avoidance or altered behaviour resulting from sensory disturbance to caribou are common. For example, barren-ground caribou will avoid areas within 1 km of roads during calving (Cronin et al. 1994; Dau and Cameron 1986) and show high levels of stress response to aircraft overflights, especially if subjected to periodic hunting (Valkenburg and Davis 1983). In winter, caribou might avoid areas where they encounter hunters on snowmobiles and might react to these disturbances from as far away as 500 m (Simpson 1987). Caribou behaviour also changes near roads with moderate to heavy vehicle traffic (Horejsi 1981; Murphy and Curatolo 1987) and beside active drilling sites where workers approach caribou (Fancy 1983). Barren-ground caribou reacted strongly to aircraft overflights during winter track surveys in the Transition Forest Ecological Zone, possibly because this area is relatively close to Inuvik and is frequently used by hunters in winter. In remote areas, reactions to project activities could be less severe initially or could be limited to periods of peak disturbance during construction. When human activity is reduced, caribou might use previously disturbed sites, including the pipeline rights-of-way.

Moose

Various authors have documented the avoidance by moose of pipelines (Morgantini 1984), seismic lines (Horesji 1979), and roads (Rudd and Irwin 1985) during periods of human activity. Horesji (1979) also reported that moose were not likely to be found within 1 km of seismic lines while seismic operations were underway.

Barren-Ground Grizzly Bears

Barren-ground grizzly bears avoid areas near seismic blasting, roads and other industrial activities (Aune and Stivers 1987; Ballard et al. 1993; Follmann and Hechtel 1990; Harding and Nagy 1980; Harting 1987; IGBC 1987; Kasworm and Manley 1990; Mattson et al. 1987; McLellan 1990; McLellan and Shackleton 1988). The diameters of zones of influence and the disturbance factors vary in relation to several factors, including:

- bear population density
- individual bear behaviour
- age, sex and reproductive status of the bear, e.g., females with cubs-of-the-year are particularly shy
- season
- characteristics and frequency of disturbances
- habitat or landscape characteristics

Bears in open tundra habitats in the North might be more sensitive to disturbance than bears occupying habitats with protective cover. They might also respond to disturbances from greater distances than bears in forested areas (McLoughlin and Messier 2001). For example, Harding and Nagy (1980) reported active avoidance and disruption of bear foraging activities up to 4 km from northern industrial developments. Displacement and tolerance responses have been reported from within 100 m to more than 900 m of open roads in southern ecosystems (Aune and Stivers 1987; Kasworm and Manley 1990; Mattson et al. 1987; McLellan 1990; McLellan and Shackelton 1988).

Low-flying aircraft, especially helicopters, create strong adverse reactions in barren-ground grizzly bears, and repeated overflights have forced bears from their dens (Quimby 1974). Noise from construction in winter might also cause barren-ground grizzly bears to abandon dens if the disturbance is close to denning sites (Harding and Nagy 1978). Den abandonment following human disturbance will not always have deleterious effects if alternative denning areas are available within a bear's home range (Linnell et al. 2000). Abandonment of dens is discussed in Volume 3, Section 10.3.1, Regional Overview of Wildlife Valued Components.

Marten and Lynx

Marten and lynx are relatively tolerant of sensory disturbance, but they might be displaced from habitats during construction, especially when denning.

Amphibians

Amphibians might be disturbed during the breeding season by loud noises from facility operations, because the noise level could interfere with detection of potential mates.

Birds

Bird responses to aircraft flights depend on distance from the aircraft, aircraft type, aircraft altitude, frequency of disturbance and bird species. For example, snow geese flew farther after being flushed by large aircraft (e.g., Hercules or DC–3) than by small (e.g., Cessna 185 or Beaver) or medium-sized (e.g., Twin Otter) aircraft on the Yukon-Alaska North Slope (Davis and Wiseley 1974). Snow geese flushed farther from helicopters than from all sizes of fixed-wing aircraft, but there was a longer interruption period in response to small fixed-wing aircraft, (i.e., average 6.3 minutes duration) than helicopters (i.e., average 5 minutes duration). Overall, snow geese were equally likely to flush from nearby helicopters as from small fixed-wing aircraft.

Salter and Davis (1974) observed the reactions of snow geese to flights of a Cessna 185, a small fixed-wing aircraft, flown at experimental heights. They noted that all flocks flushed 1.6 to 8 km away from the plane when it was flying at 90 to 120 m. When the aircraft was flying at 210 m, all flocks flushed 3.2 to 14.4 km away. When the plane was flying 300 m and 1,500 m, all flocks flushed 3.2 to 8 km away. At 1,800 m, the geese were still observed to flush, but the distance was difficult to estimate. There was evidence of some habituation by snow geese to frequent Cessna 185 overflights. On days with experimental overflights at half hour intervals, fewer geese were flushed in the afternoons than in the mornings. This result was not observed on days with overflights at two-hour intervals. Similar experiments with a Bell 206-B helicopter produced unclear results, although there were some indications of habituation (Davis and Wiseley 1974). During the oilfield expansion near the Mackenzie River at Norman Wells, the snow goose was the waterfowl species most sensitive to aircraft flights.

Disturbance issues for birds in the pipeline corridor will be similar to issues in the production area, though there will be fewer potential project–VC interactions in the pipeline corridor. All bird VCs, except the boreal chickadee, are absent from the pipeline corridor during the proposed winter construction period, and all, including migratory species, will potentially interact with the project in the pipeline corridor when camps and other features are being built before winter construction, and during operations and possibly decommissioning and abandonment.

Altered Access

Altered access refers to effects of vegetation clearing that result in better travel opportunities to previously remote areas. Altered access resulting from vegetation clearing might have effects similar to those of sensory disturbance, discussed previously. However, altered access might lead to more hunting, trapping or predation pressure on wildlife, resulting in increased mortality risk. Wildlife species might avoid an area where hunting typically occurs or where predators are

more common (Lima and Dill 1990), so altered access might reduce habitat effectiveness even when sensory disturbance is negligible. Increased mortality and its pathways are discussed in Section 10.3.1, Effect Pathways.

Vegetation Health

Wildlife habitat availability could be affected by changes in vegetation health caused by air emissions and dust at the local level at a few locations. Air emissions and dust might affect the health, vigour, growth or abundance of plant species, some of which are used by wildlife as forage. During construction, dust deposition could adversely affect lichen health, and dust deposition on caribou winter foraging habitat could have long term effects because of effects on lichen. During operations, air emissions from certain facilities will include oxides of nitrogen (NO_x), carbon dioxide (CO_2), carbon monoxide (CO), and fine particulate matter with potential adverse consequences on plant health.

Changes in vegetation health could change habitat availability for wildlife VCs. For example, NO_x emissions and nitrogen deposition might result in increased growth of grasses and shrubs, which are preferred food for barren-ground grizzly bears and some birds in the arctic tundra (Truett and Johnson 2000). However, increased growth of grasses and shrubs might shade out more sensitive species, such as lichens, which provide preferred foods for barren-ground caribou (Kelsall 1968). As a result, changes in vegetation health and subsequent changes in vegetation community structure could have various effects on wildlife VCs, depending on each species' specific habitat requirements.

10.3.1.2 Effect Pathways for Marine Valued Components

To guide the systematic assessment of potential project effects of the Niglintgak barge-based gas conditioning facility, an effect pathway diagram was developed to illustrate the potential linkage between each project phase and its means of affecting marine mammals if dredging is required to allow the barge to pass unhindered to Kumak Channel (see Figure 10-6).

Changes in habitat availability could result from:

- direct habitat alteration or loss because of:
    - physical disturbance of sediments caused by potential dredging and construction of the barge-based gas conditioning facility at Niglintgak
    - change in water quality caused by re-suspension of sediments and increased turbidity during potential dredging for the Niglintgak barge-based gas conditioning facility
- indirect habitat loss from avoidance caused by sensory disturbance during barge transport and dredging activities, facility operations or decommissioning for the Niglintgak barge-based gas conditioning facility

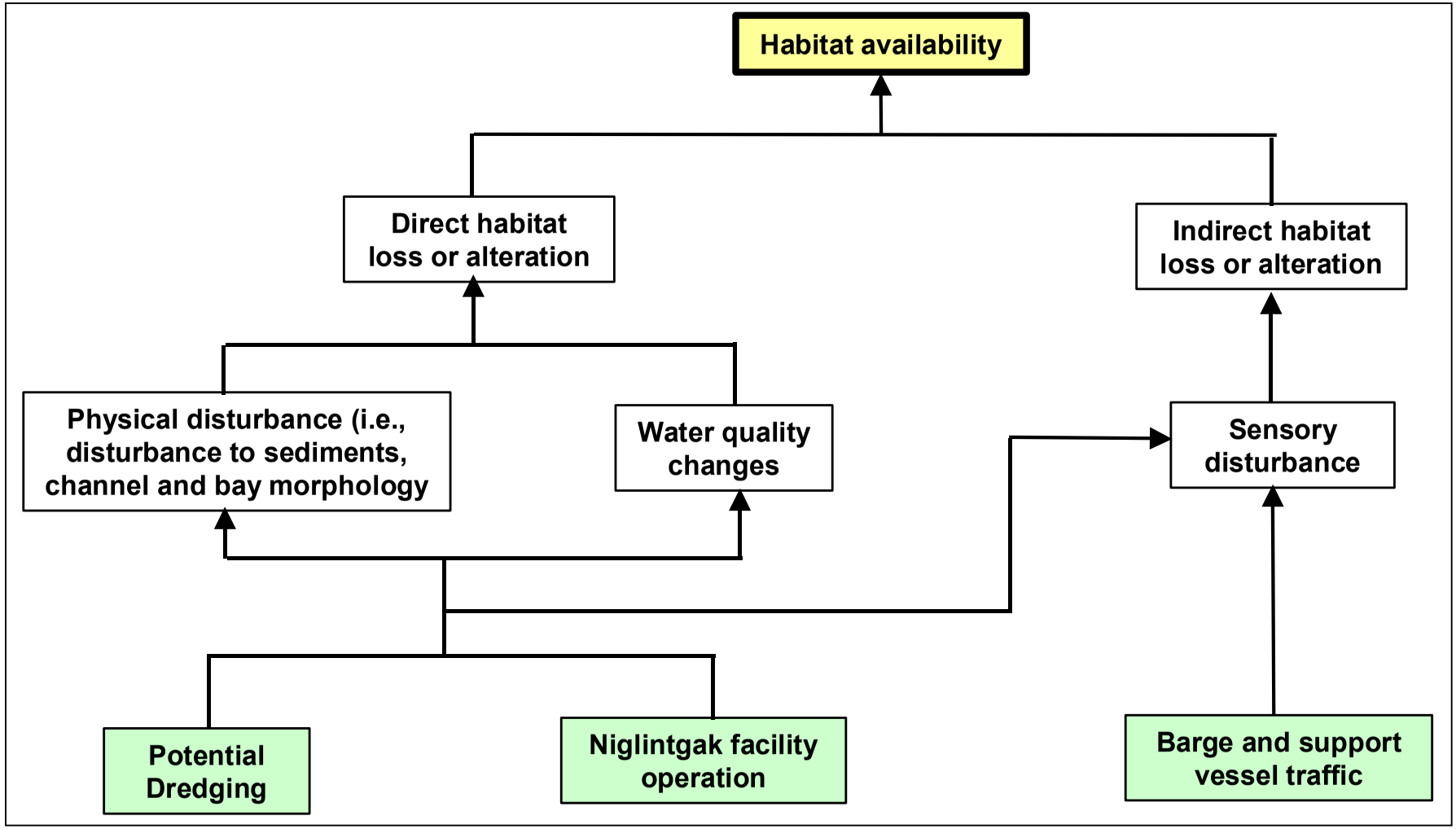

Figure 10-6: Marine Mammal Effect Pathways – Habitat Availability

Direct Habitat Loss – Physical Disturbance

Physical disturbance to marine mammal habitat would occur primarily during potential dredging in Kugmallit and Kittigazuit bays and at the Niglintgak barge landing site. The proposed Niglintgak barge will be about 110 m long and 50 m wide with a draft of 1.9 m, and it will require about 2.2-m water depth for transit. The barge will be transported along Borrow Point, Alaska and along the northern coast of Alaska to the Beaufort Sea. The barge will then be moved up the Mackenzie River to the installation site in a small channel east of Kumak Island at Niglintgak. The final design, depth of water and draft of the gas conditioning facility barge will determine whether dredging is required to allow the barge to pass unhindered to Kumak Channel.

Whereas the proposed transportation route will follow designated routes, some locations might require dredging. Barge draft and turn-radius limitations are expected because of channel depth and width constraints. Bathymetric surveying along the transport route is proposed by the proponents' technical experts to verify actual dredging requirements.

Based on preliminary evaluation of local bathymetry and channel configurations, it is estimated that 11 km of dredging might be required in southern Kugmallit Bay and Kittigazuit Bay. The need for dredging in the channels of the Mackenzie River has yet to be determined. The objective of the dredging program will be to create a channel up to 80-m wide and at least 2.2 m deep. The current estimated 11 km maximum of potential dredging would affect a total area of about 88 ha, excluding the area affected by deposition of dredge spoil. In the absence of more definitive modelling, it is assumed that perhaps twice this area, 176 ha, could be affected by dredge spoil, making the total disturbance area about 264 ha, or less than 1% of the 44,000 ha Kugmallit Bay Beluga Management Zone 1A.

The specific locations for potential dredge spoil deposition have not been determined. Investigations using Acoustic Doppler Current Profiling techniques indicate that most of the material discharged during dredging is typically confined to a zone within a few hundred metres of the discharge chute (Newell et al. 1998). The barge will occupy about one-third of the downstream end of Little Kumak Channel.

The Mackenzie River East Channel annually contributes about 19.2 Mt tonnes (20% x 96 Mt/a; Carson et al. 1998) of suspended sediment and about 0.8 Mt (20% x 4 Mt/a; Carson et al. 1998) of bedload sediment, which are subject to mobilization during normal hydrological scour, annual ice scour and storms. Dredge spoil is expected to be dispersed, redistributed and assimilated by these same mechanisms and because of the site's shallow depth. The effects of dredging are not expected to last beyond one to two years (see Section 5, Hydrology).

Aquatic habitats potentially disturbed by dredging in Kittigazuit Bay, East Channel, Middle Channel and Kumak Channel are currently characterized by high rates of natural disturbance from annual Mackenzie River sedimentation, bedload transport, ice scour and storms (Traynor and Dallimore 1992) (see Volume 3, Section 5, Hydrology), which have effects similar to those of dredging. Fish and benthic organisms inhabiting this dynamic, highly turbid and sediment-rich environment can be expected to be reasonably well adapted to such perturbations. A review of dredging impacts in coastal areas worldwide found recovery in disturbed areas is reportedly most rapid in areas with soft sediments or where natural disturbance of bottom habitat is frequent (Newell et al. 1998). Newell et al. (1998) reported recovery rates of six to eight months in estuarine muds and two to three years in sand- and gravel-dominated communities. They noted that as deposits get coarser along a gradient of increasing environmental stability, recovery rates of five to 10 years might be more realistic. The fine-textured deposits in Kugmallit Bay will likely recover in the short term.

In terms of natural suspended sediment transport, excluding bedload, the average sediment discharge from the Mackenzie River from June to the beginning of August is about 0.9 million tonnes/day (Carson et al. 1998). Analysis to date suggests about 20%, or 180,000 tonnes/day, of the river's suspended sediment volume is transported via East Channel into Kittigazuit Bay and Kugmallit Bay. Dredging is estimated to typically cause a 1% to 5% increase in suspended sediments near disposal areas (van Oostrum and Vroege 1994). Dredging details and timing have not been determined, though the effect is expected to be higher at the actual dredge site and lower as the distance from the site increases. The amount of re-suspended sediments is also expected to be a very low percentage of the average daily sediment transport into the Kittigazuit and Kugmallit bay area. Based on current information, dredging will not be done in estuarine areas believed to be important for fish spawning or when overwintering fish might be affected.

Decommissioning of the facility might involve dredging at the site to remove and transport the barge for re-use, recycling or disposal. This will occur after the estimated 25- to 30-year productive life of the associated gas fields and is expected to involve habitat disturbance similar to that of the initial transport and installation.

Change in Water Quality

The potential to affect marine mammal habitat by changing water quality primarily arises through the possibility of causing unusual, large-scale increases in turbidity and sediment loading during dredging. The potential also exists for the re-suspension of chemicals contained in sediments as discussed previously (see Section 6, Water Quality).

Sedimentation and Turbidity

Sediments will be re-suspended, transported and redeposited onto the seabed at variable rates depending on their size and specific gravity and on the water current and water depth.

Biological concerns related to water quality include:

- reduced productivity because of reduced photosynthesis
- reduced dissolved oxygen levels because of disturbed anoxic sediment layers and buried organic compounds
- re-suspension of previously buried chemicals of concern, if these are present
- reduced ability of marine mammals to detect prey because of low visibility, noise or displacement of prey

Resuspension of Chemicals of Concern

Some natural and human-caused chemicals of concern are in the sediments of the Mackenzie Delta. Short-term resuspension of these chemicals might cause temporary water quality values to exceed guideline levels, but they are expected to remain within the safety factor (see Section 6, Water Quality). Chemicals that are re-suspended in the water column or deposited within the zone of active bioturbation, i.e., the biologically active sediment layer, are potentially available for re-entry into the food chain and ultimately to be taken up by marine mammals preying on invertebrates and fish that have bio-accumulated chemicals of concern. Each year, ice scour and storms re-suspend or redistribute much of the sediment, including chemicals and organic matter, with associated high biological oxygen demand. Dredging will further disturb sediments, some of which have been part of active annual re-suspension and some of which might have been somewhat more static.

Accidental Spills

Marine mammals could be adversely affected if large quantities of fuel, lubricants, hydraulic fluids, bilge water or NGLs are accidentally released into the marine environment during barge transport or dredging, or during operation of the Niglintgak gas conditioning facility. Spilled hydrocarbons could foul or be ingested by seals while on the surface or be ingested by bowhead whales during feeding bouts (Geraci 1990). Beluga whales would be less likely to directly ingest spilled hydrocarbons but could indirectly be exposed by ingesting prey that had taken in hydrocarbons. The significance of these accidents to marine mammals will depend on the:

- amount of material released

- location of the release
- conditions during release
- emergency response to the release
- extent to which marine mammals directly or indirectly encounter spilled hydrocarbons

Indirect Habitat Loss – Sensory Disturbance

Indirect habitat loss could occur because of sensory disturbance, whereby marine mammals change their behaviour or movement in response to underwater noise from potential dredging, barge tow, barge-based gas conditioning facility installation and operations, or decommissioning and abandonment. Underwater noise, whether from natural or human sources, can also affect marine mammals by disturbing or masking sounds that are important for communication, orientation or food-finding (Richardson et al. 1995b). At very high levels, sound can also cause pain or even physical damage to an animal's hearing apparatus.

Underwater noise will be generated during potential dredging, barge transport and facility operations and decommissioning. Dredging and barge transport would be limited to the July to September open-water season when the facility will be installed. Operation of the barge-based facility will create an undetermined level of noise throughout the year, although it will be reduced by shallow water areas, soft sediments and channel bends. Decommissioning will occur during the open-water season and will generate noise similar to levels expected during the initial transport and installation.

The following sections provide relevant background information on marine acoustics and the known response of the potentially affected marine mammals to sound.

Acoustic Characteristics of Underwater Sound

Sound travels more efficiently underwater than in air. High-frequency sounds attenuate or lose energy more rapidly underwater than do low-frequency sounds (Richardson et al. 1995b). Factors such as water depth, salinity, temperature, channel width, slope and bottom type, e.g., silt or rock, influence the quality and quantity of sound received by marine mammals. In the absence of human activities, ambient or background conditions are dominated by noise from waves, wind, rain, thunder, marine mammal vocalizations and echolocation signals, some fish and invertebrates, and occasional natural seismic events (Richardson et al. 1995b).

Review of Marine Mammal Vocalizations and Hearing Sensitivity

Whales and seals use sound to navigate, communicate and locate prey, though species differ in their vocalization characteristics, echolocation signals and hearing sensitivity. Toothed whales, such as belugas, are high-frequency specialists, whereas baleen whales, such as bowheads, specialize in low frequencies (Richardson et al. 1995b). Beluga whales have poor hearing sensitivity at lower frequencies (i.e., less than 2 kHz), but have excellent sensitivity in the main frequencies where they vocalize (2 to 20 kHz) and echolocate (40 to 120 kHz) (Richardson et al. 1995b). The beluga whale's greatest sensitivity lies between about 2 and 100 kHz (Richardson et al. 1995b). Bowhead whale vocalizations, in contrast, generally range from 0.02 to 3.5 kHz, with some calls up to 5.0 kHz (Richardson et al. 1995b). Most bowhead whale sounds have little energy above 0.4 kHz. Bowhead whales and other baleen whales respond to low frequencies and are presumed to hear well in the same frequency range as their own vocalizations.

Ringed seals vocalize in the range of 0.4 to 16 kHz (Richardson et al. 1995b). Ringed seals, like other phocids, have relatively good hearing between 1 kHz and 30 to 50 kHz.

Characteristics of Shipping and Potential Dredging Noise

Shipping-generated noise is the dominant low frequency (0.2 to 5.0 kHz) noise in most marine environments. Both marine dredging and shipping generate strong low-frequency noise (Richardson et al. 1995b). However, whereas vessel traffic is transitory, dredging is often sustained for days or weeks in a limited area.

Potential channel dredging would likely involve cutter-suction dredge and support-supply vessels. Therefore, the noise generated will be a composite of these sources. The dredge would be moving slowly and the crew change vessel and other vessels would operate between the activity site and Tuktoyaktuk. The noise produced by dredging would be continuous around the dredge, with more noise produced by the frequent traffic between the activity site and Tuktoyaktuk. Most noise produced by vessels and dredging machinery would fall below 0.5 kHz (Greene 1995). In addition to vessel and dredge noise, transient sounds might be produced by couplings that join segments of the floating dredge outlet pipeline, if used. Ford (1977) found such sounds measured about 4.0 kHz at the Tuft Point dredging operation in 1976.

In deep water, the noise from potential dredging might be detectable 20 to 25 km away (Greene 1995). However, sound is attenuated much more rapidly in the shallow water proposed for dredging, i.e., in areas less than 2 m deep. During the construction of Arnak artificial island, Ford (1977) measured the attenuation rate at the Arnak site, which is 11 m deep, and at the Tuft Point dredge site, which is 5 m deep. In these relatively shallow-water environments, the attenuation rates

were linear rather than logarithmic. For example, Ford (1977) recorded an attenuation rate of 9 dB/1,000 m near Arnak and 12 dB/1,000 m in the shallower water at Tuft Point. Underwater sound produced by dredging in the extremely shallow, i.e., less than 2 m, water of southern Kugmallit Bay and Kittigazuit Bay and in the confined and irregular channels of the Mackenzie River would attenuate even more rapidly.

Previously Documented Marine Mammal Responses to Dredging and Vessel Traffic

Marine mammal responses to underwater anthropogenic noise have been documented in oceans around the world (Gisiner 1998; Richardson et al. 1995b). Avoidance has been specifically documented for beluga whales and bowhead whales in the western Arctic (Fraker et al. 1978; Richardson 1985; Richardson et al. 1990, 1995a). Observations of how various marine mammal species react to noise are discussed in the following.

Beluga Whales

During intensive marine mammal studies in the 1970s and early 1980s, beluga whales were observed responding to dredging and barging operations on several occasions. These observations provide a good basis for assessing the possible effects of the proposed barge option.

In July 1976, a barge tow passed through the beluga concentration area in Niakunak Bay southwest of Mackenzie Bay. During aerial surveys of beluga whales just before the barge transit, during the transit, and 30 hours after the transit, whales, within about 2,400 m of the barge, were observed moving away from the barge track and returning to their pre-transit distribution 30 hours later (Fraker 1977).

Observations of beluga whale behaviour near the dredging and barging operations at Tuft Point northeast Kugmallit Bay in 1976 (Fraker 1977) was also helpful in assessing possible effects on beluga whales. At Tuft Point, a sand breakwater had been built to shelter the dredging activities from storms. This breakwater was also a sound barrier (Ford 1977). On August 28, 1976, a group of 100 to 150 beluga whales moved close to shore and directly approached the dredging operation from the northeast to within about 2,400 m. On August 1, 1976, a similar-sized group approached Tuft Point, also from the northeast but travelling farther offshore passing seaward of the breakwater, which blocked sound from the activity site. The first half of the group passed the end of the breakwater, where there were no obstructions to block the sound and where they would have heard noise from the operation. The whales showed no reaction until a tug pushing a loaded barge moved toward the whales. The group immediately split, with some continuing on their intended route and others retreating from where they had come. Some observations also suggested that beluga whales were reluctant to cross the track

where barges had recently passed. Fraker (1977) suggested this was a consequence of microbubbles dissolving in the wake of tugboats. These microbubbles might appear acoustically opaque to echolocating beluga whales, so they might not cross such a wake until the bubbles have had time to dissipate.

Fraker (1977) concluded that beluga whales were relatively tolerant of the noise from a stationary suction dredge but were visibly affected, swimming quickly away, when approached by the moving barge. Fraker et al. (1978) also found beluga whale passage was blocked temporarily by a dredging operation with frequent support traffic that crossed a beluga whale travel route. However, dredging with little or no support traffic did not block beluga whale passage.

Summering beluga whales appear to tolerate frequent passages of large vessels travelling at constant speeds and in consistent directions, though fast and erratically moving boats have caused an avoidance reaction or flee response, particularly when the boats were pursuing the animals (Richardson et al. 1995b).

Richardson et al. (1990a, 1995a) investigated whale response to other offshore activities, such as drilling in the Beaufort Sea during spring migration east of Point Barrow. It was observed that most beluga whales showed no reaction to drilling noise farther than 200 to 400 m from a stationary, continuous source even though the sound was measurable several kilometres away. Some beluga whales within 200 to 400 m hesitated temporarily and changed their line of travel slightly (Richardson et al. 1990, 1995a). Richardson et al. (1995a) concluded that the temporary displacement of beluga whales was not biologically significant, i.e., not *likely to affect the long-term well-being or reproductive productivity of the population* (Richardson et al. 1995a).

Anecdotal evidence from industry personnel recording data on travelling beluga whales, observing beluga whales near operating drilling platforms and conducting aerial population surveys suggest that industry activities had no effect on the 1985 beluga whale migration or their distribution or abundance (Norton and Harwood 1986).

Bowhead Whales

In a 1980 study, where dredge sounds from construction of an artificial island were well above ambient sound levels up to several kilometres away, some bowhead whales approached the site and fed within 800 m (Richardson et al. 1985, 1995b).

Bowhead whales reacted to projected sounds of a suction dredge in another study by stopping feeding within 800 m of the simulated dredging source signal and moving more than 2 km away (Richardson et al. 1990).

In response to a wide variety of vessel traffic, bowhead whales typically interrupt their normal behaviour to avoid the vessels (Koski et al. 1989, Richardson et al. 1995a, 1995b). Bowhead whales appear more tolerant of vessels moving slowly and not directly toward them (Richardson et al. 1995b). The distance at which bowhead whales respond and the length of time before they resume their previous behaviour varies. Bowhead whales are often observed by ships' crews, which is very helpful in documenting the presence of these whales in certain areas (Fraker and Bockstoce 1980). Disturbed bowhead whales typically respond 1 to 4 km from an approaching vessel and interrupt their activities to move away from the vessel (Richardson 1985).

The typical flee response begins when the bowhead whale is 0.8 to 3.2 km away from the ship, although some reactions were recorded as far away as 5 to 7 km, and is most conspicuous when a ship directly approaches the whale (Richardson et al. 1985). Bowhead whales first try to outswim the vessel by increasing swimming speed, then changing course to swim perpendicularly away from the vessel. Bowhead whales often return to their original location and resume their previous behaviour when the ship is several kilometres away. This is usually within 30 to 60 minutes, although altered behaviour sometimes persists longer (Richardson et al. 1995b). For example, a change in dive pattern, including reduced dive and surface times, was noted for 1.5 to 2.5 hours after bowhead whales were approached within 500 m by small ships (Wartzok et al. 1989). The bowhead whales remained in the general area, and their normal dive pattern was observed over the next few days.

Bowhead whale response to active drill ships and ice breakers can result in relatively long-range displacements (Richardson et al. 1995b). In response to continuous stationary drilling noise, spring migrating bowhead whales in the Beaufort Sea east of Point Barrow continued to travel within their available migration corridor but demonstrated conspicuous altered behaviour (Richardson et al. 1995a). Bowhead whales will habituate to continuous noise and have been reported avoiding drill ship sites at the onset of dredge or drilling noise, then remaining in the locale for the same level of continuous noise (Richardson et al. 1995b). Using data for bowhead whales responding to supply ships and offshore drilling activity during spring migration, Koski et al. (1989) estimated worst-case exclusion zones. They estimated that shipping activity resulted in a 12 km path temporarily free of bowhead whales.

Seals

Most published information about seal responses to human-caused underwater noise is anecdotal (Richardson et al. 1995b). Information suggests, however, that underwater noise from anthropogenic sources does not appear to affect ringed seals in the open water season. Ringed seals are often seen within 50 m of active drill ships or within a range of simulated drilling in the open-water period (Richardson et al. 1995b). Seals hauled out in May and early June are more

responsive to boat and ship traffic than at other times of the year. For example, hauled out ringed seals often showed short-term disturbance or escape reactions when a ship came within 250 to 500 m (Richardson et al. 1995b). Disturbance reactions, such as increased alertness, were indicated by head raising and temporary departure from the haul-out site.

After several years of ringed seal surveys conducted both before and during the Beaufort Environmental Monitoring Program (BEMP), it was concluded that industrial activity in the Beaufort Sea did not have a significant exclusionary influence on seal habitat use (BEMP 1987b).

Polar Bears

Extensive research on polar bears has been conducted in the past two decades (GNWT 2004). Several studies suggest that polar bears are affected little by shipping traffic or stationary drill ships and drill sites when ice is nearby (Richardson et al. 1995b). Most bears in a study on the northeastern Alaska coast were tolerant of human activities such as capture and handling and aircraft over-flights (Amstrup 1993). However, increasing human activity associated with oil and gas exploration and development could adversely affect denning (Lentfer and Hensel 1980). Amstrup (1993) suggested that denning polar bears might be tolerant of industrial activity based on observations of the closely related barren-ground grizzly bear. However, some bears have been observed emerging from their dens when on-ice vehicle traffic passes within a few hundred metres. More recently, Linnell et al. (2000) found that all three North American bear species generally select den sites at least 1 to 2 km from human activity, such as roads, habitation, industrial activity. Human activity closer than 1 km and especially within 200 m of a den caused variable responses, including abandonment. Off-site vehicle activity that might disturb denning bears is not expected as part of this project. Although most pregnant female bears can be expected to avoid areas affected by human-caused noise, there might be some exceptions. On Svalbard Island, a female polar bear denned without incident within about 150 m of an active camp powered by a diesel generator (Derocher 2004, personal communication). The loss of a single den site following human disturbance will not always lead to deleterious effects if alternative denning areas are available within the home range (Linnell et al. 2000). Pregnant females or females with young might die if they are disturbed and abandon a den in mid-winter.

10.3.2 Overview of Project Design and Mitigation

Volume 2, Project Description, provides a description of the project and Volume 7, Environmental Management, provides an overview of the environment management strategies. Mitigation measures that might reduce potential effects on wildlife habitat have been developed for each effect pathway (see Figure 10-5, shown previously) and are presented in Table 10-8. Included are mitigation measures designed specifically to address concerns about certain species.

Table 10-8: Mitigation Strategies for Wildlife Habitat Availability

Effect Pathway	Mitigation Strategy
General effects on wildlife during construction, operations, decommissioning and abandonment	Assign a wildlife monitor during construction. Monitors will be hired from local communities whenever practical.
	Maintain contact with hunters' and trappers' committees, renewable resource councils, hunters' and trappers' associations, co-management boards, the Canadian Wildlife Service and the Department of Resources, Wildlife and Economic Development to advise of incidents involving wildlife (i.e., ungulates, bears and SARA species).
	Follow Waste Management Plan and Hazardous Materials Management Plan.
Vegetation clearing effects on habitat availability	Conduct preconstruction surveys to identify critical habitat, nests or dens. Where practical, protect these areas by using appropriate timing and buffers to limit disturbance and reduce the probability of accidentally clearing critical habitat.
	Limit clearing near critical habitats and wildlife features, e.g., active nest sites, dens and mineral licks, when practical.
	Reduce disturbances near stream banks.
	Limit grubbing to the ditchline and areas to be graded.
	Limit disturbance to riparian vegetation communities, where practical.
	Compact snow or ice on winter roads or pads to a minimum thickness of 0.10 m, or an otherwise approved thickness.
	Pipeline and access corridors should avoid paralleling potential animal movement corridors, such as riparian areas, where practical.
	Leave cleared vegetation in a pattern that does not leave a recognizable trail, where practical. This reduces accessibility and visibility to humans and predators.
Sensory disturbance effects on habitat availability	Where practical, avoid clearing and construction during sensitive periods for wildlife, such as bird breeding season, early in the denning period for bears, or during the calving season for ungulates.
	Project activities within 500 m of a raptor nest during nesting season will be avoided, where practical.
	Follow aircraft flight guidelines (flight corridors, minimum altitudes) except for aerial pipeline patrols.
	Follow GWNT Wildlife Harassment Regulations.
	Follow Kendall Island Bird Sanctuary permit requirements.
Altered human and predator access effects on habitat availability	Reclaim roads when they are no longer required for construction or operations.
	Prohibit recreational use of project roads and rights-of-way by project staff while on the job site.
	Use existing access over new access, where available.
	Place barriers, such as large berms, rolled back slash or rock piles across the right-of-way at key entrance points to limit access, where practical.
	Prohibit intentional destruction of wildlife unless authorized or required for safety reasons.

Table 10-8: Mitigation Strategies for Wildlife Habitat Availability (cont'd)

Effect Pathway	Mitigation Strategy
Project effects on barren-ground and woodland caribou	Ensure that pipelines and heavily travelled roads are separated by more than 100 m, where practical.
	Limit project activities in barren-ground caribou winter range between October and January to limit interaction with caribou to the extent practical.
	Construct above-ground pipeline at suitable heights with consideration for all season wildlife movements.
	Herd caribou from constricted corridors to limit encounters and duration of potential disturbances from project activities.
Project effects on moose	Limit disturbance to riparian vegetation communities, where practical.
	Maintain buffer zones between access roads and other infrastructure sites and riparian zones associated with streams, lakes or wetlands, except where water bodies need to be crossed by a road, where practical.
Project effects on barren-ground grizzly bear	Follow a waste management plan.
	Develop protocols for managing potential bear–human interaction, including measures to deter bears from camps and other facilities that are consistent with *Safety in Bear Country: A Reference Manual* (Resources, Wildlife and Economic Development).
	Consult territorial and federal wildlife agencies and local hunters and trappers to determine the location of known den sites.
	Conduct den surveys before beginning construction.
Project effects on marten	Barriers, such as large berms, rolled back slash or rock piles might be placed across the right-of-way at key entrance points.
Project effects on beaver	Limit disturbance to drainages by designing appropriate drainage control measures and maintain a buffer zone, where practical, between wetland features and rights-of-way.
	Review with local trappers, at least one month before the start of construction, all identified beaver dams to be removed to facilitate construction. Trappers will be given the opportunity to trap out the affected beaver colonies before construction.
	Implement measures to reduce the probability of accidental spills.
Project effects on birds and amphibians	Follow Kendall Island Bird Sanctuary permit requirements.
	Reduce the volume, duration and frequency of noise producing activities, where practical.
	Schedule potentially disturbing activities when most birds are absent, i.e., from October to April, where practical. Construction will occur all year.
	When birds are present, schedule potentially disturbing discretionary activities to occur outside the most sensitive periods, where practical.
	Route barging activity to avoid waterbodies being used by concentrations of birds, especially moulting or brood-rearing flocks, where practical. Project activities within 500 m of a raptor nest during nesting season will be avoided, where practical. Trees used by cavity nesting species, and trees with raptor stick nests located during construction will not be felled if possible.
	Follow aircraft flight guidelines for flight corridors and minimum altitudes, especially near sensitive areas and bird concentrations.

Many of these measures represent existing best-management practices used in oil and gas exploration and development in the Northwest Territories, northern Alberta and British Columbia. The following mitigation measures draw on industry experience reported by:

- Foothills Pipe Lines (Yukon) Ltd. (1979)
- Diavik Diamond Mines Inc. (1999)
- Chevron (1999)
- Golder (1999)
- Environmental Impact Screening Committee (EISC 2002)
- Boreal Caribou Committee (BCC 2001)
- De Beers (2002)

10.3.3 Niglintgak

Field development at Niglintgak will include:

- three well pads: north, central and south
- six to 12 production wells
- a gas conditioning facility
- a disposal well
- above-ground flow lines
- a remote drilling sump
- supporting infrastructure

Two options are currently being considered for the Niglintgak gas conditioning facility:

- placing it on a barge in a side channel of Kumak Channel, beside Kumak Island

- placing it on the land east of Kumak Channel

Construction of facility modules is expected to begin in western Canada in 2007 or earlier. Construction of facility sites is expected to begin in winter 2006. Facilities are scheduled to start up in 2009.

10.3.3.1 Baseline Conditions

The following describes baseline conditions for key wildlife species for the land-based gas conditioning facility development options. Marine mammals potentially affected by the barge-based gas conditioning facility at Niglintgak were discussed previously in Section 10.3.1.2, Effect Pathways for Marine Valued Components.

Barren-ground grizzly bears use Niglintgak for foraging in spring, summer and fall and for denning in winter. Waterfowl nesting colonies, especially on Richards

Island near the Kendall Island Bird Sanctuary and along the arctic coast, are a preferred source of food for grizzly bears, especially females with cubs, in late May, June and July (Nagy 2003, personal communication).

No barren-ground grizzly bears or bear dens were observed in Niglintgak during aerial surveys in 2003. However, one bear was observed and bear signs including tracks and scat were reported at two locations during spring and summer field surveys in 2002. The density of barren-ground grizzly bears has been estimated at 7 to 8 bears/1,000 km^2 in the production area (Nagy 2003, personal communication). See Volume 3, Section 10.3.2, Niglintgak, for more details about barren-ground grizzly bear habitat use.

The outer Mackenzie Delta, including Niglintgak and Taglu, is prime habitat for nesting, moulting and staging greater white-fronted geese. Greater white-fronted geese nest throughout the outer delta and gather in large flocks of brood-rearing and moulting birds along the coast of the outer delta in July and August. Flocks of geese stage before fall migration on the outer delta in late August and September.

There is a snow goose nesting colony on the islands near the Kendall Island Bird Sanctuary on the outer Mackenzie Delta. From 1996 to 2001, estimates of the number of adult snow geese at the colony ranged from 1,645 to 4,255 (Wiebe and Hines in prep.). During aerial surveys in 2001 and 2002, most snow geese in the production area were observed near the Kendall Island Bird Sanctuary in summer and early fall. Much of Niglintgak lies within the Kendall Island Bird Sanctuary. Many fall-staging snow geese use the outer Mackenzie Delta in some years. This happens when the preferred areas along the coastal tundra of north Yukon and Alaska are not accessible because of early snow cover.

There is critical habitat for nesting and moulting tundra swans throughout the outer Mackenzie Delta. During aerial surveys in 2001 and 2002, most swans observed in June and July were nesting pairs and family groups that were widely scattered throughout the area. However, large flocks were observed along the coast of the outer delta in July and August.

The outer Mackenzie Delta is used by many greater and lesser scaup. Greater scaup are believed to be the more abundant nesting scaup, and it is unclear in what proportions greater and lesser scaup use the outer delta for moulting. During aerial surveys of the outer delta in 2001 and 2002, flocks of scaup, presumably moulting, were observed on waterbodies primarily in the central and southern parts of the outer delta.

Cliff nesting habitat is not available for peregrine falcons on the outer Mackenzie Delta. Nevertheless, Niglintgak provides good foraging habitat for peregrine falcons hunting the waterfowl and shorebirds that are abundant in the area.

There is suitable habitat for nesting and migrating whimbrels on the outer Mackenzie Delta. On the outer delta, whimbrels frequent low-centred polygon lowland habitats and wet sedge tundra or high-centred polygon upland habitats (Skeel and Mallory 1996). The Canadian Wildlife Service conducted shorebird surveys on the outer Mackenzie Delta in 1991 and 1992. The Landsat-imagery classification of shorebird habitat shows 8.7% of the outer delta study area, excluding water, or 39,056 ha of polygon and sedge habitat was suitable for nesting whimbrels (Gratto-Trevor 1996).

There is suitable nesting habitat and feeding areas for Arctic terns throughout the outer Mackenzie Delta. Arctic terns were observed regularly in the 2001 and 2002 aerial surveys of the outer delta. Some nesting colonies were observed, but detailed information on the locations and sizes of nesting colonies at and near Niglintgak is currently not available. Arctic terns prefer to nest on islands with low-growing or no vegetation.

10.3.3.2 Niglintgak Effects

Land-Based Gas Conditioning Facility Option

The potential effects of construction, operations and decommissioning and abandonment on habitat availability at Niglintgak include vegetation clearing, sensory disturbance, altered human access and changes in vegetation health. Table 10-9 summarizes the effects of construction, operations and decommissioning and abandonment on barren-ground grizzly bear at Niglintgak. All effects will be low magnitude and restricted to the LSA. Positive effects of vegetation change on barren-ground grizzly bear might be long term in duration resulting from vegetation change during the reclamation period.

Barren-Ground Grizzly Bear

Table 10-10 shows the change in barren-ground grizzly bear winter, spring and fall habitat availability following construction and operation of Niglintgak.

The largest potential effects of Niglintgak, during all phases, on the availability of barren-ground grizzly bear habitat are adverse, low magnitude, local in extent and long term.

Construction

Site preparation and sensory disturbances during construction at Niglintgak might change habitat availability for barren-ground grizzly bears. Most of the reduction in habitat availability during construction results from sensory disturbance, with lesser effects related to direct habitat loss from the project footprint. In barren areas in the tundra, a minimal increase in human and predator access is expected from the project during winter construction.

Table 10-9: Effects on Barren-Ground Grizzly Bear Habitat Availability – Niglintgak

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Positive	Low	Local	Long term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

Table 10-10: Change in Barren-Ground Grizzly Bear Habitat – Niglintgak

Habitat Value	Denning		Spring Forage		Fall Forage	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
Very high	-189	-188	0	0	0	0
High	70	133	0	0	0	0
Moderate	-296	-303	-268	-280	-706	-706
Effective	-415	-358	-268	-280	-706	-706

NOTE:
Effective habitat is the sum of very high, high and moderate habitat values

When compared with the Inuvialuit Settlement Region part of the RSA, total project construction will reduce the amount of effective barren-ground grizzly bear denning habitat by 1.53%, spring foraging habitat by 1.20% and fall foraging habitat by 1.29%. Given that the home range size of a barren-ground grizzly bear in the area is estimated at 1,154 km^2 (Nagy et al. 1983), the loss of as much as 7.06 km^2 of effective habitat to construction is likely to have little effect on the barren-ground grizzly bear population. Therefore, the potential effects of project construction on barren-ground grizzly bear habitat availability are considered low magnitude.

Operations

Overall, there will be less sensory disturbance during operations than during construction. There is a possibility that air emissions will change vegetation health at a very local level at Niglintgak.

Operations will reduce effective barren-ground grizzly bear habitat. Most of the reduction of effective habitat availability is a result of sensory disturbance, with further effects from direct vegetation clearing of the project footprint. When compared with the Inuvialuit Settlement Region RSA, 0.06% of effective barren-ground grizzly denning habitat, 0.99% of spring foraging habitat, and 1.02% of fall foraging habitat is reduced because of operations. As with changes in effective habitat resulting from construction, the small reductions during operations are expected to have few effects on barren-ground grizzly bear populations.

Decommissioning and Abandonment

Potential adverse effects on barren-ground grizzly bear habitat availability are expected to decline following decommissioning and abandonment of Niglintgak. Reclaimed sites will undergo vegetation regrowth, either through natural succession or planting. Depending on the characteristics and species composition of the re-established community, reclamation could result in the gradual recovery of habitat value for barren-ground grizzly bears. Dust emissions during decommissioning and abandonment are expected to have a minor adverse effect on vegetation health, although new growth will have a positive effect on barren-ground grizzly bear habitat. Land subsidence might also cause small direct changes in foraging habitat availability for barren-ground grizzly bears.

Greater White-Fronted Goose

The largest potential effects of Niglintgak, during all phases, on the availability of greater white-fronted goose habitat are adverse, low magnitude, local in extent and long term (see Table 10-11).

Table 10-12 shows changes in greater white-fronted goose nesting and foraging habitat availability following construction and operation of Niglintgak, land-based option.

Construction

During construction, there will be reduced availability of effective nesting and foraging habitat for greater white-fronted goose. Most reduction in habitat availability will be because of sensory disturbances from construction work, with a smaller amount as a result of direct habitat loss from site preparation for the project footprint. Foraging habitat is abundant in the Inuvialuit Settlement Region RSA (see Volume 3, Section 10, Wildlife) indicating the small amount of habitat loss at Niglintgak will not affect populations of greater white-fronted geese.

Table 10-11: Effects on Bird Habitat Availability – Niglintgak

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse Positive[1]	Low	Local	Long term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Change in vegetation health	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term

NOTES:
1 Revegetation could have a positive effect on habitat for greater white-fronted goose and snow goose
Bird species included in the Niglintgak assessment were the greater white-fronted goose, snow goose, tundra swan, scaup peregrine falcon, whimbrel and Arctic tern

Table 10-12: Change in Greater White-Fronted Goose Habitat – Niglintgak

Habitat Value	Nesting		Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
High	-29	-2	-45	-11
Moderate	-142	-19	-121	-18
Effective	-171	-21	-166	-29

NOTES:
See Table 10-143 for a regional context
Effective habitat is the sum of high and moderate habitat values

The Niglintgak gas conditioning facility site is not critical to greater white-fronted geese populations on the outer Mackenzie Delta. Nesting and feeding areas for relatively few geese will be affected by vegetation clearing at this site. Aircraft and boat-related disturbance will encompass a larger area and might affect critical areas on the coast of the outer delta where greater white-fronted geese concentrate during brood rearing and moulting.

Operations and Decommissioning and Abandonment

Operations and decommissioning and abandonment will affect less effective greater white-fronted goose nesting habitat and foraging habitat than construction because of reduced sensory disturbances.

The main activity areas at Niglintgak are not critical to greater white-fronted goose populations on the outer Mackenzie Delta. However, aircraft and boat-related disturbance will encompass a larger area and might affect areas along the coast of the outer delta where greater white-fronted geese concentrate during brood-rearing and moulting. Adherence to flight routes and minimum altitudes will reduce this concern. Revegetation following decommissioning could have a low, medium-term positive effect on greater white-fronted goose habitat.

Snow Goose

The largest potential effects of Niglintgak, during all phases, on snow goose habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-11, shown previously).

Construction

Potential effects on snow goose habitat availability on the outer delta during construction will include:

- disturbance of nesting, brood-rearing and moulting snow geese at Kendall Island Bird Sanctuary and nearby areas along the coast of the outer Mackenzie Delta from June to August
- disturbance of fall-staging snow geese on the outer delta in late August and September

Project disturbance is expected to be greatest during construction.

Direct habitat loss and alteration will be centred at the Niglintgak facilities and will not reduce use of the outer delta by snow geese. Vegetation clearing will be well away from the snow goose nesting colony, but it could result in the loss of small areas of foraging habitat for fall-staging snow geese on the outer delta.

Potential effects will be reduced by following aircraft flight guidelines and avoiding important nesting and staging areas.

Operations and Decommissioning and Abandonment

Potential effects on habitat availability for snow geese on the outer delta during operations and decommissioning and abandonment are the same as those identified for construction. However, there will be less disturbance of snow geese than during construction, so the potential for effects is also reduced. Following decommissioning, revegetation could have a positive, long-term effect on habitat.

Tundra Swan

The largest potential effects of Niglintgak, during all phases, on tundra swan habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-11, shown previously).

Construction

Construction will reduce the amount of effective tundra swan nesting and foraging habitat (see Table 10-13). There will also be a reduction in available effective foraging habitat, but to a much smaller extent than for nesting habitat. The amount of habitat lost is small relative to habitat availability in the Inuvialuit Settlement Region RSA (see Volume 3, Section 10, Wildlife).

Table 10-13: Change in Tundra Swan Habitat – Niglintgak

Habitat Value	Nesting		Foraging	
	Habitat Change – Construction (ha)	**Habitat Change – Operations** (ha)	**Habitat Change – Construction** (ha)	**Habitat Change – Operations** (ha)
High	-477	-135	-241	-33
Moderate	-157	16	186	0
Effective	-634	-119	-55	-33
NOTES: See Table 10-143 for a regional context Effective habitat is the sum of high and moderate habitat values				

Tundra swan habitat availability will be most affected by sensory disturbance during construction at Niglintgak. Whereas disturbance of flightless moulting birds, especially the large flocks that gather on the coast of the outer delta, and of broods is a concern, aircraft, barge and boat traffic will likely cause the most disturbance. Direct habitat loss will be limited to the areas of the facilities, areas that are not critical to tundra swans on the outer Mackenzie Delta. Therefore, only a few nesting pairs and feeding individuals might be affected.

Operations and Decommissioning and Abandonment

Although disturbance will be less during operations and decommissioning and abandonment than during construction, some effective nesting and foraging habitat will remain unavailable. Almost half of the unavailable effective nesting habitat will be from vegetation clearing for the project facilities. Operations will have little effect on foraging habitat. As with construction, the amount of habitat loss is small relative to availability in the Inuvialuit Settlement Region RSA (see Volume 3, Section 10, Wildlife).

Tundra swan habitat availability will be affected primarily by sensory disturbance. Disturbance of flightless moulting birds, especially the large flocks that gather on the coast of the outer delta in July and August, and of broods are of particular concern. Aircraft, barge and boat traffic will cause the most disturbance.

Residual effects will be reduced by mitigation measures focused on avoiding moulting and brood-rearing swans.

Scaup

The largest potential effects of Niglintgak, during all phases, on scaup habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-11, shown previously).

Construction

Potential effects on greater and lesser scaup habitat availability on the outer delta during construction (see Table 10-14) will include:

- disturbance of flocks of flightless, moulting scaup from late June through mid-August
- disturbance of broods in July

Table 10-14: Change in Greater Scaup Habitat – Niglintgak

Habitat Value	Nesting	
	Habitat Change – Construction (ha)	**Habitat Change – Operations** (ha)
High	<1	0
Moderate	-14	-2
Effective	-13	-2
NOTES: See Table 10-143 for a regional context Effective habitat is the sum of high and moderate habitat values		

Only nesting habitat was modelled because the model is based on terrestrial vegetation types, and foraging occurs in aquatic habitat. The habitat model predicts that construction of the Niglintgak facilities will reduce the area of available effective nesting habitat for greater scaup by a small amount relative to habitat availability in the Inuvialuit Settlement Region RSA (see Volume 3, Section 10, Wildlife). Most of this decrease will be a result of sensory disturbances from construction activities.

During aerial surveys in 2001 and 2002, flocks of moulting scaup were seen most often in the central and southern parts of the outer delta, not near the coast. Broods were more widespread in the outer delta. Aircraft, barge and boat disturbances are expected to be greatest during construction.

Direct habitat loss and alteration will be centred at the Niglintgak facilities. Habitat loss and alteration at Niglintgak will not reduce use of the outer delta by scaup. Suitable habitat is plentiful on the outer delta for nesting scaup, although favoured waterbodies for moulting might be less numerous. Clearing of vegetation could result in the loss of small areas of nesting habitat for a few scaup.

Potential effects will be reduced by mitigation measures requiring aircraft, barges and boats to avoid flocks of flightless, moulting scaup.

Operations and Decommissioning and Abandonment

Effects will be less during operations and decommissioning and abandonment than during construction because there will be less sensory disturbance. However, there will continue to be a small decrease in the amount of available effective greater scaup nesting habitat compared with baseline conditions. As with construction, the amount of habitat loss is small relative to availability in the Inuvialuit Settlement Region RSA (see Volume 3, Section 10, Wildlife).

Peregrine Falcon

The largest potential effects of Niglintgak, during all phases, on peregrine falcon habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-11, shown previously).

All Phases

The project will not affect peregrine falcon nesting habitat availability at Niglintgak because there is no cliff-nesting habitat on the outer Mackenzie Delta.

Some foraging areas might be disturbed, but the disturbance will be periodic and of short duration. For example, during aircraft overflights, some peregrine falcons might be displaced to other areas of the outer delta. There are many suitable foraging areas for falcons on the outer delta.

Whimbrel

The largest potential effects of Niglintgak, during all phases, on the availability of whimbrel habitat are adverse, low magnitude, local in extent and long term (see Table 10-11, shown previously).

Construction

Potential effects on whimbrel habitat availability on the outer delta during construction at Niglintgak (see Table 10-15) will include:

- direct loss of nesting and feeding habitat from vegetation clearing
- disturbance of nesting and feeding areas by aircraft and construction activities

Table 10-15: Change in Whimbrel Habitat – Niglintgak

Habitat Value	Nesting		Foraging	
	Habitat Change – Construction (ha)	**Habitat Change – Operations** (ha)	**Habitat Change – Construction** (ha)	**Habitat Change – Operations** (ha)
High	-12	-3	-2	0
Moderate	-46	-22	-66	-25
Effective	-58	-25	-68	-25
NOTES: See Table 10-143 for a regional context Effective habitat is the sum of high and moderate habitat values				

These effects are likely to reduce nesting and foraging habitat availability for only a few whimbrel near the Niglintgak facilities. Much of the affected area is affected by sensory disturbance associated with construction. Loss of habitat availability will not reduce whimbrel populations on the outer delta because suitable whimbrel habitat is widespread throughout the area. Aircraft and human disturbance are expected to be greatest during construction.

Operations and Decommissioning and Abandonment

During operations and decommissioning and abandonment, small areas of effective nesting and foraging habitat will continue to be unavailable. These effects are likely to reduce habitat availability for only a few whimbrel near the Niglintgak facilities. That loss of habitat availability will not reduce whimbrel populations on the outer delta because habitat suitable for whimbrel is widespread throughout the outer delta.

Arctic Tern

The largest potential effects of Niglintgak, during all phases, on the availability of Arctic tern habitat are adverse, low magnitude, local in extent and long term (see Table 10-11, shown previously).

Construction

Potential effects on Arctic tern habitat availability on the outer delta during construction will include:

- destruction and disturbance of nesting colonies from June to August
- disturbance of favoured feeding areas from June to August

Arctic tern nest and forage throughout the outer Mackenzie Delta, though the proximity of nesting colonies and productive feeding areas to the Niglintgak facilities is not known.

Loss or disturbance of feeding habitat near the facilities might affect some Arctic tern. If Arctic tern colonies are near the facilities or the surrounding disturbance, there is a potential for adverse effects on the local population.

Potential effects will be reduced by mitigation measures focused on avoiding Arctic tern nesting colonies.

Operations and Decommissioning and Abandonment

Effects on Arctic terns during operations and decommissioning and abandonment will be less than during construction because of less traffic and human activity associated with sensory disturbance. Aircraft, barges and boats and other human activities will be the primary sources of this disturbance.

Barge-Based Gas Conditioning Facility Option

Marine mammal habitat availability can be affected directly by physical disturbance and change in water quality and indirectly by altering the way marine mammals choose to use their habitat in response to sensory disturbance. The duration of direct habitat disturbance or alteration from potential shallow dredging in Kugmallit Bay and Kittigazuit Bay would be temporary and likely less than one to two years, with effects that will probably be masked by larger-scale natural processes. The extent of temporary direct habitat disturbance in the Kugmallit Bay area would be less than 1% of the available equivalent habitat in the Kugmallit Bay beluga whale concentration area. Fish and benthic invertebrate species in the areas that might require dredging are adapted such that additional habitat disturbance of the kind proposed will likely be within the range of exposure experienced by these species and will affect a small percentage of available habitat. Potential dredging to level the channel bottom at Niglintgak where the barge would be grounded would have no direct effect on marine mammals or their habitat because this part of Kumak Channel is seldom, if ever, used by marine mammals and is not important for fish spawning, rearing or overwintering.

Considering the short duration of potential dredging, its location and small area of impact, the negligible effect on fish and aquatic habitat productivity, and the lack of effect on basic parameters such as salinity, water temperature and suspended sediment load, the proposed undertaking will not adversely affect marine mammal habitat availability.

Based on several studies and anecdotal observations of marine mammal behaviour and the duration, location and nature of the proposed disturbance relative to marine mammal habitats, indirect marine mammal habitat loss will be short term and will affect relatively few individuals. Sensory disturbance from the proposed project will have low- to moderate-magnitude effects on marine mammal habitat availability.

Mitigation measures to reduce potential effects on marine mammal habitat availability include monitoring for and avoiding marine mammals, limiting the requirement for dredging, and scheduling activities to avoid adverse marine mammal disturbance.

A summary of the nature of potential effects on marine mammal habitat availability is provided in Table 10-16 for beluga whales, Table 10-17 for bowhead whales, Table 10-18 for ringed seals and Table 10-19 for polar bears.

Table 10-16: Effects on Beluga Whale Habitat Availability

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Sensory disturbance	Construction (barge transport)	Adverse	Low	Local	Short term
	Construction (potential dredging and facility installation)	Adverse	Moderate	Local	Short term
	Operations	Adverse	Low	Local	Long term
	Decommissioning (barge transport)	Adverse	Low	Local	Short term
	Decommissioning (potential dredging)	Adverse	Moderate	Local	Short term
Water quality	Construction (barge transport)	Neutral	No effect	N/A	N/A
	Construction (potential dredging and facility installation)	Adverse	Low	Local	Short term
	Operations	Neutral	No effect	N/A	N/A
	Decommissioning (barge transport)	Neutral	No effect	N/A	N/A
	Decommissioning (potential dredging)	Adverse	Low	Local	Short term
Physical disturbance	Construction (barge transport)	Neutral	No effect	N/A	N/A
	Construction (potential dredging and facility installation)	Adverse	Low	Local	Medium term
	Operations	Neutral	No effect	N/A	N/A
	Decommissioning (barge transport)	Neutral	No effect	N/A	N/A
	Decommissioning (potential dredging)	Adverse	Low	Local	Short term

NOTE:
N/A = not applicable because no effect is predicted

Table 10-17: Effects on Bowhead Whale Habitat Availability

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Sensory disturbance	Construction (barge transport)	Adverse	Low	Local	Short term
	Construction (potential dredging and facility installation)	Neutral	No effect	N/A	N/A
	Operations	Neutral	No effect	N/A	N/A
	Decommissioning (barge transport)	Adverse	Low	Local	Short term
	Decommissioning (potential dredging)	Neutral	No effect	N/A	N/A
Water quality	Construction (barge transport)	Neutral	No effect	N/A	N/A
	Construction[1] (potential dredging and facility installation)	Adverse	Low	Local	Short term
	Operations	Neutral	No effect	N/A	N/A
	Decommissioning (barge transport)	Neutral	No effect	N/A	N/A
	Decommissioning (potential dredging)	Adverse	Low	Local	Short term
Physical disturbance	Construction (barge transport)	Neutral	No effect	N/A	N/A
	Construction[1] (potential dredging and facility installation)	Adverse	Low	Local	Medium term
	Operations	Neutral	No effect	N/A	N/A
	Decommissioning (barge transport)	Neutral	No effect	N/A	N/A
	Decommissioning (potential dredging)	Adverse	Low	Local	Short term

NOTES:
N/A = not applicable because no effect is predicted
1 Effect might occur via effect on habitat for species that form part of the bowhead whale food chain (e.g., plankton – bowhead)

Table 10-18: Effects on Ringed Seal Habitat Availability

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Sensory disturbance	Construction (barge transport)	Adverse	Low	Local	Short term
	Construction[1] (potential dredging and facility installation)	Adverse	Low	Local	Short term
	Operations	Neutral	No effect	N/A	N/A
	Decommissioning (barge transport)	Adverse	Low	Local	Short term
	Decommissioning (potential dredging)	Adverse	Low	Local	Short term
Water quality	Construction (barge transport)	Neutral	No effect	N/A	N/A
	Construction[1] (potential dredging and facility installation)	Adverse	Low	Local	Short term
	Operations	Neutral	No effect	N/A	N/A
	Decommissioning (barge transport)	Neutral	No effect	N/A	N/A
	Decommissioning (potential dredging)	Adverse	Low	Local	Short term

Table 10-18: Effects on Ringed Seal Habitat Availability (cont'd)

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Physical disturbance	Construction (barge transport)	Neutral	No effect	N/A	N/A
	Construction[1] (potential dredging and facility installation)	Adverse	Low	Local	Medium term
	Operations	Neutral	No effect	N/A	N/A
	Decommissioning (barge transport)	Neutral	No effect	N/A	N/A
	Decommissioning (potential dredging)	Adverse	Low	Local	Short term

NOTES:
N/A = not applicable because no effect is predicted
1 Effect might occur via impacts on habitat for species that form part of the ringed seal food chain (e.g., plankton – fish – seal)

Table 10-19: Effects on Polar Bear Habitat Availability

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Sensory disturbance	Construction (barge transport)	Neutral	No effect	N/A	N/A
	Construction (potential dredging and facility installation)	Neutral	No effect	N/A	N/A
	Operations	Adverse	Low	Local	Long term
	Decommissioning (barge transport)	Neutral	No effect	N/A	N/A
	Decommissioning (potential dredging)	Neutral	No effect	N/A	N/A
Water quality	Construction (barge transport)	Neutral	No effect	N/A	N/A
	Construction[1] (potential dredging and facility installation)	Adverse	Low	Local	Short term
	Operations	Neutral	No effect	N/A	N/A
	Decommissioning (barge transport)	Neutral	No effect	N/A	N/A
	Decommissioning (potential dredging)	Adverse	Low	Local	Short term
Physical disturbance	Construction (barge transport)	Neutral	No effect	N/A	N/A
	Construction[1] (potential dredging and facility installation)	Adverse	Low	Local	Medium term
	Operations	Neutral	No effect	N/A	N/A
	Decommissioning (barge transport)	Neutral	No effect	N/A	N/A
	Decommissioning (potential dredging)	Adverse	Low	Local	Medium term

NOTES:
N/A = not applicable because no effect was predicted
1 Effects might occur via impacts on habitat for species that form part of the polar bear food chain (e.g., plankton – fish – seal – polar bear)

Beluga Whale

The proposed transport corridor passes through the southernmost part of the Kugmallit and Kittigazuit summer concentration area, one of the three shallow estuarine summer habitats used by beluga whales from late June to mid-August. Individual beluga whales remain in the concentration area for a few to several days at a time and then head out again to the Beaufort Sea offshore (Richard et al. 2001). Few beluga whales remain in the concentration area by late July or early August (Fraker and Fraker 1982). For about 20 km, the proposed route passes through the southernmost part of a beluga whale management area, the Kugmallit Bay Beluga Management Zone 1A, as designated in the Beluga Management Plan (FJMC 2001).

Construction – Barge Transport

Sensory disturbance during barge transport is predicted to change beluga whale habitat availability (see Table 10-16, shown previously). Few beluga whales will be in the western Beaufort Sea when the barge is travelling through the Beaufort Sea enroute to the Mackenzie estuary. Based on numerous studies and empirical observation of beluga whale behaviour, indirect habitat loss caused by noise disturbance from barge transport in the Beaufort Sea and Mackenzie Delta area will affect only a few whales and only for the short period while the barge is passing nearby. The extent of indirect habitat loss that might occur from sensory disturbance will be low.

There is some potential for the barging operation to affect whale hunting. The main potential effect might be to cause the few beluga whales in the area to move up to 5 km away from the southern shore of Kugmallit Bay. Because hunters usually have to travel farther than this to encounter beluga whales (Fraker and Fraker 1982), this shift would not substantively alter access to beluga whales for the beluga whale hunters.

Construction – Potential Dredging

Physical disturbance, change in water quality and sensory disturbance causing active avoidance of estuarine areas in Kugmallit and Kittigazuit bays during potential dredging will change beluga whale habitat availability. Changes in beluga whale habitat availability at Niglintgak are not expected. In the Mackenzie Estuary, beluga whales are likely the only marine mammals that might be affected by the proposed potential dredging operation. Previous observations near dredging operations suggest that the maximum distance over which temporary disturbance to beluga whales might occur is about 2.4 km from the dredge and service vessels. Because the shipping channel in Kugmallit Bay lies about 2.5 km from shore, the area within about 5 km of shore might be temporarily affected by dredging. To the extent there are any beluga whales within the area proposed for dredging, individual whales might be displaced from within a moving radius of up

to 2.5 km along the dredging path or about 4% of the Kugmallit Bay Beluga Management Zone 1A over a one to three week period and primarily along the southern shore of Kugmallit Bay. In addition to the radius of disturbance associated with the dredge, there will also be periodic disturbance from support vessel traffic during crew movements and barge resupply. The potentially affected area is the least-used part of the concentration area, and the beluga whales will still have access to the remainder. Acoustic displacement will potentially be even less than 2.4 km because of the very shallow water in the area and the greater potential for sound attenuation.

The estimated 264 ha that might be directly disturbed by dredging represents less than 1% of the 44,000 ha Kugmallit Bay Beluga Management Zone 1A.

Dredging to level the Niglintgak landing site will be acoustically isolated from the Beluga Bay–Kendall Island Bird Sanctuary beluga whale concentration area, which is more than 20 km away. Therefore, beluga whales using the Kendall Island Bird Sanctuary concentration area will not be exposed to dredging disturbance.

Dredging has the potential to disturb fish habitat both physically and by changing water quality, though it has been determined that potential dredging will not affect critical or limited habitats for the production of prey on which beluga whales or other marine mammals feed (see Section 7, Fish and Fish Habitat).

The largest potential effects of Niglintgak, from potential dredging and facility installation during construction, on beluga whale habitat availability are adverse, low magnitude, local in extent and short term.

Operations and Decommissioning and Abandonment

Changes in beluga whale habitat availability are unlikely during facility operations and decommissioning and abandonment. The gas conditioning facility at Niglintgak is designed to operate all year for 25 to 30 years. Noise will be created primarily by compressors and piping. As previously mentioned, this site is at least 20 km from any beluga whale concentration areas and is physically and acoustically isolated from the open water to the north in the Kendall Island Bird Sanctuary beluga whale concentration area. However, there might be instances where individual beluga whales are exposed to operational noise disturbance. The largest potential effects of Niglintgak during operations and decommissioning and abandonment on beluga whale habitat availability are adverse, moderate magnitude, local in extent and will be short term in duration. Low-magnitude effects from operations will be long term (see Table 10-16, shown previously).

Bowhead Whale

Bowhead whales congregate in areas of high zooplankton concentrations, which vary from year to year. Areas off the Tuktoyaktuk Peninsula and outer Mackenzie Delta are part of the bowhead whale summer feeding grounds (Shelden and Rugh 1995). Many feeding bowhead whales can be in the waters off the Yukon coast and the Mackenzie Delta in some years, and at least a few animals are present in most years.

The largest potential effects of Niglintgak, during construction and decommissioning and abandonment, on bowhead whale habitat availability are adverse, low magnitude, local in extent will be limited to the duration of the project. No effects on bowhead whale habitat availability are expected during operations (see Table 10-17, shown previously).

Construction – Barge Transport

Any change in bowhead whale habitat availability during barge transport is predicted to result from sensory disturbance. Barge towing in August might encounter bowhead whales travelling and feeding in the Beaufort Sea.

Based on observed bowhead responses to vessel traffic, the nature of indirect displacement of bowhead by a single barge in the Beaufort Sea will be temporary, perhaps an hour, in any one area through which the barge and any support vessels pass. Noise disturbance of more than a few bowhead whales will occur only if the barge is towed through or very close to a bowhead feeding aggregation. The barge tow and any support vessels could briefly disturb some of these animals if they pass within about 3.4 km of bowhead whales, though bowhead might not respond until the barge is much closer, e.g., 0.8 km. The extent of short term exclusion from habitat will be extremely small compared with available habitat in immediately adjacent areas.

Construction – Potential Dredging

A change in bowhead whale habitat availability is expected during potential dredging, only if dredging affects the habitat of species that form part of the bowhead whale food chain, e.g., plankton, as a direct result of physical disturbance or change in water quality. Potential dredging in southern Kugmallit Bay and Kittigazuit Bay would be at least 25 km from the closest area where bowhead whales might be normally encountered. Bowhead whales will also be too far away to be disturbed by any dredging that might be required at the Niglintgak gas conditioning facility site. Whereas dredging would disturb very little fish and invertebrate habitat that might contribute to the region's marine mammal productivity in the mid to upper part of the Mackenzie River estuary, it is unlikely to measurably alter pelagic habitats that produce or distribute the plankton on which bowhead whales depend.

Operations

No change in bowhead whale habitat availability is expected during operations. The Niglintgak gas conditioning facility site is physically remote and acoustically isolated from areas used by bowhead whales, which will not be exposed to operational noise disturbance.

Decommissioning and Abandonment

Effects of decommissioning will be similar to effects of the initial dredging and transport activities.

Ringed Seal

The largest potential effects of Niglintgak on ringed seal habitat availability during construction and decommissioning and abandonment are predicted to be adverse, low magnitude, local in extent and limited to the duration of the project activity. No effects are predicted during operations (see Table 10-18, shown previously).

Construction – Barge Transport

Any potential change in seal habitat availability during barge transport is predicted to result only from sensory disturbance. Barge transport has the potential to disturb some ringed seals in waters off the Yukon coast and the Mackenzie Delta in early August. In some years, ringed seals gather in relatively high densities north of the Yukon, but even then the observed density is low, i.e., 0.75 seals/km^2. Some ringed seals can also be encountered in outer Kugmallit Bay.

Based on the dispersed nature of ringed seals, their reported low sensitivity to vessels, and the location and timing of the proposed potential dredging and barge transport, effects will at most cause very localized and short term, i.e., less than one day, displacement of a few whales.

Construction – Potential Dredging

During potential dredging, a change in seal habitat availability is not expected, except if dredging affects the habitat of species that form part of the ringed seal food chain, e.g., plankton, fish, because of physical disturbance and water quality change. Ringed seals periodically use Kugmallit and Kittigazuit bays. However, species concentration areas are not present, and few, if any, individuals are likely to be present during dredging. It is possible that the few seals in the area might be displaced or attracted locally. Although dredging has potential to disturb fish habitats, effects on critical or limited habitats for the production of fish or invertebrates on which seals or other marine mammals feed are not expected (see Section 7, Fish and Fish Habitat).

Operations

A change in seal habitat availability during operations is unlikely. The Niglintgak gas conditioning facility is relatively remote from areas likely to be more intensively used by ringed seals.

Decommissioning and Abandonment

Similar effects on ringed seals can be expected during decommissioning as during construction.

Polar Bear

The largest potential effects of Niglintgak on polar bear habitat availability during all project phases are predicted to be adverse, low magnitude, local in extent and limited to the duration of project activity (see Table 10-19, shown previously).

Construction – Potential Dredging and Barge Transport

Any change in polar bear habitat availability during construction will be a result of the potential effects of physical disturbance and water quality change on polar bear food supply from dredging and facility installation.

There is no potential for direct polar bear interaction with the project because polar bears summer in pack ice areas far from the project location.

Operations

Sensory disturbance during operations might change polar bear habitat availability. A few polar bears might approach Niglintgak closely enough to be exposed to air, noise and odours. The only potential for indirect polar bear habitat loss during operation of the Niglintgak site would be when facility noise deters bears from using habitat near the noise, e.g., denning bears. Although polar bears are generally uncommon in the Mackenzie Delta region (Chetkiewicz and Marshal 1998), some denning occurs along the north coast of the proposed production area (Nagy 2003, personal communication). Polar bears have denned on Hooper Island, Pullen Island and near Tent Island. Polar bear biologists generally agree that there has been an increase in the number of bears denning on land in the Beaufort Sea region of both Alaska and Canada as a consequence of regulations that protect female bears with cubs from hunting. If this trend continues, the probability of bears denning near Niglintgak could increase, although it is still likely to be a rare occurrence. The facility is about 10 km inland from the coast of Richards Island and is relatively far from areas where polar bears regularly travel or den and is even farther from more intensively used offshore hunting and denning areas (Amstrup 2000).

Despite this, there remains some potential for a localized, low-level effect on polar bears over the long term.

Decommissioning and Abandonment

There is no potential for interaction with polar bears during decommissioning because the location of the activity is far from summer pack ice areas where polar bears could be expected. However, as with construction, there is a potential for low magnitude indirect effects through changes in polar bear food supply.

10.3.4 Taglu

Field development at Taglu will include:

- one well pad
- 10 to 15 production wells
- a gas conditioning facility
- above-ground flow lines
- one or two disposal wells
- supporting infrastructure, including an airstrip

The initial field development will involve drilling five to seven production wells from a single well pad. Full field development will require drilling an additional three to eight production wells from the same well pad within 10 years of start-up.

Construction of facility modules is expected to begin in Western Canada in 2006. Construction of facility sites is expected to begin in winter 2006. Facilities are scheduled to start up in 2009.

10.3.4.1 Baseline Conditions

Barren-ground grizzly bears use the Taglu area for foraging in spring, summer and fall, and for denning in winter. Waterfowl nesting colonies, especially on Richards Island, near the Kendall Island Bird Sanctuary and along the arctic coast are a preferred source of food for grizzly bears (Nagy 2003, personal communication).

Five bears were observed and bear signs including tracks and scat were reported at four locations during spring and summer field surveys in 2002. No barren-ground grizzly bears were observed at Taglu during aerial surveys in 2003, though seven dens were found in the Taglu lease and nearby area in 2003. See Volume 3, Section 10.3.3, Taglu, for more details about barren-ground grizzly bear habitat use.

As at Niglintgak, which is part of the outer delta, there are few caribou at Taglu and habitat is not abundant. The hydrologic and vegetation characteristics of the outer delta limit the growth of lichens, which are considered the primary winter food for caribou (Kelsall 1968). Therefore, barren-ground caribou were not considered further for the assessment in Taglu.

The baseline conditions for the bird VCs in the Taglu LSA are the same as those described for Niglintgak (see Section 10.3.3.1, Baseline Conditions), which is also on the Mackenzie Delta.

10.3.4.2 Taglu Effects

The potential effects of construction, operations and decommissioning and abandonment on habitat availability at Taglu include vegetation clearing, sensory disturbance, altered human access and changes in vegetation health.

Barren-Ground Grizzly Bear

The largest potential effects of Taglu, during all phases, on the availability of barren-ground grizzly bear habitat are adverse, low magnitude, local in extent and long term (see Table 10-20).

Table 10-21 shows changes in winter, spring and fall habitat availability during construction and operations in the Taglu LSA.

Table 10-20: Effects on Barren-Ground Grizzly Bear Habitat Availability – Taglu

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Positive[1]	Low	Local	Long term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

NOTE:
1 Revegetation could have a positive effect on habitat

Table 10-21: Change in Barren-Ground Grizzly Bear Habitat – Taglu

Habitat Value	Denning		Spring Forage		Fall Forage	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
Very high	-25	-14	0	0	0	0
High	-29	-4	0	0	-41	-41
Moderate	-34	14	-57	-57	-96	-52
Effective	-88	-4	-57	-57	-137	-93

NOTES:
See Table 10-143 for a regional context
Effective habitat is the sum of very high, high and moderate habitat values

Construction

During construction, there will be a loss of about 88 ha of effective denning habitat, 57 ha of effective spring foraging habitat and 137 ha of fall foraging habitat in the 8774-ha Taglu LSA.

Most of the reduction in habitat availability is from sensory disturbance, with fewer effects related to direct habitat loss from the project footprint, from altered human access because of the permanent road and airstrip, and fewer changes in vegetation health resulting from dust emissions.

Total project construction in the Inuvialuit Settlement Region part of the RSA will reduce the amount of effective barren-ground grizzly bear denning habitat by 1.53%, spring foraging habitat by 1.20%, and fall foraging habitat by 1.29%. Given that the home range size of a barren-ground grizzly bear is 1,154 km^2 (Nagy et al. 1983), these losses will have minimal effects on the barren-ground grizzly bear population.

Operations

Most of the reduction of effective habitat is from sensory disturbance, with fewer effects from direct vegetation clearing of the project footprint, i.e., 25 ha, increased access, and changes to vegetation health resulting from air emissions. Overall, sensory disturbance will be lower during operations than during construction. Sensory disturbances will be limited to facility maintenance periods, which will primarily be in winter. However, predicted noise levels are greater during operations than during construction. Noise levels are predicted to be even higher during maintenance flaring. The winter road will be maintained throughout operations, increasing human access to Taglu.

When compared with the Inuvialuit Settlement Region RSA, 1.02% of effective barren-ground grizzly fall foraging habitat, 0.06% of denning habitat, and 0.99% of spring foraging habitat will be lost because of operations. For similar reasons as during construction, operations will have little effect on barren-ground grizzly bear habitat availability in the Taglu LSA.

Decommissioning and Abandonment

Adverse effects on direct habitat availability for barren-ground grizzly bear will decline following decommissioning and abandonment of Taglu. Reclaimed sites will re-grow vegetation, either through natural revegetation or planting. Depending on the characteristics and species composition of the re-established community, reclamation could result in enhanced habitat for barren-ground grizzly bears.

Although no further vegetation clearing is expected during operations, land subsidence might result in direct changes to habitat availability. However, land subsidence is expected to have little effect on vegetation at Taglu. Subsidence will probably not affect denning habitat because dens tend to be on steep embankments and ridges that are not prone to flooding.

Greater White-Fronted Goose

The largest potential effects of Taglu, during all phases, on the availability of greater white-fronted goose habitat are adverse, low magnitude, local in extent and long term (see Table 10-22).

Table 10-23 shows the results of nesting and foraging habitat modelling for the greater white-fronted goose and the change in habitat availability during construction and operation of Taglu.

Construction

Construction will decrease effective nesting and foraging habitat for greater white-fronted geese relative to habitat availability in the Inuvialuit Settlement Region RSA (see Volume 3, Section 10, Wildlife). Most of this reduction is from sensory disturbance confined to construction. A smaller amount will result from direct habitat loss from vegetation clearing for the project footprint.

The Taglu gas conditioning facility site is not critical to greater white-fronted goose populations on the outer Mackenzie Delta. Nesting and feeding areas for relatively few geese would be affected by vegetation clearing at these sites. Aircraft and boat-related disturbance will encompass a larger area and might affect critical areas on the coast of the outer delta where greater white-fronted geese concentrate during brood-rearing and moulting.

Operations and Decommissioning and Abandonment

Project effects on greater white-fronted goose effective nesting and foraging habitat will be less during operations and decommissioning and abandonment than during construction because of reduced sensory disturbance. However, as with construction, the amount of habitat loss is small relative to habitat availability in the Inuvialuit Settlement Region RSA (see Volume 3, Section 10, Wildlife).

Table 10-22: Effects on Bird Habitat Availability – Taglu

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse Positive[1]	Low	Local	Long term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Change in vegetation health	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term

NOTES:
Birds species included in Taglu assessment: greater white-fronted goose, snow goose, tundra swan, scaup, peregrine falcon, whimbrel and Arctic tern
1 Revegetation could have a positive effect on habitat for greater white-fronted goose, snow goose and scaup

Table 10-23: Change in Greater White-Fronted Goose Habitat – Taglu

Habitat Value	Nesting		Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
High	-1	0	-6	-4
Moderate	-11	-2	-4	2
Effective	-12	-2	-10	-2

NOTES:
See Table 10-143 for a regional context
Effective habitat is the sum of high and moderate habitat values

Snow Goose

The largest potential effects of Taglu, during all phases, on snow goose habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-22, shown previously).

Construction

Potential effects on snow goose habitat availability on the outer delta during construction will include:

- disturbance of nesting, brood-rearing and moulting snow geese at Kendall Island Bird Sanctuary and nearby areas along the coast of the outer Mackenzie Delta from June to August

- disturbance of fall-staging snow geese on the outer delta in late August and September

Project disturbance is expected to be greatest during construction.

Direct habitat loss and alteration will be centred at the facilities and are not considered likely to reduce use of the outer delta by snow geese. Vegetation clearing will be well away from the snow goose nesting colony. Clearing could result in the loss of small areas of foraging habitat for fall-staging snow geese on the outer delta.

Residual effects will be reduced by mitigation measures focused on aircraft avoiding snow goose nesting and staging areas.

Operations and Decommissioning and Abandonment

Disturbance of snow geese during operations and decommissioning is expected to be less than during construction. Therefore, the potential for effects is also reduced. Revegetation at decommissioning and abandonment might have positive, long-term effects on snow goose habitat.

Tundra Swan

The largest potential effects of Taglu, during all phases, on tundra swan habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-22, shown previously). Table 10-24 shows the change in habitat for tundra swans from construction and operation of Taglu.

Construction

The habitat model predicts that construction will reduce the amount of available effective tundra swan nesting and foraging habitat by 231 ha. The amount of habitat loss is small relative to habitat availability in the Inuvialuit Settlement Region RSA (see Volume 3, Section 10, Wildlife). Most of the loss will be from sensory disturbance caused by construction activities. The remainder will largely be a result of direct habitat loss from vegetation clearing for the project footprint.

Table 10-24: Change in Tundra Swan Habitat – Taglu

Habitat Value	Nesting		Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
High	-174	-12	-19	-8
Moderate	-57	-17	13	3
Effective	-231	-29	-6	-5
NOTES: See Table 10-143 for a regional context Effective habitat is the sum of high and moderate habitat values				

Disturbance of flightless moulting birds, especially the large flocks that gather on the coast of the outer delta, and of broods are of particular concern. Aircraft and barge and boat traffic will likely cause the most disturbance. Direct habitat loss is expected to be limited to the areas of the facilities, which are not critical to tundra swans on the outer Mackenzie Delta. Therefore, only a few nesting pairs and feeding individuals might be affected by direct habitat loss.

Operations and Decommissioning and Abandonment

During operations and decommissioning and abandonment, loss of effective tundra swan nesting and foraging habitat will be minimal and less than during construction. Tundra swan habitat availability will be affected primarily by sensory disturbance.

Scaup

The largest potential effects of Taglu, during all phases, on scaup habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-22, shown previously).

Table 10-25 shows the changes in nesting habitat availability for greater scaup during construction and operation of Taglu.

Table 10-25: Change in Greater Scaup Habitat – Taglu

Habitat Value	Nesting	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
High	0	0
Moderate	0	0
Effective	0	0
NOTES: See Table 10-143 for a regional context Effective habitat is the sum of high and moderate habitat values		

Construction

Construction at Taglu is not expected to reduce the amount of available effective greater scaup nesting habitat.

Potential effects on habitat availability for greater and lesser scaup on the outer delta during construction will include:

- disturbance of flocks of flightless, moulting scaup from late June through mid-August
- disturbance of broods in July

During aerial surveys in 2001 and 2002, flocks of moulting scaup were seen most often in the central and southern parts of the outer delta, not near the coast. Broods were more widespread in the outer delta. Disturbances that result in the avoidance of favoured moulting and brood-rearing areas could affect up to several thousand scaup. Aircraft, barge and boat disturbances are expected to be greatest during construction.

The alteration of habitat availability will be centred at the Taglu facilities. Habitat loss and alteration at Taglu is not considered likely to reduce use of the outer delta by scaup. There is much suitable habitat on the outer delta for nesting scaup, although favoured waterbodies for moulting might be less numerous. Clearing of vegetation could result in the loss of small areas of nesting habitat for a few scaup.

Mitigation measures will require that aircraft, barges and boats avoid flocks of flightless, moulting scaup.

Operations and Decommissioning and Abandonment

Operations and decommissioning and abandonment at Taglu will not decrease the amount of available effective nesting habitat for greater scaup and will create less sensory disturbance than construction because of less aircraft, barge and boat traffic.

Little vegetation clearing for site maintenance will be required during operations because most clearing will be completed during construction. Revegetation at decommissioning could enhance habitat availability for scaup in the long term.

Peregrine Falcon

The largest potential effects of Taglu, during all phases, on peregrine falcon habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-22, shown previously).

Construction

Construction activities are not expected to affect habitat availability for peregrine falcons at Taglu because there is no cliff-nesting habitat on the outer Mackenzie Delta.

Some foraging areas might be disturbed, but disturbance is expected to be periodic and of short duration. For example, some peregrine falcon species might be dispersed during aircraft overflights to other areas of the outer delta. There are many suitable foraging areas for peregrine falcons on the outer delta.

Operations and Decommissioning and Abandonment

Operation and decommissioning and abandonment activities at Taglu are not expected to affect habitat availability for peregrine falcons because they are uncommon in the area and suitable cliff-nesting habitat does not exist. There will continue to be some minor indirect effects through loss and disturbance of the habitats of their prey, and through direct disturbance of some hunting peregrine falcons by aircraft.

Whimbrel

The largest potential effects of Taglu, during all phases, on whimbrel habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-22, shown previously). Table 10-26 shows the effect on habitat for whimbrel from construction and operation of Taglu.

Table 10-26: Change in Whimbrel Habitat – Taglu

Habitat Value	Nesting		Foraging	
	Habitat Change – Construction (ha)	**Habitat Change – Operations** (ha)	**Habitat Change – Construction** (ha)	**Habitat Change – Operations** (ha)
High	0	0	0	0
Moderate	-8	-7	-8	-8
Effective	-8	-7	-8	-8
NOTES: See Table 10-143 for a regional context Effective habitat is the sum of high and moderate habitat values				

Construction

Potential effects on whimbrel habitat availability on the outer delta during construction will include:

- direct loss of nesting and feeding habitat resulting from vegetation clearing
- disturbance of nesting and feeding areas by aircraft and human activities

Construction will decrease the amount of available effective nesting and foraging habitat for whimbrel at Taglu by only a few hectares.

These effects are likely to reduce habitat availability for only a few whimbrel near the Taglu facilities. Loss of habitat availability will not reduce whimbrel populations on the outer delta because suitable habitat for whimbrel is widespread throughout the outer delta.

Operations and Decommissioning and Abandonment

Loss of available nesting and foraging habitat during operations and decommissioning and abandonment will be low and will affect a few whimbrel near the Taglu facilities. Large areas of habitat will remain unaffected.

Aircraft and human disturbance are expected to be less than during construction, and there will be minimal additional vegetation clearing.

Arctic Tern

The largest potential effects of Taglu, during all phases, on Arctic tern habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-22, shown previously).

Construction

Potential effects on Arctic tern habitat availability on the outer delta during construction will include:

- destruction and disturbance of nesting colonies from June to August
- disturbance of favoured feeding areas from June to August

Arctic terns nest and forage throughout the outer Mackenzie Delta. However, the proximity of nesting colonies and productive feeding areas to the Taglu facilities is not known.

The loss or disturbance of feeding habitat near the Taglu facilities might affect some Arctic tern. If Arctic tern colonies are near the facilities or the surrounding disturbance, there is a potential for adverse effects on the local population.

Residual effects will be reduced by mitigation measures focused on avoiding Arctic tern nesting colonies.

Operations and Decommissioning and Abandonment

Habitat loss and sensory disturbance will be lower during operations and decommissioning and abandonment than during construction. Disturbance from aircraft, barges and boats and other human activities will continue to some extent during these project phases. With mitigation measures in place, only a few Arctic tern might be affected in localized areas.

10.3.5 Parsons Lake

Development at Parsons Lake will include:

- a north pad consisting of:
  - nine to 19 production wells
  - two disposal wells
  - a gas conditioning facility
- a south pad with three to seven production wells
- above-ground flow lines on the north pad and from the south pad to the north pad
- supporting infrastructure, including an airstrip

The initial development will involve drilling nine wells from the proposed north pad. Up to 10 contingent wells might be drilled at the north pad. Three wells will be drilled at the south pad seven to 10 years after the initial phase. Up to four contingent wells might be drilled at the south pad. The initial well drilling will occur uninterrupted for 18 months.

Construction of facility modules is expected to begin in Western Canada in 2007 or earlier. Construction of facility sites is expected to begin in winter 2007. Facilities are scheduled to start up in 2009.

10.3.5.1 Baseline Conditions

The Parsons Lake lease falls within the annual early winter range of the Cape Bathurst caribou herd. The Cape Bathurst herd extends west into the production area through the Parsons Lake lease to the Mackenzie River in winter (Nagy et al. 1999). There are no calving grounds near the proposed development area.

Aerial surveys in 2003 recorded 795 caribou and reindeer on the Parsons Lake lease. No caribou tracks were observed in the lease during the late winter track count surveys, although habitat use by caribou might vary greatly between years. Caribou signs observed during field surveys were noted in habitat types that support a relatively high cover of lichens, the principal winter food source of caribou.

The rolling terrain with silty, sandy and gravel deposits on the Parsons Lake lease provides denning opportunities and a variety of forage types for grizzly bears. It might also support Arctic ground squirrel colonies, a food source for barren-ground grizzly bears. See Volume 3, Section 10.3.4, Parsons Lake for more details about barren-ground grizzly bear habitat use.

Barren-ground grizzly bears were not observed on the leases during aerial surveys in June 2003, though a visual observation of one bear and sign of digging were recorded during spring and summer field surveys in 2002. Twelve dens were located during aerial surveys in 2003.

There is little suitable nesting habitat for greater white-fronted geese in the Parsons Lake area. Few greater white-fronted geese were recorded there during aerial surveys in 2001 and 2002, and no large flocks of brood-rearing or moulting geese were seen in the area.

Few snow geese were observed in the Parsons Lake area during aerial surveys in 2001 and 2002. Habitat for snow geese appears to be very limited. There are no snow goose nesting colonies in the Parsons Lake area.

Tundra swans were observed primarily northwest and north of Parsons Lake during aerial surveys in 2001 and 2002. There was a smaller concentration of sightings to the northeast and east of the lake. Few swans were seen along the North Storm Hills, which are along the west edge of the Parsons Lake lease. There are relatively few ponds and lakes in that area and minimal nesting habitat for tundra swans. Few large flocks of tundra swans were observed in the Parsons Lake area during the aerial surveys, and the observations suggest that, unlike the outer Mackenzie Delta, the area is not used by large flocks of moulting or brood-rearing birds.

The Parsons Lake area provides suitable nesting habitat for scaup. Several waterbodies in the area are used by many moulting scaup during the late summer, including Parsons Lake, West Hans Lake and East Hans Lake. The North Storm Hills are higher and drier with fewer waterbodies and fewer waterfowl, including scaup.

Peregrine falcons are uncommon in the Parsons Lake area. Cliff-nesting habitat is not available for peregrine falcons near Parsons Lake facilities. There are cliffs in Caribou Hills overlooking the delta, but no nests are known in that area (GNWT 2004). The cliffs are also far enough from Parsons Lake facilities that project activities will not disturb any new nesting attempts. Extensive foraging habitat does exist in the Parsons Lake area, and shorebirds, waterfowl and other prey are abundant there.

Whimbrels were regularly observed in small numbers during nesting-season ground surveys in the Parsons Lake area in 2002. However, the extent of suitable nesting habitat is not completely known. Whimbrels frequent low-centred polygon lowland habitats and wet sedge tundra or high-centred polygon upland habitats (Skeel and Mallory 1996).

The Parsons Lake area has many areas suitable for Arctic tern nesting and feeding. During 2001 and 2002 aerial surveys, most Arctic terns were observed northwest, north and northeast of Parsons Lake. Sightings included observations of nesting colonies and foraging flocks.

10.3.5.2 Parsons Lake Effects

The potential effects of construction, operations and decommissioning and abandonment on habitat availability at Parsons Lake include vegetation loss, sensory disturbance, altered human access and changes to vegetation health resulting from air and dust emissions.

The highest level of effect will occur on barren-ground caribou, where sensory disturbance could have a moderate, local effect. Vegetation change could also cause a low, local but far future effect on habitat availability for several VCs.

Barren-Ground Caribou

The Parsons Lake lease is within the Cape Bathurst herd's primary range from mid-October through November. The herd typically moves to the east of the Husky Lakes by mid-December (Nagy 2003, personal communication). The Parsons Lake area is a secondary range from December through mid-April, i.e., some, although fewer caribou locations were noted (Nagy 2003, personal communication).

Caribou distribution and habitat use in the Parsons Lake lease are not well understood. Regional movements of caribou in winter are likely affected by several factors, including snow depth, forage availability and disturbance. As a result, the distribution and abundance of caribou in the lease could vary from year to year, depending on the influence of these factors within and outside the lease.

Table 10-27 shows the effects on barren-ground caribou habitat availability at Parsons Lake.

Construction

Sensory disturbance during construction will include noise and movements from vehicles, aircraft, construction equipment, drilling, flaring, human presence and visual disturbances from lights and flaring. Increased access because of the project is not expected in barren areas of the tundra. Dust generated by vehicles on the new all-weather roads and airstrip could affect vegetation health up to 200 m away.

Construction in the Parsons Lake lease will reduce barren-ground caribou effective winter foraging habitat (see Table 10-28). Most of the loss of effective habitat is from sensory disturbance.

Although effective habitat loss is 2.61% in the Inuvialuit Settlement Region, potential effects result in a moderate-magnitude effect because this area is used for hunting.

Table 10-27: Effects on Barren-Ground Caribou Habitat Availability – Parsons Lake

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Far future
	Operations	Adverse	Low	Local	Far future
	Decommissioning and abandonment	Adverse	Low	Local	Far future
Sensory disturbance	Construction	Adverse	Moderate	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Far future
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

Table 10-28: Change in Barren-Ground Caribou Habitat – Parsons Lake

Habitat Value	Winter Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
Very high	-215	0
High	149	0
Moderate	-768	-52
Effective	-834	-52

NOTES:
See Table 10-143 for a regional context
Effective habitat is the sum of very high, high and moderate habitat values

Operations

Sensory disturbances will generally be lower during operations than during construction because fewer people will be working at Parsons Lake. Changes in vegetation health at Parsons Lake because of NO_2 emissions could adversely affect caribou winter forage, particularly lichens at a very local level in a few locations.

In the Inuvialuit Settlement Region, 0.46% of effective barren-ground caribou winter foraging habitat is lost during operations. Because sensory disturbance decreases during operations, the magnitude of effects is considered low.

Decommissioning and Abandonment

Adverse effects on barren-ground caribou habitat availability are expected to gradually decline following reclamation of the Parsons Lake well pads. Reclaimed sites will undergo successional replacement by pioneer vegetation communities. This will result in recovery of habitat capability, although regeneration of lichens, the preferred winter food source for caribou, will occur slowly and might not return to baseline conditions for 50 to 100 years or more. Only minor and local effects of dust on vegetation health could occur during decommissioning.

The largest potential effects of Parsons Lake during decommissioning and abandonment on the availability of barren-ground caribou habitat are adverse, low magnitude, local in extent and far future in duration.

Barren-Ground Grizzly Bear

Barren-ground grizzly bears use the Parsons Lake area for foraging in spring, summer and fall and for denning in winter. The Parsons Lake lease might be more important for denning than either Niglintgak or Taglu.

The largest potential adverse effects of Parsons Lake, during all phases, on barren-ground grizzly bear habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-29).

Table 10-29: Effects on Barren-Ground Grizzly Bear Habitat Availability – Parsons Lake

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Positive[1]	Low	Local	Long term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

NOTE:
1 Revegetation could have a positive effect on habitat

Table 10-30 shows the change in winter, spring and fall habitat availability during construction and operation of Parsons Lake.

Table 10-30: Change in Barren-Ground Grizzly Bear Habitat – Parsons Lake

Habitat Value	Denning		Spring Foraging		Fall Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
Very high	-1,190	-176	0	0	0	0
High	211	90	-92	-92	-22	-22
Moderate	-660	-132	-322	-292	-264	-238
Total	-1,639	-218	-414	-384	286	-260

NOTES:
See Table 10-143 for a regional context
Effective habitat is the sum of very high, high and moderate habitat values

Construction

Year-round construction will generate building noise, smells from food and wastes, visual disturbances from human and equipment movements, and light from flaring and facilities. Bears are unlikely to become quickly habituated to construction disturbance because they are hunted in the region. In barren areas of the tundra, increased access because of the project is not expected. Any potential effects of dust on barren-ground grizzly bear habitat will occur at a very local level and in just a few locations.

Construction at Parsons Lake will reduce the amount of effective barren-ground grizzly bear habitat. Most of the reduction of effective barren-ground grizzly bear habitat is from sensory disturbance, with lesser effects caused by direct loss from the footprint.

Within the Inuvialuit Settlement Region part of the RSA, total project construction will reduce the amount of effective barren-ground grizzly bear denning habitat by 1.53%, spring foraging habitat by 1.20%, and fall foraging habitat by 1.29%.

Relative to the 1,154 km^2 home range of a barren-ground grizzly bear (Nagy et al. 1983) and because barren-ground grizzly bear denning habitat is not limiting in the region (Nagy 2003, personal communication), the loss of 1,638 ha of denning habitat, 414 ha of spring foraging habitat and 286 ha of fall foraging habitat will have little effect on the grizzly bear population.

Operations

As with construction, the main effect of operations in the Parsons Lake LSA will be sensory disturbances from facility processes, such as noise from compressors

and occasional flaring. Visual disturbances from human presence, vehicle and aircraft movement and construction activities will decrease during operations and be limited to facility maintenance periods, which will be primarily in winter.

Decreases in effective habitat availability for spring and fall foraging barren-ground grizzly bears during operations were similar to changes in the availability of these habitats during construction. However, effective denning habitat during operations will be affected less than during construction.

Total project operations in the Inuvialuit Settlement Region part of the RSA will reduce the amount of effective barren-ground grizzly bear denning habitat by 0.06%, spring foraging habitat by 0.99%, and fall foraging habitat by 1.02%, which will have little effect on the grizzly bear population.

Decommissioning and Abandonment

As with barren-ground caribou, adverse effects on barren-ground grizzly bear habitat availability are expected to gradually decline following reclamation and abandonment of Parsons Lake. Reclaimed sites will undergo vegetation regrowth, either through natural succession or planting. Depending on the characteristics and species composition of the re-established community, reclamation could result in enhanced habitat value for barren-ground grizzly bears.

Greater White-Fronted Goose

The largest potential effects of Parsons Lake, during all phases, on the availability of greater white-fronted goose habitat are adverse, low magnitude, local in extent and long term (see Table 10-31).

Table 10-32 shows the changes in nesting and foraging habitat availability for the greater white-fronted goose during construction and operation of Parsons Lake.

Construction

Project construction will cause a small reduction in the amount of available effective nesting and foraging habitat for greater white-fronted geese. However, relative to habitat availability in the Inuvialuit Settlement Region RSA (see Volume 3, Section 10, Wildlife), this amount of habitat loss will have no effect on white-fronted goose populations. The reduction in habitat availability will be largely a result of sensory disturbance from construction activities and aircraft.

Operations and Decommissioning and Abandonment

Operations activities will reduce the area of greater white-fronted goose effective nesting and foraging habitat by a very small amount. Less sensory disturbance during operations will result in fewer effects on habitat availability than during construction. Nesting and especially foraging habitat will remain abundant in the Parsons Lake LSA.

Table 10-31: Effects on Bird Habitat Availability – Parsons Lake

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse Positive[1]	Low	Local	Long term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Change in vegetation health	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term

NOTES:
Bird species included in the Parsons Lake assessment: greater white-fronted goose, snow goose, tundra swan, scaup, peregrine falcon, whimbrel and Arctic tern
1 Revegetation could have a positive effect on habitat for greater white-fronted goose and snow goose

Table 10-32: Change in Greater White-Fronted Goose Habitat – Parsons Lake

Habitat Value	Nesting		Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
High	-1	0	-1	0
Moderate	-25	-8	-32	-14
Effective	-26	-8	-33	-14

NOTES:
See Table 10-143 for a regional context
Effective habitat is the sum of high and moderate habitat values

Snow Goose

The largest potential effects of Parsons Lake, during all phases, on snow goose habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-31, shown previously).

All Phases

Few snow geese use the Parsons Lake area, so important project interactions with snow geese at Parsons Lake are not expected. Habitat availability for a few snow geese might be affected, and a few geese might be affected by aircraft overflights.

Tundra Swan

The largest potential effects of Parsons Lake, during all phases, on tundra swan habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-31, shown previously). Table 10-33 shows the change in tundra swan habitat from construction and operation of Parsons Lake.

Table 10-33: Change in Tundra Swan Habitat – Parsons Lake

Habitat Value	Nesting		Foraging	
	Habitat Change – Construction (ha)	**Habitat Change – Operations** (ha)	**Habitat Change – Construction** (ha)	**Habitat Change – Operations** (ha)
High	-166	-7	-19	-5
Moderate	-438	-21	9	-2
Effective	-604	-28	-10	-7
NOTES: See Table 10-143 for a regional context Effective habitat is the sum of high and moderate habitat values				

Construction

There will be a reduction in the amount of effective tundra swan nesting or foraging habitat in the Parsons Lake lease during construction. Most of this reduction will be sensory disturbance from construction activities, with the remainder caused by the footprint of the facilities. Relative to habitat availability in the Inuvialuit Settlement Region RSA (see Volume 3, Section 10, Wildlife), this amount of habitat loss will have no effect on swan populations. There will still be a lot of unaffected habitat at Parsons Lake.

Tundra swans were observed primarily to the northwest and north of Parsons Lake, and there was a smaller concentration of sitings to the northeast and east of the lake. Few swans were seen along the North Storm Hills, which is along the south edge of the Parsons Lake lease. There are relatively few ponds and lakes in that area and little nesting habitat for tundra swans.

Few large flocks of tundra swans were observed in the Parsons Lake area during aerial surveys. The observations suggest that, unlike the outer Mackenzie Delta, the area is not used by large flocks of moulting or brood-rearing birds.

Operations and Decommissioning and Abandonment

Once construction is completed and normal operations begin, sensory disturbance will be reduced. Effects on effective nesting and foraging habitat will result primarily from the project footprint and will be minimal.

Operations and decommissioning and abandonment of the facilities will not adversely affect habitat availability for large concentrations of swans. This is because of the dispersed distribution of breeding and moulting swans in the Parsons Lake area. Some swans might avoid habitat because of disturbance, though the area affected will likely be small relative to the area used by breeding tundra swans in the Parsons Lake area.

Scaup

The largest potential effects of Parsons Lake, during all phases, on scaup habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-31, shown previously). Table 10-34 shows the change in great scaup habitat from construction and operation of Parsons Lake.

Construction

A habitat model for greater scaup was only constructed for nesting habitat because data was not available for aquatic habitats. Construction will reduce the area of effective nesting habitat by only a few hectares and will have no effect on scaup populations.

Table 10-34: Change in Greater Scaup Habitat – Parsons Lake

Habitat Value	Nesting	
	Habitat Change – Construction (ha)	**Habitat Change – Operations** (ha)
High	0	0
Moderate	-3	-2
Effective	-3	-2
NOTES: See Table 10-143 for a regional context Effective habitat is the sum of high and moderate habitat values		

Operations and Decommissioning and Abandonment

As with construction, operations and decommissioning and abandonment will make only a few hectares of effective greater scaup nesting habitat unavailable.

Aircraft disturbance will be lower during operations than during construction and will continue into decommissioning.

Peregrine Falcon

The largest potential effects of Parsons Lake, during all phases, on peregrine falcon habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-31, shown previously).

Construction

Peregrine falcons are uncommon in the Parsons Lake area. Cliff-nesting habitat is not available for peregrine falcons and there are no known nest sites in the area. However, extensive foraging habitat does exist in the area, and shorebirds, waterfowl and other prey are abundant there.

Some foraging areas might be disturbed, but disturbance is expected to be periodic and of short duration. For example, some peregrine falcon species might be dispersed during aircraft overflights to other areas of the outer delta. There are many suitable foraging areas for peregrine falcons on the outer delta.

Operations and Decommissioning and Abandonment

Operations and decommissioning and abandonment at Parsons Lake are not expected to affect habitat availability for peregrine falcons because the species is uncommon in the area and suitable cliff-nesting habitat does not exist. There will continue to be some minor indirect effects from loss and disturbance of the habitats of their prey and from direct disturbance of some hunting peregrine falcons by aircraft.

Whimbrel

The largest potential effects of Parsons Lake, during all phases, on whimbrel habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-31, shown previously). Table 10-35 shows the change in whimbrel habitat from Parsons Lake construction and operations.

Table 10-35: Change in Whimbrel Habitat – Parsons Lake

Habitat Value	Nesting		Foraging	
	Habitat Change – Construction (ha)	**Habitat Change – Operations** (ha)	**Habitat Change – Construction** (ha)	**Habitat Change – Operations** (ha)
High	-3	-2	-12	-11
Moderate	0	0	3	1
Effective	-3	-2	-9	-10

NOTES:
See Table 10-143 for a regional context
Effective habitat is the sum of high and moderate habitat values

Construction

The amount of effective whimbrel nesting or foraging habitat will decrease by a very small amount during construction.

Disturbance effects are likely to reduce habitat availability for a few whimbrel, primarily near the north and south pads. Reductions of whimbrel populations in the Parsons Lake area are not expected. Aircraft and human disturbance are expected to affect few whimbrel.

Operations and Decommissioning and Abandonment

Operations and decommissioning and abandonment will reduce the area of effective whimbrel nesting and foraging by only a few hectares. Disturbance effects are likely lower during operations and decommissioning than during construction.

Arctic Tern

The largest potential effects of Parsons Lake, during all phases, on Arctic tern habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-31, shown previously).

Construction

Loss of Arctic tern habitat availability in the Parsons Lake area during construction is related to disturbance. Disturbance of nesting colonies and favoured feeding areas from June to August is a potentially important effect. Disturbance will be greatest around the north and south pads. The north pad at the northeast corner of Parsons Lake is closer than the south pad to areas with higher densities of Arctic terns. Based on observations in 2001 and 2002, the most suitable nesting and feeding habitats for Arctic terns are northwest, north and northeast of Parsons Lake. Loss or disturbance of feeding habitat near the facilities might affect several birds.

Operations and Decommissioning and Abandonment

The main potential project effects on habitat availability for Arctic terns in the Parsons Lake area during operations and decommissioning and abandonment are related to disturbance and will be similar to those predicted for construction.

10.3.6 Gathering Pipelines and Associated Facilities

This part of the assessment considers potential effects of the components of the gathering pipelines and associated facilities, including pipelines that collect and transport natural gas and NGLs from the three anchor fields to the facility in Inuvik. The gathering pipelines and associated facilities include the:

- Niglintgak lateral
- Parsons Lake lateral
- Taglu lateral
- Storm Hills lateral
- Inuvik area facility
- Storm Hills pigging facility

Gathering pipelines will be buried, except where the Niglintgak lateral is suspended from an access bridge at the barge landing and across Zed Creek where the Parsons Lake lateral might have an aerial suspension.

Ice roads and pads might be constructed on the travel lanes north of the Inuvik area facility to facilitate construction equipment movement along the right-of-way. Maintenance crews equipped with graders and water trucks will maintain the travel lane during pipeline construction.

All clearing and pipeline installation will take place under frozen soil conditions over two winter seasons. Some working areas outside the final pipeline right-of-way width will be cleared at water crossings and facility sites.

Disturbance of the natural environment will be minimal during operations, involving periodic pipeline pigging, monthly aerial patrols and seasonal ground patrols at select locations. Wet soil conditions will prohibit ground patrols along much of the lateral lines in summer. Woody regrowth immediately over lateral pipeline trenches and the adjacent travel lines, which have a total width of 10 m or less, will be cleared at least every 10 years. Pipeline operations involve pipeline pigging, aerial line patrols and pipeline integrity inspection all year. Summer-only activities include ground patrol, pipeline repair, vegetation management, if needed, and post-construction monitoring.

The Storm Hills pigging facility will disturb a footprint of about 5.2 ha, of which 1 ha will be fenced. The associated electric and, or, diesel generators and pumps will produce noise when operating. Lighting will be restricted to times when personnel are on site. Expected air emissions from the electrical generators, stabilizer reboiler and heat medium reboiler include NO_x, i.e., nitrogen oxide, CO_2, i.e., carbon dioxide, CO, i.e., carbon monoxide, and particulate matter.

Natural gas and NGLs will be separated and processed at the Inuvik area facility. The size of the Inuvik area facility site will be about 48 ha, of which 26 ha will be fenced. The facility will house the maintenance, administration and control room

structures for operations and maintenance staff. Electric and, or, diesel generators and pumps at the facility will produce noise when operating. Lighting will be restricted to times when personnel are on site. Expected air emissions from the residue gas compressors, propane refrigerant compressors, electrical generators, stabilizer reboiler and heat medium reboiler include NO_x, i.e., nitrogen oxide, CO_2, i.e., carbon dioxide, CO, i.e., carbon monoxide, and particulate matter. A vent and flare system will include a high-pressure and low-pressure flare that will release combustible gaseous streams during operational upsets. A more detailed description of the gathering pipelines and associated facilities can be found in Volume 2, Project Description.

The project will affect wildlife habitat availability along the gathering pipelines and associated facilities by vegetation change, sensory disturbance, altered access and change in vegetation health.

10.3.6.1 Baseline Conditions

The Parsons Lake lateral and the gathering pipelines south of Richards Island cross barren-ground caribou winter range. Caribou arrive in this area by mid-October and leave, depending on the year, from December to April. In particular, the Parsons Lake area is considered a focal area for barren-ground caribou in November.

No barren-ground caribou or tracks were sighted during aerial surveys and winter track counts along the gathering pipelines. However, caribou pellets were counted in the riparian black spruce and shrub habitat type. Barren-ground caribou were sighted incidentally in nine habitat types and along the Niglintgak and Parsons Lake laterals. Habitat use by caribou varies greatly between years, so caribou occurrence could also vary greatly between years.

Barren-ground grizzly bears use the area of the gathering pipelines and associated facilities area for foraging in spring, summer and fall, and for denning in winter. Foraging on caribou carrion has been noted in the Parsons Lake area, and foraging on waterfowl nesting colonies has been observed on Richard's Island. Dens along the gathering pipelines are in upland areas characterized by rolling hills, loose soils and numerous lakes and wetlands.

Barren-ground grizzly bear were sighted along the gathering pipelines area during spring and summer surveys. Fifty-nine barren-ground grizzly bear den sites were recorded during aerial surveys along the gathering pipelines.

Suitable nesting habitat for greater white-fronted geese only exists along the northern part of the gathering pipelines, on the outer Mackenzie Delta. Relatively few scattered, presumably nesting, birds reside there. No large flocks of this species were observed along the gathering pipelines route during field work in 2001 and 2002. Flocks appeared to prefer the coast of the outer delta.

Snow goose habitat is found primarily along the northern part of the gathering pipelines, where they will traverse the outer Mackenzie Delta.

Tundra swans were distributed unevenly along the route of the gathering pipelines during aerial surveys in 2001 and 2002. Their distribution reflected the distribution of waterbodies along the proposed corridor. The most suitable habitat was on the outer Mackenzie Delta, southeast of Noell Lake, south of Jimmy Lake and southeast of Bonnetplume Lake.

There is good nesting and moulting habitat available for scaup along the gathering pipelines, though densities of scaup were lower along the gathering pipelines than in the Parsons Lake area.

The route of the gathering pipelines includes suitable foraging habitat for peregrine falcons, but there are no known nests or cliff-nesting habitat in the area (GNWT 2004).

Whimbrels occur along the route of the gathering pipelines, but their numbers and distribution are poorly known. During aerial surveys in 2001 and 2002, whimbrels were observed most frequently in the area of North Storm Hills, south of Parsons Lake.

Most Arctic terns observed during aerial surveys of the gathering pipelines and associated facilities were sighted in the north where the gathering pipelines will cross the outer Mackenzie Delta. That area provides the best nesting and feeding habitat.

10.3.6.2 Gathering Pipelines and Associated Facilities

The potential effects of construction, operations and decommissioning and abandonment on habitat availability along the gathering pipelines and associated facilities include vegetation clearing, sensory disturbance, altered human and predator access, and effects on vegetation health resulting from dust and air emissions.

Barren-Ground Caribou

The potential effects of the gathering pipelines and associated facilities on barren-ground caribou habitat availability will occur during construction, when sensory disturbance could have a moderate-magnitude effect within the local study area. All other effects will be low magnitude and restricted to the LSA. The duration of all effects will be limited to the duration of project activities, except low-magnitude, local effects of vegetation clearing, which could extend into the far future (see Table 10-36).

Table 10-36: Effects on Barren-Ground Caribou Habitat Availability – Gathering Pipelines and Associated Facilities

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Far future
	Operations	Adverse	Low	Local	Far future
	Decommissioning and abandonment	Adverse	Low	Local	Far future
Sensory disturbance	Construction	Adverse	Moderate	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

Results of barren-ground caribou winter foraging habitat model for the gathering pipelines and associated facilities are shown in Table 10-37.

Table 10-37: Change in Barren-Ground Caribou Habitat – Gathering Pipelines and Associated Facilities

Habitat Value	Winter Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
Very high	-5,019	-213
High	-893	-41
Moderate	-3,835	-239
Effective	-9,747	-493
NOTES: See Table 10-143 for a regional context Effective habitat is the sum of very high, high and moderate habitat values		

Construction

Disturbance during construction of the gathering pipelines and associated facilities will include noise from vehicles, helicopters, construction equipment and human presence. It is not likely that caribou will quickly habituate to construction disturbances because caribou already avoid contact with humans because of the hunting that occurs throughout the region. Dust deposition during

construction could adversely affect vegetation health, particularly lichen health, and could extend into the far future because lichen recovery can take up to 100 years (see Section 9, Vegetation).

Construction will reduce the amount of effective barren-ground caribou winter foraging habitat. Most of the effective habitat lost is from sensory disturbance. Although over 9,000 ha of foraging habitat will be removed during construction, this area represents a small portion of the habitat available in the Inuvialuit Settlement Region RSA (see Table 10-143). Construction is predicted to decrease effective barren-ground caribou habitat by only 2.61%. Given the large winter range of barren-ground caribou, construction is likely to have a low- to moderate-magnitude effect on barren-ground caribou habitat availability.

Operations

Vegetation clearing during operations consists of removing woody regrowth immediately over the lateral pipelines about every 10 years, causing little additional direct habitat change. At the Storm Hills pigging facility and the Inuvik area facility, air emissions during operations will include nitrogen oxides, carbon dioxide, carbon monoxide and particulate matter with potential changes to lichen health. Sensory disturbance will be substantially less during operations than during construction because human activity will be much less. For example, workers will only be on site during periodic maintenance at facility sites, including periodic pigging, repairs and vegetation management. The rights-of-way will also be flown at regular intervals, and ground checks will be done at specific locations. A minimal increase in access is expected in barren areas in the tundra.

Operations of the gathering pipelines and associated facilities will reduce the amount of effective barren-ground caribou winter foraging habitat. Most of the loss of effective caribou winter foraging habitat during operations is from the footprint, with lesser amounts caused by disturbance. The loss of 493 ha of effective caribou winter foraging habitat during operations will likely have a low-magnitude effect on barren-ground caribou habitat availability, particularly in areas near Parsons Lake.

Total project operations in the Inuvialuit Settlement Region portion of the RSA will reduce the amount of effective barren-ground caribou winter foraging habitat by 0.46%.

Decommissioning and Abandonment

Sensory disturbance related to decommissioning activities will have low, local effects on barren-ground caribou habitat availability. Low magnitude vegetation effects from the initial clearing during construction might persist through this phase and into the far future.

Barren-Ground Grizzly Bear

The largest potential effects of the gathering pipelines and associated facilities, during all phases, on the availability of barren-ground grizzly bear habitat are adverse, low magnitude and local in extent. Most effects will be limited to the duration of the project activity, except positive effects from vegetation clearing, which could extend into the long term (see Table 10-38).

Table 10-38: Effects on Barren-Ground Grizzly Bear Habitat Availability – Gathering Pipelines and Associated Facilities

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Positive[1]	Low	Local	Long term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

NOTE:
1 Revegetation could have a positive effect on habitat availability

Models for grizzly bear winter, spring and fall habitat were developed for the gathering pipelines and associated facilities. Changes in habitat availability during construction and operations are shown in Table 10-39.

Construction

Vegetation clearing, sensory disturbance, changed access and vegetation changes related to dust during construction of the gathering pipelines and associated facilities might change barren-ground grizzly bear habitat. Most of the construction will occur in winter when bears are denning. Sensory disturbance at this time might cause abandonment of nearby dens, subsequent loss of denning habitat and potential mortality. Den abandonment following human disturbance will not always have deleterious effects if alternative denning areas are available in a bear's home range (Linnell et al. 2000) (see Volume 3, Section 10.3.1,

Regional Overview of Wildlife Valued Components). Changes in vegetation health from dust emissions during construction might have a low-magnitude effect on barren-ground grizzly bear habitat for the gathering pipelines and associated facilities.

Table 10-39: Change in Grizzly Bear Habitat – Gathering Pipelines and Associated Facilities

Habitat Value	Denning		Spring Foraging		Fall Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
Very high	-1,815	-1,248	0	0	0	0
High	-438	918	-190	-190	-85	-85
Moderate	-2,739	-1,604	-603	-589	-406	-340
Effective	-4,992	-1,934	-793	-779	-491	-425

NOTES:
See Table 10-143 for a regional context
Effective habitat is the sum of very high, high and moderate habitat values

Construction of the gathering pipelines and associated facilities will reduce barren-ground grizzly bear habitat. Most of the reduction of effective denning habitat, i.e., 4,992 ha, is from sensory disturbance, with lesser effects caused by the project footprint. In contrast, most of the reduction of effective spring, i.e., 793 ha, and fall foraging habitat, i.e., 491 ha, is caused by the project footprint, i.e., 713 ha, with lesser effects from sensory disturbance.

Within the Inuvialuit Settlement Region RSA, 1.53% of effective barren-ground grizzly denning habitat, 1.20% of spring foraging habitat and 1.29% of fall foraging habitat will be lost because of construction activities. The loss of spring and fall foraging habitat is likely to have little effect on barren-ground grizzly bear habitat availability. Denning habitat is not considered limiting for barren-ground grizzly bears on nearby Richards Island (Nagy 2003, personal communication).

Operations

Vegetation will be mowed to remove shrubby growth along the gathering pipeline rights-of-way at about 10-year intervals. Barren-ground grizzly bear feed on forbs and grasses in the spring, so their spring foraging habitat might increase along the right-of-way during operations. However, barren-ground grizzly depend on berries and ground squirrels in the fall, so shrub removal along the right-of-way during operations might decrease fall foraging habitat. Sensory disturbance will be less during operations than during construction. As a result, effects on barren-ground grizzly bears from sensory disturbance will probably be low magnitude.

Operations of the gathering pipelines and associated facilities will:

- reduce effective barren-ground grizzly denning habitat
- reduce effective spring foraging habitat
- reduce effective fall foraging habitat

These losses are likely to have low-magnitude effects on barren-ground grizzly bear habitat availability.

Within the Inuvialuit Settlement Region RSA, 0.06% of effective barren-ground grizzly denning habitat, 0.99% of spring foraging habitat and 1.02% of fall foraging habitat will be lost because of operations.

Decommissioning and Abandonment

Sensory disturbance from decommissioning activities will have low, local effects on barren-ground grizzly bear habitat availability. Low magnitude, positive vegetation effects from revegetation might enhance barren-ground grizzly bear habitat in the long term.

Greater White-Fronted Goose

The largest potential effects of the gathering pipelines and associated facilities, during all phases, on the availability of greater white-fronted goose habitat are adverse, low magnitude, local in extent and long term (see Table 10-40).

Models for greater white-fronted goose nesting and foraging habitat were developed for the gathering pipelines and associated facilities. Changes in habitat availability during construction and operations are shown in Table 10-41.

Construction

Sensory disturbance from construction will eliminate greater white-fronted goose effective nesting habitat and reduce available foraging habitat in the gathering pipelines LSA. However, the amount lost will be small relative to total habitat availability in the Inuvialuit Settlement Region RSA (see Volume 3, Section 10, Wildlife).

Vegetation clearing will also result in some loss of habitat availability, which will extend into the long term.

Operations and Decommissioning and Abandonment

Effects of the gathering pipelines and associated facilities operations on greater white-fronted goose effective nesting and foraging habitat will be less than during construction, primarily because of the reduction in sensory disturbance. Decommissioning activities will increase disturbance for a short period and

therefore reduce habitat availability. Revegetation during decommissioning and abandonment could enhance greater white-fronted goose habitat availability in the long term.

Table 10-40: Effects on Bird Habitat Availability – Gathering Pipelines and Associated Facilities

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse Positive[1]	Low	Local	Long term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Change in vegetation health	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term

NOTES:
Bird species included in the gathering pipelines and associated facilities assessment: greater white-fronted goose, snow goose, tundra swan, scaup, peregrine falcon, whimbrel and Arctic tern
1 Revegetation could have a positive effect on habitat availability for greater white-fronted goose and snow goose

Table 10-41: Change in Greater White-Fronted Goose Habitat – Gathering Pipelines and Associated Facilities

Habitat Value	Nesting		Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
High	-344	-8	-301	-24
Moderate	-915	-37	-802	-65
Effective	-1,259	-45	-1,103	-89

NOTES:
See Table 10-143 for a regional context
Effective habitat is the sum of high and moderate habitat values

Few greater white-fronted geese occur along or near the gathering pipelines and associated facilities, and those are primarily on the outer delta. No or very little vegetation will be cleared.

Snow Goose

The largest potential effects of the gathering pipelines and associated facilities, during all phases, on snow goose habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-40, shown previously).

Construction

Potential project effects on snow goose habitat availability during construction of the gathering pipelines and associated facilities are restricted to the outer Mackenzie Delta. These potential effects are:

- disturbance of nesting, brood-rearing and moulting snow geese at the Kendall Island Bird Sanctuary and nearby areas along the coast of the outer Mackenzie Delta from June to August
- disturbance of fall-staging snow geese on the outer delta in late August and September

Direct habitat loss and alteration from vegetation clearing and health effects will be centred along the proposed gathering pipeline and are not considered likely to reduce use of the outer delta by snow geese. Vegetation clearing will be well away from the snow goose nesting colony. However, clearing might result in the loss of small areas of foraging habitat for fall-staging snow geese.

Operations and Decommissioning and Abandonment

Disturbance during operations is expected to be lower than during construction, with a period of higher disturbance during decommissioning activities. Revegetation during decommissioning and abandonment might enhance snow goose habitat availability in the long term.

Tundra Swan

The largest potential effects of the gathering pipelines and associated facilities, during all phases, on tundra swan habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-40, shown previously). Table 10-42 shows the change in tundra swan habitat from construction and operations of the gathering pipelines and associated facilities.

Construction

Construction will reduce the amount of effective tundra swan nesting and foraging habitat in the gathering pipelines and associated facilities LSA. However, the amount lost will be small relative to total habitat availability in the Inuvialuit Settlement Region RSA (see Volume 3, Section 10, Wildlife). Much of the reduction in nesting habitat availability will be because of sensory disturbances from construction activities.

Table 10-42: Change in Tundra Swan Habitat – Gathering Pipelines and Associated facilities

Habitat Value	Nesting		Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
High	-1,312	-111	-988	-68
Moderate	-1,841	-107	157	-66
Effective	-3,153	-218	-831	-134
NOTES: See Table 10-143 for a regional context Effective habitat is the sum of high and moderate habitat values				

Losses of habitat availability are not expected to result in regional-level effects on the production area population. A few nesting pairs and some local feeding areas will be affected.

Operations and Decommissioning and Abandonment

Sensory disturbance will decrease during operations, resulting in an increase in habitat availability compared with construction. The total amount of habitat loss will be low relative to that available in the Inuvialuit Settlement Region RSA (see Volume 3, Section 10, Wildlife). Only a few nesting pairs and some feeding sites in local areas will be affected. Sensory disturbance from decommissioning activities is predicted to cause some reduction in tundra swan habitat availability. The effects of vegetation changes caused by construction might persist for a long term in duration.

Scaup

The largest potential effects of the gathering pipelines and associated facilities, during all phases, on scaup habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-40, shown previously). Table 10-43 shows the change in greater scaup habitat from construction and operations.

Table 10-43: Change in Greater Scaup Habitat – Gathering Pipelines and Associated Facilities

Habitat Value	Nesting	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
High	0	0
Moderate	-196	-31
Effective	-196	-31
NOTES: See Table 10-143 for a regional context Effective habitat is the sum of high and moderate habitat values		

Construction

The habitat model for greater scaup nesting habitat predicts that the amount of effective habitat for this species will be reduced during construction. However, the amount of habitat loss will be low relative to habitat availability in the Inuvialuit Settlement Region RSA (see Volume 3, Section 10, Wildlife). Much of the reduction in habitat availability will result from sensory disturbances that are restricted to this phase of the project.

The potential project-specific effects on scaup habitat availability along the route of the gathering pipelines are:

- disturbance of flocks of flightless, moulting scaup from late June to mid-August
- disturbance of broods in July

These effects could occur along the entire route of the gathering pipelines. However, direct loss of habitat will be minimal.

Operations and Decommissioning and Abandonment

Operations will reduce the area of greater scaup effective nesting habitat by a small amount. Some of this reduction will be because of the footprint occupied by the new facilities.

As during construction, habitat availability for scaup along the route of the gathering pipelines will be potentially affected by sensory disturbance during operations.

The main potential project effects on habitat availability for scaup along the route of the gathering pipelines during decommissioning will be similar to effects during operations, although activity levels causing sensory disturbance will be slightly higher.

Peregrine Falcon

All Phases

The largest potential effects of the gathering pipelines and associated facilities, during all phases, on the availability of peregrine falcon habitat are adverse, low magnitude, local in extent and long term (see Table 10-40, shown previously).

Project effects on peregrine falcon habitat availability are not expected during construction along the route of the gathering pipelines because there is no cliff-nesting habitat along the proposed route.

Disturbance at some foraging areas might occur if prey species are disturbed, which could reduce their availability for capture by peregrine falcons. However, disturbance is expected to be periodic and of short duration. For example, some peregrine falcon prey species might be dispersed to other areas during aircraft overflights. However, there are many suitable foraging areas for peregrine falcons along the route of the gathering pipelines.

Whimbrel

The largest potential effects of the gathering pipelines and associated facilities, during all phases, on whimbrel habitat availability are adverse, low magnitude, local and long term (see Table 10-40, shown previously). Table 10-44 shows the change in whimbrel habitat from gathering pipeline construction and operations.

Table 10-44: Change in Whimbrel Habitat – Gathering Pipelines and Associated Facilities

Habitat Value	Nesting		Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
High	-377	-100	-1,147	-337
Moderate	-719	-294	-221	-295
Effective	-1,096	-394	-1,368	-632

NOTES:
See Table 10-143 for a regional context
Effective habitat is the sum of high and moderate habitat values

Construction

Construction will reduce amount of available effective whimbrel nesting and foraging habitat. However, the amount of habitat loss will be small relative to total habitat availability in the Inuvialuit Settlement Region RSA (see Volume 3, Section 10, Wildlife). Much of the reduction will be because of sensory disturbance associated with construction.

Because large areas of habitat, especially effective foraging habitat, will remain available, potential project effects on whimbrel habitat availability along the route of the gathering pipelines during construction are not expected to affect regional whimbrel populations.

Operations and Decommissioning and Abandonment

Effects of the gathering pipelines and associated facilities on whimbrel habitat availability will be less during operations than during construction because of reduced sensory disturbance. There will be an increase in disturbance again during decommissioning. During both phases, potential project effects on whimbrel habitat availability along the route of the gathering pipelines will be localized and are not expected to affect regional whimbrel populations.

Arctic Tern

All Phases

The largest potential effects of the gathering pipelines and associated facilities, during all phases, on Arctic tern habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-40, shown previously).

Arctic tern nesting colonies and productive waterbodies used for feeding are vulnerable to project effects during construction of the gathering pipelines and associated facilities. These effects are of most concern from June to August. The proximity of colony sites and favoured feeding areas to the proposed gathering pipeline route is not known. Vegetation clearing and disturbance could cause Arctic terns to abandon nesting colonies or disrupt nesting activities.

Effects of habitat loss and avoidance are likely to be low, local in extent and to occur during construction and decommissioning.

10.3.7 Pipeline Corridor

This part of the assessment covers the corridors of the natural gas and NGL pipelines. Individual components of the pipeline corridor assessed include:

- 11 intermediate block valves
- an NGL meter station at Norman Wells
- four compressor stations
- the Trout River heater station
- the NGTL interconnect facility

The Inuvik area facility was assessed under the gathering pipelines and associated facilities (see Section 10.3.6, Gathering Pipelines and Associated Facilities).

The natural gas pipeline right-of-way is 1,220-km long and 50-m wide between the Inuvik area facility and Norman Wells and 40-m wide between Norman Wells and the NGTL interconnect facility. The NGL pipeline shares the natural gas corridor for 476 km until reaching Norman Wells where it connects with the existing Enbridge liquids facility.

Most clearing and pipeline installation will take place under frozen soil conditions from January to April over two seasons of construction. Some working areas in addition to the final pipeline right-of-way width will be cleared at water crossings and facility sites. Four compressor stations will be located along the gas pipeline route at about 225 km intervals south of the Inuvik area facility. Each compressor station will disturb 9.5 ha. The compressor stations will use natural gas from the pipeline for fuel, for electrical power and for operating the pipeline compressors. A standby diesel-powered generator will provide power for emergencies.

Disturbance of the natural environment during operations will be minimal, involving periodic pipeline pigging, monthly aerial patrols and seasonal ground patrols at select locations. Wet soil conditions will prohibit ground patrols along much of the pipeline corridor in summer. At intervals of likely not less than 10 years, based on experience with the Enbridge pipeline, the woody regrowth immediately over the pipeline trench and the adjacent travel line, a total width of 10 m or less, will be cleared.

The project will affect wildlife habitat availability in the pipeline corridor by direct habitat change, change in habitat effectiveness and change in vegetation health.

10.3.7.1 Baseline Conditions

The pipeline corridor passes through three ecological zones, the Transition Forest, North Taiga Plains and South Taiga Plains, with a great diversity of environmental conditions.

Barren-ground caribou winter in the Transition Forest and North Taiga Plains ecological zones (see Volume 3, Section 10.3.1, Regional Overview of Wildlife Valued Components). The pipeline corridor crosses a part of the winter range of the Bluenose West and Bluenose East barren-ground caribou herds. Both herds are known to winter as far west as the Mackenzie River. The Bluenose west herd occurs in the northern part of the alignment as far south as the Sahtu Settlement Area, and the Bluenose East herd extends south through the Sahtu Settlement Area.

Because barren-ground caribou and woodland caribou are difficult to distinguish by tracks, pellets or aerial surveys, caribou survey information applies to both barren-ground and woodland caribou. Caribou populations were assumed to be barren-ground in the Transition Forest Ecological Zone and woodland in the North Taiga Plains and South Taiga Plains ecological zones.

Wildlife surveys recorded caribou tracks, pellets, observations and incidental signs in the Transition Forest and North Taiga Plains ecological zones. Although some of the habitat types in which they were recorded have low terrestrial lichen cover (see Volume 3, Section 10, Wildlife), caribou might have been foraging there on arboreal lichens in late-successional forests. Caribou are known to forage on arboreal lichens when snow cover is deep or crusted.

Found occasionally in the Transition Forest Ecological Zone, woodland caribou are distributed throughout the North Taiga Plains and South Taiga Plains ecological zones. Unlike barren-ground caribou, woodland caribou are year-around residents of the project area. They depend heavily on lichens for forage in winter, so they select forested habitats with a high density of arboreal and terrestrial lichens. See Volume 3, Section 10.3.1, Regional Overview of Wildlife Valued Components, for more information on woodland caribou.

Field observations confirmed the presence of caribou in the area of the pipeline corridor. Caribou sightings, tracks, pellets and incidental observations were recorded in the North Taiga Plains and South Taiga Plains ecological zones. Most caribou observed in the North Taiga Plains Ecological Zone were probably woodland caribou. Radio telemetry studies being conducted by RWED have confirmed that woodland caribou range as far north as the Transition Forest Ecological Zone (Nagy 2003, personal communication).

Although moose occur throughout forested parts of the Northwest Territories, some of the most suitable moose habitats are in the valleys of the Mackenzie River and its major tributaries. Of particular importance are the alluvial floodplains along these drainages, where preferred winter browse species are abundant and snow conditions are less restrictive to movement and foraging (see Volume 3, Section 10.3.1, Regional Overview of Wildlife Valued Components).

For much of its length, the pipeline corridor will pass through upland habitats that do not provide suitable winter range for moose (Prescott et al. 1973). However, at several locations, including the crossings of the Great Bear River, Brackett River and Hanna River, there is potential for the project to intersect moose winter range, resulting in direct habitat loss.

Field observations confirmed the presence of moose in the Transition Forest, North Taiga Plains and South Taiga Plains ecological zones of the pipeline corridor. Winter track surveys along the proposed pipeline corridor indicated highest use by moose in the riparian shrub habitat type of the Transition Forest Ecological Zone, in the recent burn habitat of the North Taiga Plains Ecological Zone, and in the mixedwood and black spruce-tamarack and shrub habitats of the South Taiga Plains Ecological Zone.

Barren-ground grizzly bears occur in the Transition Forest Ecological Zone. The northern interior barren-ground grizzly bear population is found in the North Taiga Plains and South Taiga Plains ecological zones. As the behaviour and habitat requirements of the northern interior barren-ground grizzly bear are similar to those of the barren-ground grizzly bear, the two populations are assessed together.

Field studies confirm the presence of barren-ground grizzly bear in the Transition Forest, North Taiga Plains and South Taiga Plains ecological zones of the pipeline corridor. Incidental observations for barren-ground grizzly bear indicate that shrub lowland fen and bog and black spruce coniferous forest are commonly used habitats in the North Taiga Plains Ecological Zone. One barren-ground grizzly bear observation was recorded in disturbed habitat in the South Taiga Plains Ecological Zone.

Whereas barren-ground grizzly bears occur throughout the pipeline corridor, population densities appear to decline farther south along the corridor with

diminishing relief and increasing homogeneity of closed forest habitats. Most of the habitat along the pipeline corridor is of relatively low quality for barren-ground grizzly bears. There are occasional occurrences of moderate quality habitat near low-lying mountain ranges, foothills and ridges along or near the pipeline route.

Marten are distributed across northern Alberta and the Northwest Territories and occasionally range beyond the treeline to the arctic coast.

Winter track count data and incidental observations from 2002 and 2003 indicate that marten are common and widely distributed along the proposed pipeline corridor. Field studies confirm the presence of marten in all habitat types of the Transition Forest, South Taiga Plains and North Taiga Plains ecological zones. These findings are consistent with previous studies that show marten inhabit a wide range of habitat types, with use of specific habitats varying in relation to changes in prey species availability. In contrast to food habits in many other parts of its North American range, marten in the Northwest Territories rely heavily on snowshoe hares as a food source. They will shift their prey selection to mice, voles and lemmings when snowshoe hare cycles decline.

Lynx is found south of the treeline in the Northwest Territories, especially in the southwest part of the territory and in the Mackenzie Delta. The range and distribution of lynx corresponds to the distribution and population of their main source of prey, the snowshoe hare. Lynx populations exhibit an eight to eleven year cycle of abundance, in general synchrony with snowshoe hare populations, and are particularly vulnerable to over-trapping during periods of low hare densities (Brand and Keith 1979). Field observations confirmed the presence of lynx in the Transition Forest, South Taiga Plains and North Taiga Plains ecological zones. Track densities for lynx were highest in the riparian shrub habitat type of the Transition Forest Ecological Zone, the sedge-peatmoss of the North Taiga Plains Ecological Zone and the deciduous forest of the South Taiga Plains Ecological Zone. There were no field observations of lynx in the Alberta part of the pipeline corridor, but based on lynx range and habitat, they do occur there.

Beaver colonies along the pipeline corridor were not inventoried, but Poole and Croft (1990) reported an average density of 26 active beaver lodges/100 km^2 in the western Northwest Territories, including several blocks near the pipeline route in the Sahtu Settlement Area and the Deh Cho Region. These densities are comparable to densities reported in other northern boreal habitats. Densities are even higher in some parts of the Mackenzie Valley. For example, observed densities between 1989 and 2001 in the Sahtu Settlement Area ranged from 43 to 58 lodges/100 km^2 (Popko et al. 2002).

The number of beaver colonies that will be affected by vegetation clearing is not known, but it has been estimated the pipeline will cross 514 streams and rivers.

Although most of these are small drainages, beaver will likely inhabit many. Beaver are also expected to inhabit many of the ponds and lakes along the pipeline corridor**.**

All amphibians in the Northwest Territories are living at or very near the extreme northern limits of their species range in North America. Although the full extent of their special adaptations to northern climatic conditions is not known, the range of adaptations currently understood underscores the scientific and ecological importance of these northernmost populations (GNWT 2004).

Amphibians in the Northwest Territories include members of four different families. A single species from the mole salamander family, the long-toed salamander, i.e., *Ambystoma macrodactylum*, occurs in the extreme southwestern corner of the territory (GNWT 2004). The toad family is represented by the Canadian toad, i.e., *Bufo hemiophrys*. The tree frog family is represented by the boreal chorus frog, i.e., *Pseudacris (triseriata) maculata*. The true frogs family is represented by two species: the northern leopard frog, i.e., *Rana pipiens*, and the wood frog, i.e., *Rana sylvatica* (see Volume 3, Section 10, Wildlife).

Field surveys did not include amphibians, though within the pipeline right-of-way, amphibians can be found in vegetation in shallow water margins. Breeding can start soon after ice melts from lakes and ponds, but it might be delayed until summer in northern latitudes. Amphibians might be found in marshy or damp wooded areas in the nonbreeding season, and some might overwinter in relatively dry sites, such as decaying stumps or anthills.

Key staging habitat for snow geese in the spring is on islands in the middle and lower Mackenzie River, commonly on the islands between Fort Good Hope and the confluence with the Tree River, and near Tulita and Norman Wells (Alexander et al. 1991). No baseline information was collected at the specific sites of the proposed compressor stations as their locations were not known when the field surveys were conducted. However, two proposed compressor station locations, at Little Chicago and near Norman Wells, are near spring snow goose staging areas on islands in the Mackenzie River (see Volume 2, Project Description).

The lesser scaup is the predominant scaup species in the region. Suitable nesting and moulting habitat for scaup exists throughout the pipeline corridor. Scaup densities are greater in areas with large wetland complexes (see Volume 3, Section 10, Wildlife). There is much suitable habitat for scaup and they occur throughout the pipeline route area from late May or early June through September.

There is nesting and foraging habitat for peregrine falcons along the pipeline corridor, though specific baseline surveys of peregrine falcon habitat were not conducted in 2001 or 2002. The GNWT maintains up-to-date information on

known peregrine falcon nest sites along the corridor. The only known nest site within 1 km of the pipeline is in the Sahtu Settlement Area in the South Taiga Plains Ecological Zone, 0.7 km from the pipeline (GNWT 2004). Another known nest is 5 to 10 km from the compressor station at Norman Wells (GNWT 2004).

The lesser yellowlegs nests and migrates throughout the pipeline corridor in a variety of forested habitats, including wet bogs and open muskegs, open boreal forest and forest-tundra transition areas. Detailed baseline information on habitat availability for lesser yellowlegs along the pipeline corridor is not currently available.

Arctic terns occur throughout the Mackenzie Valley, but their distribution is more localized than in the Tundra Ecological Zone. Suitable island nesting sites are less widely distributed than on the outer Mackenzie Delta and in the Parsons Lake area. During the June 2001 aerial surveys, which were conducted during nesting season, Arctic terns were seen only in the Gwich'in Settlement Area and the Sahtu Settlement Area. The only area of relatively high concentration was at Travaillant Lake in the Gwich'in Settlement Area.

Boreal chickadees occur throughout the Mackenzie Valley in boreal forest communities (see Volume 3, Section 10, Wildlife). However, detailed quantitative information on the amount of available habitat for boreal chickadees along the pipeline corridor is currently unavailable.

10.3.7.2 Pipeline Corridor Effects

The potential effects of construction, operations and decommissioning and abandonment on habitat availability in the pipeline corridor include vegetation clearing, sensory disturbance, altered human and predator access, and effects on vegetation health resulting from air and dust emissions.

The effects of the pipeline corridor on habitat availability are predicted to be low magnitude, local in extent and limited to the duration of the project except for:

- moderate, local effects on moose resulting from sensory disturbance
- low, far-future effects on caribou and marten because of the length of time required for mature vegetation communities to develop

Barren-Ground Caribou

The largest potential effects of the pipeline corridor, during all phases, on the availability of barren-ground caribou habitat are adverse, low magnitude, local in extent and far future in duration (see Table 10-45). Table 10-46 shows the change in barren-ground caribou habitat from construction and operation of the pipeline corridor.

Table 10-45: Effects on Barren-Ground Caribou Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Far future
	Operations	Adverse	Low	Local	Far future
	Decommissioning and abandonment	Adverse	Low	Local	Far future
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Far future
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

Table 10-46: Change in Barren-Ground Caribou Habitat – Pipeline Corridor

Habitat Value	Winter Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
Very high	-1,557	-85
High	-3,453	-252
Moderate	-475	-27
Effective	-5,485	-364

NOTES:
Effective habitat is the sum of very high, high and moderate habitat values
Modelling completed for the Transition Forest Ecological Zone

Construction

Construction might temporarily remove 5,485 ha of effective barren-ground caribou winter foraging habitat along the pipeline corridor in the Transition Forest Ecological Zone. Most of this potential loss of habitat can be attributed to the sensory disturbance of construction, with lesser effects from the direct habitat change of the footprint. From a regional perspective, 2.4% of barren-ground caribou habitat could be lost because of construction in the pipeline corridor.

Disturbance during construction of the pipeline corridor will include noise from vehicles, helicopters, construction equipment and human presence. Access for local hunters might increase as rights-of-way are developed through shrub and

treed areas. Changes in vegetation health from dust deposition during winter construction (see Section 9, Vegetation) could decrease the amount of barren-ground caribou habitat available in the pipeline corridor.

Relative to the size of the winter range of barren-ground caribou (see Volume 3, Section 10, Wildlife), the loss of 5,485 ha of effective habitat at the extreme edge of the range is likely to have a minimal effect on the barren-ground caribou population overall.

Operations

Vegetation clearing, sensory disturbance, altered human access and changes in vegetation health might change barren-ground caribou habitat availability during operations. Levels of human activity along the pipeline right-of-way will be confined to periodic aerial and ground inspection surveys and regular maintenance activities. Additional intermittent disturbance in the pipeline right-of-way at an access point or travel route used by hunters, trappers and others might cause temporary displacement of caribou from the right-of-way. Wolves and other predators that might use the right-of-way as a travel route could also reduce the effectiveness of habitats immediately beside the right-of-way. However, these potential effects are not substantiated from analysis of wildlife use of habitats along the Enbridge pipeline in the Deh Cho Region where wildlife were found to use the right-of-way and not avoid habitats near the pipeline. At the Storm Hills pigging facility and the Inuvik area facility, air emissions during operations will include nitrogen oxides, carbon dioxide, carbon monoxide and particulate matter with potential changes to lichen health.

Operations within the pipeline corridor might reduce the amount of effective barren-ground caribou winter foraging habitat. The habitat disturbed by noise and other construction activities will become effective during operations when these activities cease. From a regional perspective, 0.55% of barren-ground caribou habitat could be lost because of operations in the pipeline corridor.

Relative to the winter range of barren-ground caribou, a loss of 364 ha of effective habitat at the edge of their winter range will likely have a minimal effect on barren-ground caribou.

Decommissioning and Abandonment

Adverse effects on habitat availability for barren-ground caribou are expected to gradually decline following reclamation of the pipeline corridor right-of-way. Reclaimed sites will undergo successional replacement of pioneer vegetation communities by grass, herb, shrub and then forest communities. This will result in gradual recovery of habitat, although terrestrial lichens, barren-ground caribou's preferred winter food source, will regenerate slowly and might not return to baseline conditions for over 100 years. Because regrowth of woody vegetation proceeds to the tall shrub stage, use of the abandoned right-of-way as a travel corridor by hunters and recreational users might decrease, reducing the potential for sensory disturbance. Dust might be a factor during decommissioning and have minor effects on the amount of barren-ground caribou habitat available in the pipeline corridor.

Woodland Caribou

The largest potential effects of the pipeline corridor, during all phases, on the availability of woodland caribou habitat are adverse, low magnitude, local in extent and far future in duration (see Table 10-47).

Table 10-47: Effects on Woodland Caribou Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Far future
	Operations	Adverse	Low	Local	Far future
	Decommissioning and abandonment	Adverse	Low	Local	Far future
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Far future
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

See Table 10-48 for results of woodland caribou habitat models for the North Taiga Plains and South Taiga Plains ecological zones in the pipeline corridor.

Table 10-48: Change in Woodland Caribou Habitat – Pipeline Corridor

Habitat Value	Winter Foraging	
	Habitat Change – Construction (ha)	**Habitat Change – Operations** (ha)
North Taiga Plains Ecological Zone		
Very high	-7,369	-3,938
High	-8,504	-2,024
Moderate	-2,052	1,394
Effective	-17,925	-4,568
South Taiga Plains Ecological Zone		
Very high	-303	-83
High	-1,571	-386
Moderate	-11,383	-3,482
Effective	-13,257	-3,951
Total		
Very high	-7,672	-4,021
High	-10,075	-2,410
Moderate	-13,435	-2,088
Effective	-31,182	-8,519

NOTES:
Effective habitat is the sum of very high, high and moderate habitat values
Modelling completed for the North Taiga Plains and South Taiga Plains ecological zones

Construction

Surface material removal will lead to an immediate habitat disturbance on a part of the right-of-way. During construction, sensory disturbances could cause woodland caribou to avoid habitats beside the right-of-way. Sensory disturbances will occur at specific locations along the right-of-way, such as on the construction spreads, and for limited periods during construction. Access to humans and predators will increase in the pipeline corridor with the clearing of shrubs and trees. Dust deposition during construction might affect lichen health, which is a large component of the woodland caribou winter foraging habitat in the pipeline corridor (see Section 9, Vegetation).

Construction will reduce effective woodland caribou winter foraging habitat. Most of the reduction of winter habitat is from sensory disturbance, with lesser amounts a result of the footprint. This loss represents 0.60 to 2.95% of the effective habitat in the pipeline corridor RSA. Relative to the winter range of woodland caribou, this loss will have little effect on the population.

Operations

The clearing of shrub and tree growth during maintenance will cause direct habitat change in the pipeline corridor during operations. Although revegetation of disturbed areas in the pipeline corridor might provide some spring and summer foraging opportunities for caribou, lichens, the woodland caribou's preferred winter food source, will regenerate very slowly and might not return to baseline conditions for over 100 years. Human disturbance will be confined to periodic aerial and ground inspection surveys and regular maintenance for the project and intermittent activity by hunters, trappers and recreational users. Wolves and other predators that might use the right-of-way as a travel route could also reduce the effectiveness of habitats immediately beside the right-of-way. However, these potential effects are not substantiated from analysis of wildlife use of habitats along the Enbridge pipeline in the Deh Cho region where wildlife were found to use the right-of-way and not avoid habitats near the pipeline.

Operations might reduce the amount of effective woodland caribou winter foraging habitat. Most of the effective woodland caribou habitat lost is from sensory disturbance with lesser amounts, caused by the footprint. This loss represents 0.19 to 0.45% of the effective habitat in the pipeline corridor RSA.

Decommissioning and Abandonment

Factors that will affect use of the abandoned right-of-way by woodland caribou following decommissioning are similar to those described for barren-ground caribou. Caribou might respond to the reduced levels of human activity and from the gradual re-establishment of natural vegetation communities on the right-of-way. However, because of the slow rate at which lichen communities become re-established on disturbed sites, the right-of-way will be of little value as winter foraging habitat for many years. It is estimated that these sites might not return to baseline conditions for over 100 years.

Moose

The largest potential effects of the pipeline corridor on moose habitat availability are adverse, local in extent and long term. During construction, effects will be of moderate magnitude, dropping to low magnitude during operations and decommissioning and abandonment (see Table 10-49).

See Table 10-50 for results of moose winter foraging habitat models for the Transition Forest, North Taiga Plains and South Taiga Plains ecological zones in the pipeline corridor.

Table 10-49: Effects on Moose Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Long term
	Operations	Adverse Positive[1]	Low	Local	Long term
	Decommissioning and abandonment	Positive	Low	Local	Long term
Sensory disturbance	Construction	Adverse	Moderate	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

NOTE:
1 Initially adverse, then positive during later stages of operation

Construction

Vegetation clearing during construction will cause a direct loss of winter foraging habitat, and sensory disturbance might displace moose from key wintering habitat. Although previous studies indicated moose are relatively tolerant of noise from construction and vehicle or aircraft movements, high levels of human activity will likely result in avoidance by moose. As access increases with vegetation clearing, adult moose might be at greater risk of predation by wolf packs, and moose calves might be at greater risk of predation by grizzly and black bears. Dust during construction could decrease vegetation health along the pipeline corridor at a very local level at a few locations (see Section 9, Vegetation).

Construction will decrease effective moose winter foraging habitat along the pipeline corridor. Most of the decrease in moose habitat is from sensory disturbance, with lesser amounts caused by the project footprint. This loss represents 1.8 to 2.92% of the effective habitat in the pipeline corridor RSA. Moose are more vulnerable to disturbance in winter when movements are restricted and many animals experience energy deficits, so construction of the project is likely to have a moderate-magnitude effect on the moose population, particularly where the pipeline corridor crosses alluvial floodplains and rivers.

Table 10-50: Change in Moose Habitat – Pipeline Corridor

Habitat Value	Winter Foraging	
	Habitat Change – Construction (ha)	**Habitat Change – Operations** (ha)
Transition Forest Ecological Zone		
Very high	-25	-25
High	-840	-840
Moderate	-440	-440
Effective	-1,305	-1,305
North Taiga Plains Ecological Zone		
Very high	-1,361	-589
High	-5,446	-1,783
Moderate	-7,553	-1,151
Effective	-14,360	-3,523
South Taiga Plains Ecological Zone		
Very high	-1,438	-524
High	-10,502	-2,117
Moderate	-15,569	-963
Effective	-27,509	-3,604
Total of Transition Forest, North Taiga Plains and South Taiga Plains ecological zones		
Very high	-2,824	-1,137
High	-16,788	-4,741
Moderate	-23,562	-2,554
Effective	-43,175	-8,432
NOTES: Effective habitat is the sum of very high, high and moderate habitat values Modelling completed for the Transition Forest, North Taiga Plains and South Taiga Plains ecological zones		

Operations

Whereas the potential effects of construction of the pipeline right-of-way on moose habitat availability will be adverse during the first stages of the project, there will be net improvements in the quality of moose habitat later because the vegetation that moose browse on will thrive along the edges of the right-of-way.

Human activity causing sensory disturbance along the pipeline right-of-way will be substantially less than during construction, limited to periodic aerial and ground inspection surveys and regular maintenance. An increase in human and predator access in the pipeline corridor during operations might disturb moose near the pipeline, but such an effect might not result based on observations of wildlife habitat use along the Enbridge pipeline. Dust during operations in the pipeline corridor could affect vegetation health.

The amount of effective moose winter foraging habitat will decrease during operations. Most of the decrease in effective moose habitat is from sensory disturbance, with lesser amounts caused by the project footprint. This loss represents 0.46 to 0.74% of the effective habitat in the pipeline corridor RSA, resulting in little effect on moose habitat availability.

Decommissioning and Abandonment

Reclaimed sites will undergo successional replacement by pioneer vegetation communities with grass, herb and shrub, and finally forest communities. Moose are expected to use woody browse as soon as it becomes available, in five to 10 years, but it might take several decades before effective cover is re-established. Depending on the methods employed, decommissioning of the pipeline could cause some temporary sensory disturbance from noise and activities. Altered human and predator access will continue until shrubs and trees fill the right-of-way.

Barren-Ground Grizzly Bear

The largest potential effects of the pipeline corridor, during all phases, on the availability of grizzly bear habitat are adverse, low magnitude, local in extent and long term (see Table 10-51).

Table 10-51: Effects on Grizzly Bear Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Positive	Low	Local	Long term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

See Table 10-52 for results of barren-ground grizzly bear habitat models for the Transition Forest, North Taiga Plains and South Taiga Plains ecological zones in the pipeline corridor.

Table 10-52: Change in Barren-Ground Grizzly Bear Habitat – Pipeline Corridor

Habitat Value	Denning		Spring Forage		Fall Forage	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
Transition Forest Ecological Zone						
Very high	-24	-15	0	0	0	0
High	-79	-36	-19	-25	59	-4
Moderate	-156	-63	-208	-229	417	-46
Effective	-259	-114	-227	-254	476	-50
North Taiga Plains Ecological Zone						
Very high	-2,557	-1,712	-553	-1,126	10,565	-1,350
High	-1,747	411	-1,261	-1,770	21,188	-1,599
Moderate	-7,428	-4,080	-105	510	2,626	660
Effective	-11,732	-5,381	-1,919	-2,386	34,379	-2,289
South Taiga Plains Ecological Zone						
Very high	-5,023	-3,117	-291	-625	742	-158
High	-3,046	1,946	-1,466	-1,672	12,999	-1,486
Moderate	-7,935	-2,616	-1,149	-1,374	15,269	-1,016
Effective	-16,004	-3,787	-2,906	-3,671	29,010	-2,660
Total						
Very high	-7,604	-4,844	-844	-1,751	11,307	-1,508
High	-4,872	2,321	-2,746	-3,467	34,246	-3,089
Moderate	-15,519	-6,759	-1,462	-1,093	18,312	-402
Effective	-27,995	-9,282	-5,052	-6,311	63,865	-4,999

NOTES:
Effective habitat is the sum of very high, high and moderate habitat values
Modelling completed for the Transition Forest, North Taiga Plains and South Taiga Plains ecological zones

Construction

Barren-ground grizzly bears will potentially be exposed to direct changes in habitat because of vegetation clearing during construction. The greatest potential effects are from loss of localized habitats, such as concentrated seasonal food sources or denning areas. However, most clearing and construction will occur in mid to late winter when barren-ground grizzly bears are in hibernation. Because human access increases with vegetation clearing, barren-ground grizzly bears will be at greater risk from accidental contact or hunting. Dust emissions during construction might decrease vegetation health in the pipeline corridor at a very local level in a few locations.

Construction in the pipeline corridor will temporarily reduce barren-ground grizzly bear habitat. Most of the decrease in effective barren-ground grizzly bear habitat is from sensory disturbance, with lesser effects caused by the footprint. Because most construction will take place in winter when barren-ground grizzly bears are hibernating, actual effects from sensory disturbance in the pipeline corridor are likely to be less than calculated, except when dens are located within the footprint.

In the pipeline corridor RSA, 0.05 to 1.43% of barren-ground grizzly bear fall foraging habitat, 0.74 and 9.23% of effective denning habitat, and 0.21 to 1.52% of effective spring foraging habitat might be lost because of construction. Relative to the range of barren-ground grizzly bear and the general low quality of habitat in the pipeline corridor, construction is likely to have little effect on the barren-ground grizzly bear population.

Operations

Potential project effects on barren-ground grizzly bear habitat availability will be substantially less during operations than during construction. Levels of human activity along the pipeline right-of-way will be much lower, and the growth of herbaceous communities and berry-producing shrubs in the right-of-way will increase foraging opportunities for bears. Human disturbance from periodic aerial and ground inspection surveys, regular maintenance activities or from use of the pipeline right-of-way as an access point or travel route by hunters, trappers and recreational users could temporarily displace barren-ground grizzly bears from the right-of-way in spring, summer or fall. Bears should not be affected by human use of the right-of-way in winter. Operations will reduce effective barren-ground grizzly bear habitat. Most of the loss of effective barren-ground grizzly bear habitat is from sensory disturbance, with lesser effects caused by the 1,274-ha footprint.

In the pipeline corridor RSA, 0.06 to 0.96% of barren-ground grizzly bear fall foraging habitat, 0.32 to 1.62% of denning habitat, and 0.82 to 0.96% of spring foraging habitat might be lost because of project operations. The effects of project operations along the pipeline corridor on barren-ground grizzly bear habitat will be minimal.

Decommissioning and Abandonment

Some sensory disturbance and dust emissions affecting barren-ground grizzly bear habitat availability during decommissioning might occur at a few locations and at a very local level. As reclaimed sites replace pioneer herbaceous communities with shrub communities and finally forest communities, the capability of these habitats will change. The abandoned right-of-way is expected to be used most by barren-ground grizzly bears during the initial period following decommissioning, when herbaceous forage and berry-producing shrubs provide

attractive foraging opportunities. The value of the right-of-way as a foraging habitat will likely decline as communities, dominated by tall shrubs and saplings, replace these pioneer communities.

Marten

The largest potential effects of the pipeline corridor, during all phases, on the availability of marten habitat are adverse, low magnitude and local in extent. Effects might extend into the far future because a long time is required for re-establishment (see Table 10-53).

Table 10-53: Effects on Marten Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Far future
	Operations	Adverse	Low	Local	Far future
	Decommissioning and abandonment	Adverse	Low	Local	Far future
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

Table 10-54 shows results of marten habitat models for the Transition Forest, North Taiga Plains and South Taiga Plains ecological zones in the pipeline corridor.

Construction

During construction, the primary issue associated with vegetation clearing will be potential loss of old-growth forest and avoidance of clearcuts by marten. Snags, deadfall and coarse-woody debris typically found in older stands provide winter foraging habitat and denning habitat where females give birth. Although marten are relatively tolerant of human activity, they will probably avoid areas near work sites during periods of high noise or human activity. This could result in some additional local, short-term loss of habitat, although the distance over which this would occur is likely to exceed 200 m. Humans and predators, such as foxes, will have access increased during the pipeline corridor construction.

Table 10-54: Change in Marten Habitat – Pipeline Corridor

Habitat Value	Winter Foraging	
	Habitat Change – Construction (ha)	**Habitat Change – Operations** (ha)
Transition Forest Ecological Zone		
High	-554	-64
Moderate	-1,841	-259
Effective	-2,395	-323
North Taiga Plains Ecological Zone		
High	-16,280	-1,844
Moderate	4,615	-272
Effective	-11,665	-2,116
South Taiga Plains Ecological Zone		
High	-13,374	-1,337
Moderate	-2,185	-798
Effective	-15,559	-2,135
Total		
High	-30,209	-3,245
Moderate	589	-1,329
Effective	-29,620	-4,574
NOTE: Modelling completed for the Transition Forest, North Taiga Plains and South Taiga Plains ecological zones		

Construction will decrease effective marten winter foraging habitat in the pipeline corridor. Most of the loss of effective marten habitat is from sensory disturbance, with lesser effects caused by the footprint. This loss represents 0.34 to 0.77% of marten winter foraging habitat in the pipeline corridor RSA. Removal of 30 to 35% of the forest cover in a home range represents a critical threshold for marten (Potvin et al. 2000). Marten home range sizes in northern Canada are about 4.7 km^2 for adult females (Archibald and Jessup 1984). Habitat losses from clearing a 50 m right-of-way would fall well below this threshold, so pipeline construction alone will not threaten the integrity of marten populations.

Operations

During operations, small mammal populations will colonize parts of the pipeline corridor right-of-way on which dense vegetation cover is established. These vegetation types provide foraging opportunities for marten. Foraging activities will probably be mostly restricted to the snow-free period because of the absence of trees and the scarcity of coarse, woody debris. Marten are relatively tolerant of the sensory disturbance associated with human activity, and it is unlikely that periodic aerial and ground inspection surveys, maintenance activities, or use of the right-of-way as a travel route by hunters, trappers or recreational users will

displace marten from habitats beside the right-of-way. Analysis of track densities within 300 m of the existing Enbridge right-of-way and track densities farther away suggests marten occur more frequently near the right-of-way. This possible edge effect appears to outweigh the adverse effects of human use of the right-of-way.

Effective marten winter foraging habitat will decrease during operations. Most of the loss of effective marten habitat is from sensory disturbance, with lesser effects caused by the footprint. This loss represents 0.12 to 0.18% of winter foraging habitat for marten in the pipeline corridor RSA. Operations will have little effect on marten populations.

Decommissioning and Abandonment

The reclaimed right-of-way will undergo successional replacement of pioneer vegetation communities with grass, herb and shrub and finally forest communities. Structural features that will develop during the successional process, including establishment of overhead cover and coarse woody debris, will increase cover values for marten. Marten are expected to begin using reclaimed habitats once a dense shrub layer is established to provide overhead cover and foraging opportunities. However, high-quality marten habitat is in mature and old-growth forests with large woody structures, such as trees, snags and deadfall, which are suitable for denning. These conditions are expected to take more than 100 years to become established on reclaimed sites.

Lynx

The largest potential effects of the pipeline corridor, during all phases, on lynx habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-55).

See Table 10-56 for results of lynx habitat models for the Transition Forest, North Taiga Plains and South Taiga Plains ecological zones in the pipeline corridor.

Construction

The issues associated with habitat reduction from vegetation clearing during construction are loss of suitable den sites and loss of foraging habitat. The requirements for these two habitats differ. Lynx select den sites in mature forests or burns with abundant deadfall and coarse woody debris. Prime foraging habitats include the dense, shrubby stands that provide optimum habitat for hares. Both types of habitat are common along the pipeline corridor right-of-way. Sensory disturbance during construction might displace lynx, especially during periods of intense human activity. Dust could affect vegetation health at a very local level at a few locations.

Table 10-55: Effects on Lynx Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

Table 10-56: Change in Lynx Habitat – Pipeline Corridor

Habitat Value	Winter Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
Transition Forest Ecological Zone		
High	0	0
Moderate	0	0
Effective	0	0
North Taiga Plains Ecological Zone		
High	-5,574	-963
Moderate	-5,243	-968
Effective	-10,817	-1,931
South Taiga Plains Ecological Zone		
High	-4,840	-4,835
Moderate	-17,200	-17,194
Effective	-22,040	-22,029
Total in pipeline corridor		
High	-10,414	-5,798
Moderate	-22,443	-18,162
Effective	-32,857	-23,960
NOTE: Modelling completed for the Transition Forest, North Taiga Plains and South Taiga Plains ecological zones		

Construction will decrease effective lynx winter foraging habitat. Most of the decrease in effective habitat is from sensory disturbance, with lesser effects caused by the project footprint. This loss represents 0.68 to 0.78% of lynx winter foraging habitat in the pipeline corridor RSA.

Population-level effects of habitat change are likely to vary throughout the 8- to 11-year population cycle. The densities of lynx in the Northwest Territories have been reported to vary over this cycle from about 3 to 30/100 km^2 according to changes in snowshoe hare cycles (Chetkiewicz and Marshal 1998). If construction is during high parts of the cycle, loss of foraging habitat along the right-of-way might have less effect at the population level than during cyclic lows when prey availability is limiting. During cyclic lows, lynx might rely on refugia, which are areas of optimum habitat capable of supporting viable lynx populations during periods of low prey abundance. Habitat loss in these areas during cyclic lows could be an issue. However, construction is likely to have only local effects on the lynx population.

Operations

Grass and herb communities initially along the pipeline corridor right-of-way will be succeeded during operations by shrub communities that increase habitat for hares and small mammals and increase foraging opportunities for lynx. Periodic aerial and ground inspection surveys, regular maintenance activities, and use of the pipeline right-of-way as an access point or travel route by humans are expected to disturb and temporarily displace lynx from the right-of-way and immediately adjacent habitats.

Effective lynx winter foraging habitat will be reduced during operations. Most of the decrease in effective habitat is from sensory disturbance, with lesser effects caused by the project footprint. This loss represents 0.12 to 0.19% of winter lynx foraging habitat along the pipeline corridor RSA. Because the sensory disturbance will be periodic, operations in the pipeline corridor will have little effect, if any, on the lynx population. Analysis of habitat use near the Enbridge pipeline did not detect any effects on lynx or on its main prey, the snowshoe hare.

Decommissioning and Abandonment

Adverse effects on lynx habitat availability are not expected following reclamation of the pipeline right-of-way. Use of the right-of-way by lynx might increase as project-related human activity ceases and vegetation succession returns the corridor to structural stages that provide cover and foraging opportunities for lynx. Lynx will respond to the dense shrub communities that will form early in the successional process because of the availability of snowshoe hares. As forest communities replace shrub communities on the right-of-way, foraging opportunities might decline, but habitat suitability for reproduction and denning is expected to increase.

Beaver

The largest potential effects of the pipeline corridor, during all phases, on beaver habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-57).

Table 10-57: Effects on Beaver Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

Construction

Habitat for beaver could be directly affected by vegetation clearing and by de-watering of beaver impoundments. In most cases, clearing a 50-m wide right-of-way would not likely be sufficient to cause food shortages or force the relocation of beaver colonies, though a colony whose lodge or winter food cache is directly on the pipeline right-of-way might be at risk. At northern latitudes, beaver face severe winter energy deficits and rely on the ability to store an adequate cache of food to survive the winter. Loss of a food cache or clearing of prime foraging areas near lodges could affect the productivity and survival of affected colonies. Depending on the crossing method used, there is often a need to extend the width of the cleared right-of-way at watercourse crossings, causing additional loss of riparian habitat.

Removal of beaver dams also affects beaver habitat availability. Extensive beaver impoundments make constructing pipelines across watercourses more difficult. It is sometimes necessary to remove beaver dams before construction. Because dam removal must occur close to freezeup to be effective, there is a high risk that water levels will be lowered. Overwinter survival is jeopardized if access to winter food caches is threatened.

Beaver are relatively tolerant of human disturbance, so habitat avoidance resulting from sensory disturbance is not considered an issue for the species. Human and predator access would increase during pipeline corridor construction. Dust could affect vegetation health during operation of the pipeline corridor at a very local level at a few locations (see Section 9, Vegetation).

Operations

Effects of vegetation clearing on habitat availability for beaver during operations are expected to be negligible. Willow, a primary food species for beaver in the Northwest Territories, regenerates relatively quickly, even as far north as the Mackenzie Delta. Beaver are expected to begin foraging on cleared sites within five years. No additional clearing of vegetation is expected beside watercourse crossings.

There will not be an operational requirement to remove beaver dams along the pipeline right-of-way, except in isolated cases in which beaver impoundments threaten the integrity of access roads or, above-ground facilities. Where it is necessary to remove beaver dams, some additional short-term loss of habitat would result.

Decommissioning and Abandonment

Following decommissioning, the reclaimed right-of-way will undergo successional replacement by pioneer vegetation communities with grass, herb and shrub and finally forest communities. Beaver are an early successional species that will begin using cleared sites once regeneration of willow and other food species begins. This process will begin after construction, and by the time of decommissioning, residual adverse effects on beaver habitat will be unlikely.

Amphibians

The largest potential effects of the pipeline corridor on amphibian habitat availability are adverse, low magnitude, local in extent and limited to the duration of the project activity (see Table 10-58).

Construction

Amphibians will be exposed to direct changes in habitat availability during peak construction primarily because of vegetation clearing along the right-of-way. Surface material removal might lead to an immediate removal of riparian habitats along the right-of-way, resulting in a direct loss of amphibian habitat. Construction noises are not expected to measurably affect habitat effectiveness for these species. Sensory disturbances will be short term and local, at specific locations along the right-of-way construction spreads, and for a few days only.

Table 10-58: Effects on Amphibian Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Altered human and predator access	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term

Vegetation clearing along the pipeline right-of-way of marshy and damp woody areas might directly affect amphibian habitat availability. The clearing of downed woody debris, such as decaying stumps, might affect available overwintering sites for amphibians.

Altered human access resulting from the pipeline right-of-way and associated infrastructure might affect amphibians if the access destroys existing available habitat, such as potential breeding sites or adjacent marshy and damp woody areas.

The dust resulting from surface material removal during construction might have a localized effect on wetland vegetation health, which might have a low-magnitude effect on the availability of amphibian habitat.

Operations

Amphibians might be exposed to the continuing effects of changes in habitat availability during peak operations. During operations, riparian and wetland breeding and overwintering habitats will have been reclaimed to aquatic-dominated communities and upland foraging areas will have been reclaimed to grass-dominated communities. With succession, wetland and riparian habitats will see continued improvements in quality over time. Sensory disturbance from periodic maintenance and vehicle operations will not affect amphibians.

Decommissioning and Abandonment

Following decommissioning, the reclaimed right-of-way will undergo succession and wetland and riparian habitats will see continued improvements, with habitat availability restored with the short term.

Snow Goose

The largest potential effects of the pipeline corridor, during all phases, on snow goose habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-59). Revegetation might enhance snow goose habitat availability in the long term.

Table 10-59: Effects on Bird Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Long term Far future[1]
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse Positive[2]	Low	Local	Long term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Change in vegetation health	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term

NOTES:
Bird species included in the pipeline corridor assessment: snow goose, scaup, peregrine falcon, Arctic tern and boreal chickadee
1 Far future effects relate to clearing that will affect lesser yellowlegs and boreal chickadee habitats
2 Revegetation could have a positive effect on habitat availability for snow goose

Construction

The main potential project effect on snow geese habitat availability along the pipeline is disturbance of spring staging snow geese on Mackenzie River islands in May, when many snow geese are concentrated in small areas of open water along the river. During the oilfield expansion at Norman Wells, aircraft flights produced a response in snow geese 70% of the time when aircraft were 0.5 to

1 km from the geese, but only 14% of the time at distances of more than 1 km. These disturbances caused the birds to flush, circle briefly and return to the same place 91% of the time. In most cases, the geese returned to the same staging area within three minutes. Geese continued to use the islands during the expansion. In 1983, flights appeared to cause less disturbance than in 1980, suggesting that the geese had habituated somewhat to the flights. During the current project, disturbance is expected to be greatest during construction.

Direct habitat loss and alteration are not considered likely to reduce use of the Mackenzie Valley by snow geese. Vegetation clearing will be well away from the snow goose staging islands and is unlikely to affect snow goose foraging behaviour. Clearing could result in the loss of small areas of foraging habitat for staging snow geese.

Effects will be reduced by following aircraft flight guidelines.

Operations and Decommissioning and Abandonment

The primary potential project effect on snow goose habitat availability along the pipeline during operations and decommissioning and abandonment is disturbance of staging snow geese on Mackenzie River islands in May. If project-related aircraft disturbance of staging snow geese is avoided, the effects of habitat loss and avoidance are likely to be low or of no effect, and local in extent.

Scaup

All Phases

The largest potential effects of the pipeline corridor on scaup habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-59, shown previously). Table 10-60 shows the change in lesser scaup habitat from construction and operations of the pipeline corridor.

Potential project effects on habitat availability for scaup are:

- disturbance of flocks of flightless, moulting scaup from late June to mid-August
- disturbance of broods in July

The habitat model predicts construction and operations will reduce the area of effective lesser scaup nesting habitat by a very small amount and could result in the loss of small areas of nesting habitat for a few scaup. Direct habitat loss and alteration are not considered likely to reduce use of the pipeline corridor by scaup. There is much suitable habitat along the corridor for nesting scaup, although favoured waterbodies for moulting might be less numerous.

Table 10-60: Change in Lesser Scaup Habitat – Pipeline Corridor

Habitat Value	Nesting	
	Habitat Change – Construction (ha)	**Habitat Change – Operations** (ha)
Transition Forest Ecological Zone		
High	0	0
Moderate	0	0
Effective	0	0
North Taiga Plains Ecological Zone		
High	-1	-1
Moderate	-7	-7
Effective	-8	-8
South Taiga Plains Ecological Zone		
High	-1	-1
Moderate	-3	-3
Effective	-4	-4
Total of Transition Forest, North Taiga Plains and South Taiga Plains ecological zones		
High	-1	-1
Moderate	-10	-10
Effective	-11	-11
NOTES: Effective habitat is the sum of high and moderate habitat values Modelling completed for the Transition Forest, North Taiga Plains and South Taiga Plains ecological zones		

Disturbance that results in the avoidance of favoured moulting and brood-rearing areas could affect several hundred scaup, but effects will be low magnitude. Aircraft, barge and boat disturbance are expected to be much lower during peak operations than during construction.

Peregrine Falcon

All Phases

Nesting and foraging habitat for peregrine falcons is present along the pipeline corridor, and pipeline construction near nesting cliffs or bluffs along the Mackenzie River could displace nesting peregrine falcons. In addition, construction and operation of compressor stations could disturb nesting falcons.

Some foraging areas could be disturbed, but disturbance is expected to be periodic and of short duration. For example, some peregrine falcon prey species might be dispersed to other areas by aircraft.

The largest potential effects of the pipeline corridor, during all phases, on peregrine falcon habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-59, shown previously).

Lesser Yellowlegs

All Phases

During construction, and to a lesser degree during operations, habitat availability for lesser yellowlegs could be affected in the following ways:

- direct loss of nesting and feeding habitat resulting from vegetation clearing
- disturbance of nesting and feeding areas by aircraft and human activities

Construction of the pipeline will decrease the amount of available effective lesser yellowlegs nesting habitat by a small amount (see Table 10-61), though available effective nesting habitat will remain abundant in the pipeline corridor RSA.

Effects are likely to reduce habitat availability for only a few lesser yellowlegs near the pipeline. Loss of habitat availability will not reduce lesser yellowlegs populations because suitable habitat for lesser yellowlegs is widespread throughout the RSA. Aircraft and human disturbance are expected to be greatest during construction.

The largest potential effects of the pipeline corridor, during all phases, on lesser yellowlegs habitat availability are adverse, low magnitude, local in extent and long term.

Arctic Tern

The largest potential effects of the pipeline corridor, during all phases, on Arctic tern habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-59, shown previously).

Construction

During construction, habitat availability for Arctic terns could be affected in the following ways:

- destruction and disturbance of nesting colonies from June to August
- disturbance of favoured feeding areas from June to August

Table 10-61: Change in Lesser Yellowlegs Habitat – Pipeline Corridor

Habitat Value	Nesting	
	Habitat Change – Construction (ha)	**Habitat Change – Operations** (ha)
Transition Forest Ecological Zone		
High	-9	-9
Moderate	-61	-61
Effective	-70	-70
North Taiga Plains Ecological Zone		
High	-56	-56
Moderate	-180	-180
Effective	-236	-236
South Taiga Plains Ecological Zone		
High	-51	-51
Moderate	-188	-188
Effective	-239	-239
Total of Transition Forest, North Taiga Plains and South Taiga Plains ecological zones		
High	-116	-116
Moderate	-428	-429
Effective	-544	-545
NOTES: Effective habitat is the sum of high and moderate habitat values Modelling completed for the Transition Forest, North Taiga Plains and South Taiga Plains ecological zones		

Arctic terns nest and forage throughout the Mackenzie Valley. However, during June 2001 aerial surveys, Arctic terns were seen only in the Gwich'in and Sahtu settlement areas.

Disturbance and direct habitat loss are expected to be greatest during construction.

Direct habitat loss and alteration will be restricted to the pipeline right-of-way, but potential disturbance effects will encompass a larger area. If Arctic tern nesting colonies are near the pipeline corridor, there is a potential for adverse effects on the local population resulting from sensory disturbance. Because feeding areas are likely more widespread than colony sites, the loss or disturbance of feeding habitat is not expected to limit Arctic tern populations in the Mackenzie Valley, though it might affect local individuals.

Operations and Decommissioning and Abandonment

Effects on Arctic tern habitat availability are expected to be lower during operations and decommissioning than during construction. The potential disturbance during operations is similar to that of construction, though the level of disturbance is likely to be lower.

Boreal Chickadee

The largest potential effects of the pipeline corridor, during all phases, on boreal chickadee habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-59, shown previously).

Construction

Habitat availability for boreal chickadees during construction could be affected in the following ways:

- direct loss of nesting and feeding habitat resulting from vegetation clearing
- disturbance of nesting and feeding areas by human activities

Construction will reduce a small area of boreal chickadee effective nesting habitat (see Table 10-62). The boreal chickadee's nesting and foraging habitats are similar, so that no separate habitat model was prepared for foraging habitat.

Table 10-62: Change in Boreal Chickadee Habitat – Pipeline Corridor

Habitat Value	Nesting	
	Habitat Change – Construction (ha)	**Habitat Change – Operations** (ha)
Transition Forest Ecological Zone		
High	0	0
Moderate	-4	-4
Effective	-4	-4
North Taiga Plains Ecological Zone		
High	-2	-2
Moderate	-310	-310
Effective	-312	-312
South Taiga Plains Ecological Zone		
High	-53	-53
Moderate	-347	-347
Effective	-400	-400
Total of Transition Forest, North Taiga Plains and South Taiga Plains ecological zones		
High	-55	-55
Moderate	-662	-662
Effective	-717	-717
NOTES: Effective habitat is the sum of high and moderate habitat values Modelling completed for the Transition Forest, North Taiga Plains and South Taiga Plains ecological zones		

These effects are likely to reduce habitat availability for only a few boreal chickadees near the pipeline. Loss of habitat availability is not expected to reduce boreal chickadee populations because suitable habitat is widespread throughout the Mackenzie Valley.

Operations and Decommissioning and Abandonment

Operations and decommissioning and abandonment will decrease a similar amount of effective nesting habitat as construction because the preferred mature forest will be unavailable throughout both phases.

The most likely potential project effect on boreal chickadee habitat availability is disturbance of nesting and feeding areas by human activities. This effect is likely to reduce habitat availability for only a few boreal chickadees near the pipeline. Loss of habitat availability will not reduce boreal chickadee populations because suitable boreal chickadee habitat is widespread throughout the Mackenzie Valley.

10.3.8 Northwestern Alberta

10.3.8.1 Baseline Information Used

Baseline information has come from literature and some key publications on the traditional knowledge of the Dene Tha' First Nation (Goulet 1998; Horvath et al. 2001). Wildlife baseline information can be found in Volume 3, Section 10, Wildlife.

10.3.8.2 Effects on Wildlife

In northwestern Alberta, wildlife species such as woodland caribou, moose, furbearers, waterfowl and other birds will likely encounter changes in habitat availability because vegetation needs to be cleared and the topsoil needs to be moved for the pipeline and its infrastructure to be built. Noise from machines and people might disturb wildlife during construction. To keep effects related to habitat availability to a minimum, preferred habitats for the different wildlife species and time of year will be considered when making decisions about building. Information is still being gathered to find out more about how and where construction will take place.

The current assessment revealed that effects on habitat and movement would affect several wildlife species, waterfowl and other birds, but that the effects would be localized and would not change hunting opportunities because the project sites are well away from preferred waterfowl breeding and feeding grounds. During operations, the right-of-way and some new access roads could improve access to previously remote areas. This is of particular concern for woodland caribou in northwestern Alberta. Although analysis of wildlife use of habitats along the Enbridge pipeline indicates that wildlife species use the right-of-way and do not seem to avoid habitats near the pipeline, the conclusions of the analysis are weak for woodland caribou. Marten tracks were more often found within 300 m of the right-of-way than farther away (see Volume 3, Section 10, Wildlife), and moose did not seem to be affected. Based on the mitigation measures described following and on information about how animals react to the

Enbridge pipeline, the project will be expected to disturb some animals in some locations, but will not alter opportunities for hunting, trapping or viewing wildlife by changing wildlife distribution.

Woodland caribou habitat is abundant, and there is no evidence that food or cover are in short supply. However, oil and gas development in northern Alberta has been found to affect caribou habitat use and distribution. Habitat for woodland caribou along the pipeline right-of-way will change because of the development. Woodland caribou will often return if people reduce their use of such areas, indicating that woodland caribou might be disturbed more when the project is being built than during operations. Clearing black spruce forests and disturbing peatland could affect woodland caribou at the local level. Roadsides might attract caribou and result in an increase in vehicle-caused deaths, and new access roads might result in more hunting pressures. Hunters and predators could affect woodland caribou through increased access before natural vegetation re-grows.

Moose travel along the edges of waterways, such as rivers. Whereas clearing vegetation in forested areas will produce more browse for moose, clearing areas along rivers and streams will affect moose habitat availability and might affect how moose move along these corridors and how they use these areas as places to overwinter. Once people leave disturbed sites, moose will often return. During operations, the effect on moose habitat should be less than during construction, because:

- fewer people will be working along the right-of-way
- the deciduous plant communities that will begin to grow, following the clearing for building purposes, will provide forage for moose

Moose might be displaced from habitat by construction noise.

Clearing vegetation to build the pipeline will affect marten whose home ranges overlap the proposed pipeline route and right-of-way. Data collected in the field shows that once people stop or decrease their use of an area, marten will readily use suitable habitat that is next to rights-of-way. Because parts of the right-of-way need to have vegetation cut back for inspection and maintenance, and other areas will be allowed to naturally re-grow tall shrubs, small mammals will likely live in these places and be preyed on by marten. Marten have been seen crossing open areas at least 100 m wide, so most clearing for the project should not keep them from moving from one area to another. There is not much information on how tolerant marten are of noise from human activity, though they might temporarily leave areas near construction worksites. Increased access to new places where marten live could lead to more trapping of marten and predation by other animals.

The pipeline corridor is good lynx and hare habitat. Removal of forested areas will change the nature of lynx habitats. Although habitat might be lost along a

right-of-way, field data shows that lynx will return to areas next to the right-of-way once human activity is reduced. The right-of-way will also provide a corridor for trappers, predators and animals that compete with lynx for space and food. More site-specific information on lynx and dialogue with northern trappers is needed before potential effects of disturbing and displacing lynx are considered. Lynx will be disturbed less once construction is complete.

Beaver could be affected if deciduous vegetation is cleared around lakes, streams and rivers. However, regeneration of cleared areas could produce good habitat for beavers. Beaver are not greatly affected by human disturbance, but they could be trapped or preyed on more if access is increased.

Construction noise could disturb amphibians, and clearing marshy and damp woody areas along the right-of-way might affect habitat availability. Increased access for people could also affect amphibians, if such areas are removed.

The total area of habitat lost or altered in northwestern Alberta will be small compared with the overall habitat. Therefore, overall habitat availability will not be significantly reduced. There are no important staging areas for snow geese along the pipeline corridor in northwestern Alberta, and Arctic terns were not observed during aerial surveys of northwestern Alberta. Although there is likely a small population of Arctic terns in northwestern Alberta, the proposed pipeline route is not known to be an important breeding area. Scaup were relatively abundant during the Alberta surveys. However, lesser scaup, lesser yellowlegs and boreal chickadees are widespread in northwestern Alberta and are not likely to be affected by the small loss of habitat. No peregrine falcons were recorded during the field surveys, and if peregrine falcon nesting areas or Arctic tern colonies are detected, they will be avoided by project activities.

Table 10-63 summarizes project effects on wildlife in northwestern Alberta by combining the predicted effects of the various project components. The assessment in the table is qualitatively based on a compilation of the effects on expected habitat removal, the effects on movements and the effects on mortality.

Table 10-63: Effects on Wildlife in Northwestern Alberta

Valued Component	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Woodland caribou	Construction	Adverse	Low–moderate	Local–regional	Long term
	Operations	Adverse	Low	Regional	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Moose	Construction	Adverse	Moderate	Regional	Long term
	Operations	Adverse	Low–moderate	Regional	Long term
	Decommissioning and abandonment	Adverse	Low	Local–regional	Long term

Table 10-63: Effects on Wildlife in Northwestern Alberta (cont'd)

Valued Component	Phase When Impact Occurs	Effect Attribute			
Marten	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Regional	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Lynx	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Regional	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Beaver	Construction	Adverse	Low–moderate	Local	Long term
	Operations	Adverse	Low	Regional	Far future
	Decommissioning and abandonment	Adverse	Low	Local	Far future
Amphibians	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Regional	Far future
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Snow goose	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Scaup (greater and lesser)	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Peregrine falcon	Construction	Adverse	Low	Local	Far future
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Lesser yellowlegs	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Arctic tern	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Boreal chickadee	Construction	Adverse	Low	Local	Far future
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term

10.3.9 Infrastructure

This part of the assessment considers the potential effects of project infrastructure on wildlife habitat availability. Infrastructure components are split into three groups for the purpose of this assessment as follows:

- Group 1 includes permanent and temporary airstrips, icestrips and helipads, access roads and barge landing sites. Group 1 components planned include 20 km of all-weather permanent roads, more than 92.5 km of winter roads, 25 barge landing sites, 18 airstrips and 24 helipads.

- Group 2 includes 70 borrow sites, each of which will be about 10 ha in size. They will be used when needed for construction in both the production area and the pipeline corridor.

- Group 3 includes camps, pipe and material stockpile sites, fuel storage sites, and staging and marshalling sites. Group 3 components planned include 27 temporary camps, three existing camps, 34 stockpile sites, 32 fuel storage sites and three communication centres.

10.3.9.1 Production Area Infrastructure

Transportation infrastructure planned for the production area includes 17.5 km of all-weather permanent roads, more than 64.5 km of winter roads, eight barge landing sites, six airstrips and 10 helipads.

Seventeen borrow sites are planned for excavation in the production area.

Infrastructure sites planned for the production area includes 11 temporary camps, the ongoing maintenance of two existing camps, 11 stockpile sites, 11 fuel storage sites and one communication centre. Many infrastructure sites are combined camp and storage sites.

Mammals – Baseline Conditions

Group 1

Baseline conditions for mammals were not specifically assessed for Group 1 infrastructure sites because alignment drawings were not available during baseline surveys. Incidental observations were used to determine whether VCs were present at transportation sites. Reconnaissance-level wildlife surveys of four barge landing sites were carried out in the production area in 2002.

Evidence of barren-ground caribou was found in all areas in the production area where roads are planned to be built and at all barge landings except Camp Farewell and Tununuk Point (Bar C) in the production area. However, barren-ground caribou are generally only in the production area in the winter.

Evidence of barren-ground grizzly bear was found in the areas where roads are planned and at many barge landings in the production area. Grizzly dens were found in some areas where roads and barge landings are planned.

Group 2

Reconnaissance-level wildlife surveys of all planned borrow sites in the production area of the Inuvialuit Settlement Region were done in 2002.

Evidence of barren-ground caribou was found at all but two borrow sites, both near Parsons Lake. However, barren-ground caribou are only expected to be in the production area in the winter.

Evidence of barren-ground grizzly bears was found at all borrow sites surveyed in the production area and in some areas where roads and barge landings are planned.

Group 3

Reconnaissance-level wildlife surveys in the production area of the Inuvialuit Settlement Region were carried out at 10 potential Group 3 infrastructure sites in 2002 and five in 2003.

Evidence of barren-ground caribou was found at all infrastructure sites examined in the production area, except Camp Farewell and Tununuk Point (Bar C). However, barren-ground caribou are only expected to be in the production area in the winter.

Evidence of barren-ground grizzly bear was found at all Group 3 infrastructure sites assessed in the production area. Barren-ground grizzly bear dens were found near Camp Farewell, Lucas Point and Swimming Point. Grizzly dens were found in some areas where roads and barge landings are planned.

Birds

No site-specific baseline studies for birds were conducted at infrastructure components in the production area because the locations were not known during the field surveys. See Volume 3, Section 10, Wildlife, for an overview of baseline bird communities in the production area.

Production Area Infrastructure Effects

Construction of infrastructure in the production area could change wildlife habitat availability if:

- vegetation clearing directly changes habitat
- sensory disturbance alters habitat effectiveness
- altered human and predator access changes habitat effectiveness
- air and dust emissions change vegetation health

Operation of infrastructure facilities, roads and borrow sites could change wildlife habitat availability primarily if:

- altered human and predator access alters habitat effectiveness
- air and dust emissions change vegetation health

Sensory disturbance will be less during operations than during construction, and very little new vegetation clearing will occur.

Decommissioning and abandonment of infrastructure could potentially alter wildlife habitat availability if:

- sensory disturbance alters habitat effectiveness
- altered human and predator access changes habitat effectiveness
- dust emissions change vegetation health

Barren-Ground Caribou

Table 10-64 is a summary of potential effects of Group 1, 2 and 3 infrastructure on barren-ground caribou habitat in the production area. All effects are low magnitude and local except for moderate, regional effects of access associated with Group 1 infrastructure. Far future effects related to vegetation clearing are associated with all infrastructure groups.

Table 10-65 shows results of barren-ground caribou winter foraging habitat models for infrastructure sites in the production area.

Barren-Ground Caribou – Construction

Construction of all infrastructure sites will result in a loss of 0.66% of effective barren-ground caribou winter foraging habitat in the production area RSA.

Group 1

About 92.5 km of winter roads will be built to service well pads, camps, borrow sites, barge landings and other construction areas. Winter roads will be designed to avoid arctic tundra rutting and damage. A 2.5-km permanent all-weather road will be built in the part of the production area that crosses caribou range. All-weather road construction will involve vegetation clearing, including some lichen removal. Sensory disturbance during construction, including noise and movements of vehicles, helicopters, construction equipment, and people, might cause habitat avoidance by barren-ground caribou. As a result, sensory disturbance during construction decreases habitat effectiveness near infrastructure sites, including both winter and all-weather roads. The zone of influence from disturbances might extend up to 500 m from activity centres. Caribou are not likely to habituate to construction disturbances quickly because hunting occurs throughout the production area and they have a natural aversion to humans.

Table 10-64: Effects of Infrastructure on Barren-Ground Caribou Habitat Availability – Production Area

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Far future
	Operations	Adverse	Low	Local	Far future
	Decommissioning and abandonment	Adverse	Low	Local	Far future
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low Moderate[1]	Local Regional[1]	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term Long term[2]
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

NOTES:
1 Moderate, regional effect relates to Group 1 infrastructure
2 Long-term effect relates to Group 1 and Group 2 infrastructure

Table 10-65: Change in Barren-Ground Caribou Habitat – Infrastructure Sites, Production Area

Habitat Value	Winter Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
Very high	-3,136	-1,252
High	868	-136
Moderate	-2,534	-755
Effective	-4,802	-2,143

NOTE:
Effective habitat is the sum of very high, high and moderate habitat values

Increased human and predator access could change barren-ground caribou habitat effectiveness in areas where roads are planned for construction. However, wolves have been known to use little used linear corridors as hunting routes, and barren-ground caribou habitat effectiveness could be altered by increased numbers of predators.

Dust from road and barge landing site construction could alter vegetation health primarily by producing dust (see Section 9, Vegetation).

Group 2

The level of vegetation clearing at borrow sites is considered to be relatively low, and borrow sites are only planned to be 10 ha in size. Most borrow sites will be within known barren-ground caribou range.

Sensory disturbance during borrow site excavation could cause habitat avoidance by barren-ground caribou. Disturbance during excavation of borrow sites will include noise, vehicle movement, construction equipment movement and human presence. The zone of influence from disturbances might extend up to 500 m from activity centres, though the effects of sensory disturbance are considered low because few borrow sites will be in caribou range in the production area.

Increased human access could change barren-ground caribou habitat effectiveness in areas where borrow sites are planned for excavation.

Dust from borrow site construction could alter vegetation health primarily by producing dust (see Section 9, Vegetation).

Group 3

Habitat availability during construction could be influenced by vegetation cleared for construction of infrastructure sites and by sensory disturbance of caribou near infrastructure sites. However, the extent of clearing at the sites is relatively small. Depending on the quality of habitat lost relative to that available elsewhere in the production area, vegetation clearing will likely result in little loss of habitat availability for caribou.

Increased human presence could change barren-ground caribou habitat effectiveness near infrastructure facilities.

Dust from construction at infrastructure sites could alter vegetation health by producing dust at fuel storage sites (see Section 9, Vegetation).

Barren-Ground Caribou – Operations

Sensory disturbance will be substantially less during operations than during construction because there will be much less human activity. As a result, effects of sensory disturbance during operations are expected to be low.

Operation of all infrastructure sites will result in a loss of 0.29% of effective barren-ground caribou winter foraging habitat in the production area RSA.

Group 1

Some of the all-weather roads might be decommissioned and begin to be reclaimed during operations. Human activity will be limited to periodic inspection and maintenance work because most of the facilities are designed to operate remotely. This is not expected to involve visits at more than weekly intervals, with access predominantly by helicopter. The amount of traffic on remaining all-weather and winter roads will also be decreased. However, wolves have been known to use little used linear corridors for hunting routes, so barren-ground caribou habitat effectiveness could continue to be altered by increased numbers of predators.

Group 2

Borrow sites not required during operations will be abandoned and reclaimed. Adverse effects on barren-ground caribou habitat availability are expected to gradually decline following reclamation and abandonment of borrow sites, and incremental habitat losses during operations are expected to be small.

Effects of sensory disturbance and human presence at remaining borrow sites on barren-ground caribou during operations are expected to be low magnitude, and levels of human activity will be substantially less than experienced during project construction.

Effects of dust on vegetation health are expected to be low magnitude at borrow sites during operations.

Group 3

Many of the stockpile sites, fuel storage sites, camp sites and staging and marshalling sites will no longer be operational during operations and will be undergoing reclamation. The amount of sensory disturbance on barren-ground caribou at remaining camps, stockpile sites and fuel storage sites is expected to be low. Vegetation clearing will be finished, though habitat effectiveness might still be altered by human presence and sensory disturbance. Effects on vegetation health are expected to be low magnitude.

Barren-Ground Caribou – Decommissioning and Abandonment

Reclaimed sites will undergo successional replacement of pioneer herbaceous communities. This will result in gradual recovery of habitat capability, though lichens, the preferred winter food source for caribou, will regenerate very slowly and might not return to baseline conditions for 50 to 100 years.

Group 1

Wolves have been known to use little-used linear corridors for hunting routes, so barren-ground caribou habitat effectiveness could continue to be altered by increased numbers of predators post-decommissioning.

Group 2

Adverse effects on barren-ground caribou habitat availability are expected to gradually decline following decommissioning of Group 2 infrastructure.

Group 3

Sensory disturbance might occur during decommissioning and cause a reduction of barren-ground caribou habitat effectiveness at remaining infrastructure sites. Vegetation health could be affected by dust during decommissioning at a very local level at a few locations.

Barren-Ground Grizzly Bear

Table 10-66 and Table 10-67 summarize potential effects of Group 1, 2 and 3 infrastructure on barren-ground grizzly bear habitat in the production area. All effects are low magnitude and local except moderate, regional effects of sensory disturbance for Group 2 infrastructure and altered access for Group 1 infrastructure.

Barren-Ground Grizzly Bear – Construction

Construction of all infrastructure sites will result in a loss of 0.81% of effective barren-ground grizzly bear fall foraging habitat, 0.49% of denning habitat and 0.89% of spring foraging habitat in the production area RSA. In some instances, a reduction in one category of habitat quality results in an increase in a lower category.

Group 1

Vegetation clearing during road construction could cause loss of grizzly bear foraging habitat, though the effects will be short in duration because their foraging habitat is mostly early successional shrub species. Decreases in foraging habitat availability might affect bears on an individual level and are not likely to have effects at the regional scale.

Dust from road and barge landing site construction could alter vegetation health primarily by producing dust at a very local level at a few locations.

Table 10-66: Effects of Infrastructure on Barren-Ground Grizzly Bear Habitat Availability – Production Area

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Positive	Low	Local	Long term
Sensory disturbance	Construction	Adverse	Low Moderate[1]	Local Regional[1]	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term Long term[3]
Altered human and predator access	Construction	Adverse	Low Moderate[2]	Local Regional[2]	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

NOTES:
1 Moderate, regional effects are related to Group 2 infrastructure
2 Moderate, regional effects are related to Group 1 infrastructure
3 Long-term effects are related to Group 2 and Group 3 infrastructure

Table 10-67: Change in Barren-Ground Grizzly Habitat – Infrastructure Sites, Production Area

Habitat Value	Denning		Spring Forage		Fall Forage	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
Very high	-3585	-3,195	0	0	0	0
High	264	1,684	-4,369	-4,053	-1,871	-1,749
Moderate	1,005	1,376	-4,347	-3,057	-608	-98
Effective	-2,316	-135	-8,716	-7,110	-2,479	-1,847

NOTE:
Effective habitat is the sum of very high, high and moderate habitat values

Sensory disturbance by roads could cause abandonment of nearby dens, with subsequent loss of denning habitat and avoidance of foraging habitat. Roads in certain areas, such as the Yaya Lake esker-kame complex, might overlap with several bear denning sites. The sensory disturbance zone of influence might extend up to 500 m from activity centres.

Grizzly bears have no known predators in the Northwest Territories other than humans. Roads could affect grizzly habitat effectiveness by providing human access to previously inaccessible areas.

Group 2

Barren-ground grizzly bears use borrow sites for both foraging and denning.

The extent of vegetation clearing at borrow sites is considered low at about 10 ha per site. Depending on the quantity and quality of foraging and denning habitat lost relative to that available elsewhere in the production area and regionally, granular resource extraction will likely result in a loss of foraging and denning habitat availability for barren-ground grizzly bears.

Dust from borrow site construction could alter vegetation health and grizzly bear foraging habitat primarily by producing dust. Reconnaissance-level surveys found evidence of grizzly dens at four of the potential borrow sites examined in the production area. Most borrow site development and use will be under frozen soil conditions in mid to late winter when barren-ground grizzly bears are in hibernation. Many of the proposed borrow sites are associated with eskers, which have high potential as denning habitat for barren-ground grizzly bears in the Northwest Territories. The principal barren-ground grizzly bear habitat issue will be the potential loss of active den sites and the related concern for the welfare of bears that could be inadvertently displaced from dens in winter. Displaced bears can face severe physiological and metabolic stress and potential mortality. Although surveys can be conducted immediately before construction to locate den sites, dens are often difficult to locate in forested habitats.

Sensory disturbance during borrow activities could change barren-ground grizzly bear habitat effectiveness. There is also some uncertainty about the distance winter industrial activities can be from winter dens without causing bears to desert their dens.

Group 3

Sensory disturbance during construction could cause habitat avoidance by barren-ground grizzly bears, though most construction activity at Group 3 infrastructure facilities will be in winter when bears are denning.

Reconnaissance-level surveys indicate that barren-ground grizzly bears feed at infrastructure sites in summer. No evidence of denning was observed near infrastructure sites, though the extent of clearing at the sites is considered relatively low (see the barren-ground caribou assessment preceding). Depending on the quality of foraging and denning habitat lost relative to that available elsewhere in the lease area and regionally, vegetation clearing will likely result in little loss of habitat availability for barren-ground grizzly bears.

Increased human presence could change grizzly bear habitat effectiveness near Group 3 infrastructure facilities.

Dust during construction at infrastructure sites could alter vegetation health by producing dust at fuel storage sites at a local level at a few locations.

Barren-Ground Grizzly Bear – Operations

Sensory disturbance will be less during operations than during construction, so effects on barren-ground grizzly bears of sensory disturbance at infrastructure sites are expected to be low magnitude.

Operation of infrastructure sites will result in a loss of 0.6% of effective barren-ground grizzly bear fall foraging habitat, 0.03% of denning habitat and 0.73% of spring foraging habitat in the production area RSA.

Group 1

Roads not required during operations will be decommissioned, blocked and will begin to be reclaimed during operations. Less traffic will occur on remaining transportation routes during operations. Human activity will be limited to periodic inspection and maintenance work because most of the facilities are designed to operate remotely with not more than weekly access, usually by helicopter. Therefore, there will be fewer adverse effects on barren-ground grizzly bear habitat availability during operations than during construction.

Group 2

Adverse effects on the availability of dens and forage, such as Arctic ground squirrel for grizzly bears, might not decline if borrow materials are exhausted at the sites. The level of impact will depend on the availability of intact borrow sites, such as eskers, within the project study area and regionally.

Effects of sensory disturbance on barren-ground grizzly bears during operations are expected to be low magnitude because borrow sites not required during operations will be abandoned and reclaimed, with a subsequent reduction in human activity. Several sites will likely remain active during operations for road and well pad maintenance.

Vegetation communities will start to regenerate after borrow sites are abandoned and grizzly bear habitat might improve over what was available during baseline as the shrubs they prefer are early successional species.

Any further effects of dust on vegetation health will be very local at a few locations.

Group 3

Many of the stockpile sites, camp sites and staging and marshalling sites will no longer be operational and will be undergoing reclamation during operations. The amount of sensory disturbance of barren-ground grizzly bears at remaining camps, stockpile sites and fuel storage sites is expected to be low. Vegetation clearing will no longer be occurring. Increased human presence could change grizzly habitat effectiveness near infrastructure facilities.

Barren-Ground Grizzly Bear – Decommissioning and Abandonment

Group 1

Monitoring programs during site decommissioning could cause some sensory disturbance to bears, especially during the spring, summer and fall. However, most site visits will likely be brief and will probably not disturb bears.

Group 2

Adverse effects on the availability of dens and forage, such as Arctic ground squirrel, might not decline following reclamation and abandonment of borrow sites if granular materials are exhausted at these sites. The level of impact will depend on the availability of intact borrow sites, such as eskers, within the project study area and regionally.

Group 3

Sensory disturbance and human presence during the decommissioning of camps, stockpile sites and fuel storage sites could reduce habitat effectiveness for barren-ground grizzly bears.

Dust might also affect vegetation health at a very local level at a few locations during decommissioning primarily by producing dust.

Adverse effects on barren-ground grizzly bear habitat availability are also expected to gradually decline following reclamation and abandonment of infrastructure sites. Reclaimed sites will re-grow vegetation, either by natural succession or planting. Depending on the characteristics and species composition of the re-established community, reclamation should result in the recovery of habitat capability for barren-ground grizzly bears in previously suitable habitats.

Greater White-Fronted Goose

Potential effects of Group 1 and 3 infrastructure in the production area during all phases on the availability of greater white-fronted goose habitat are predicted to be adverse, low magnitude, local in extent and long term (see Table 10-68). Group 2 sites are outside nesting and moulting areas typically used by greater white-fronted geese, so no effects are predicted for Group 2.

Table 10-69 is a summary of potential effects of Group 1, 2 and 3 infrastructure on greater white-fronted goose habitat in the production area.

Greater White-Fronted Goose – Construction

Construction of production area infrastructure will reduce the area of effective nesting and foraging habitats for the greater white-fronted goose. The amounts of affected nesting and foraging habitat will be very similar, but little will be high-value habitat. Large areas of habitat in the production area RSA will be unaffected, and much of the reduction in habitat availability will be caused by sensory disturbances from construction activities.

Group 1

Sensory disturbance from construction, aircraft, and barge and boat activities at infrastructure sites might be more important when a larger area is affected. Project interactions with greater white-fronted geese during peak construction are expected to be limited to the vicinity of each infrastructure site and to affect the availability of nesting and feeding habitat for relatively few geese.

Table 10-68: Effects of Infrastructure on Bird Habitat Availability – Production Area

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Change in vegetation health	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
NOTE: Bird species included in the production area infrastructure assessment: greater white-fronted goose, snow goose, tundra swan, scaup, peregrine falcon, whimbrel and Arctic tern					

Table 10-69: Change in Greater White-Fronted Goose Habitat – Infrastructure Sites, Production Area

RSA Habitat Value	Nesting		Terrestrial Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
High	-48	-16	-34	-25
Moderate	-123	-37	-133	-71
Effective	-171	-53	-167	-96

Group 3

Most greater white-fronted geese in the production area nest on the outer Mackenzie Delta. Few nest in the Parsons Lake area. Therefore, potential effects on habitat availability are only possible in association with Niglintgak and Taglu and with the Swimming Point, Lucas Point and Tununuk Point equipment-staging areas. None of these sites is known to be critical for greater white-fronted geese in the production area. The amount of habitat change is small relative to the size of the area used by this species on the outer delta.

Greater White-Fronted Goose – Operations

Operations will reduce the availability of effective nesting habitat. However, less habitat will be affected than during construction because the sensory disturbances from construction will have ended. The amount of lost habitat will be a small fraction of the effective habitat available in the production area RSA.

Group 1

Sensory disturbance from aircraft and barge and boat activities at infrastructure sites is expected to be the primary effect on greater white-fronted goose habitat availability during peak operations. However, these effects are expected to be limited mainly to the vicinity of each infrastructure site and to affect the availability of nesting and feeding habitat for relatively few geese.

Group 3

Potential Group 3 infrastructure site interactions with greater white-fronted geese during operations are expected to be associated only with Niglintgak and Taglu, and with the Swimming Point, Lucas Point and Tununuk Point staging areas. None of those sites is known to be critical for greater white-fronted geese in the production area.

Greater White-Fronted Goose – Decommissioning and Abandonment

Group 1

Sensory disturbance from aircraft and barge or boat activities in support of decommissioning at infrastructure sites is expected to be the primary effect of Group 1 infrastructure on greater white-fronted geese. These effects are expected to be limited to the vicinity of each infrastructure site and to affect the availability of nesting and feeding habitat for relatively few individuals.

Group 3

Potential infrastructure site and VC interactions are expected to be associated only with Niglintgak and Taglu and the staging sites at Swimming Point, Lucas Point and Tununuk Point. None of these sites is known to be in critical habitat for greater white-fronted geese in the production area. The reclamation of habitat through decommissioning will be positive, although the area restored is very small.

Snow Goose

Potential effects of Group 1 and 3 infrastructure in the production area during all phases on the availability of snow goose habitat are predicted to be adverse, low magnitude, local in extent and long term (see Table 10-68, shown previously). Group 2 sites are located away from snow goose habitat and so are not expected to have an effect.

Snow Goose – Construction

Group 1 and Group 3

Infrastructure site construction is expected to have potential effects on snow goose populations for access roads and barge landings proposed for the outer delta at Swimming Point, Lucas Point and Tununuk Point. The effects of direct habitat loss will be minimal, likely affecting staging habitat for relatively few geese. Disturbance, especially aircraft overflights, could cause some snow geese to avoid otherwise suitable areas. Adhering to Kendall Island Bird Sanctuary permits requirements and aircraft flight guidelines will reduce potential effects.

Snow Goose – Operations

Group 1 and Group 3

Potential effects of infrastructure on snow goose populations in the production area during operations are similar to those discussed for construction.

Snow Goose – Decommissioning and Abandonment

Group 1 and Group 3

Sensory disturbance, especially aircraft overflights, near Niglintgak, Taglu, Swimming Point, Lucas Point and Tununuk Point could cause some snow geese to avoid otherwise suitable areas. Adhering to Kendall Island Bird Sanctuary permit requirements and aircraft flight guidelines will reduce potential effects.

Tundra Swan

The largest potential effects of infrastructure in the production area during all phases on tundra swan habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-68, shown previously). Table 10-70 shows the change in tundra swan habitat from construction and operation of infrastructure sites in the production area.

Table 10-70: Change in Tundra Swan Habitat – Infrastructure Sites, Production Area

Habitat Value	Nesting		Terrestrial Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
High	-1,012	-92	-190	-105
Moderate	-355	-121	48	-12
Effective	-1,367	-213	-142	-117

Tundra Swan – Construction

The habitat model for tundra swan predicts that construction will reduce the amount of available effective nesting habitat and foraging habitat. Some of this reduction will be caused by sensory disturbances from construction activities. Large areas of effective nesting and foraging habitat in the production area RSA will be unaffected.

Group 1

Aircraft, barge and boat disturbance of the large flocks of swans along the coast of the outer Mackenzie Delta in July and August are potentially the most important effects of infrastructure site construction. Potential disturbance effects on nesting pairs are not likely to affect many pairs or to reduce use of the nesting areas because nesting pairs are often widely dispersed.

Group 2

Breeding tundra swans are distributed widely in low densities throughout the outer Mackenzie Delta and Parsons Lake area where borrow sites are proposed, so potential effects on habitat availability are expected to affect scattered individuals,

pairs and family groups rather than regionally important congregations of swans. One exception might be disturbance of flocks of swans that gather along the coast of the outer delta in July and August, though these areas appear to be beyond the likely zone of potential disturbance associated with the borrow sites. Otherwise, the potential effects of direct habitat loss and disturbance are expected to affect only a few tundra geese near the borrow sites.

Group 3

Direct habitat loss during construction will be restricted to the vicinity of the infrastructure sites, which could affect habitat availability for a few locally nesting swans.

Tundra Swan – Operations

Operations will decrease the amount of effective nesting and foraging habitat. The reduction in effective foraging habitat will be similar to that during construction. Large areas of effective nesting and foraging habitat will continue to be available in the production area RSA.

Tundra Swan – Decommissioning and Abandonment

Effects of decommissioning on tundra swans by any of the three infrastructure groups will be similar to or lower than those predicted for construction.

Scaup

The largest potential effects of infrastructure in the production area during all phases on the availability of scaup habitat are adverse, low magnitude, local in extent and long term (see Table 10-68, shown previously). Table 10-71 shows the change in great scaup habitat from construction and operation of infrastructure sites in the production area.

Table 10-71: Change in Greater Scaup Habitat – Infrastructure Sites, Production Area

Habitat Value	Nesting	
	Habitat Change – Construction (ha)	**Habitat Change – Operations** (ha)
High	0	0
Moderate	-40	-30
Effective	-40	-30

Scaup – Construction

Little effective nesting habitat for greater scaup will be removed during construction of infrastructure sites in the production area. Large areas of effective nesting habitat in the production area RSA will be unaffected.

Groups 1 and 3

Construction activities at the infrastructure sites could result in direct habitat loss and alteration for a few nesting scaup near the sites. The more important effects during construction would be disturbance of moulting flocks and broods. Disturbance could also cause temporary avoidance of favoured moulting, brood-rearing and feeding lakes, though most construction will occur in winter.

Group 2

The most important potential effects on scaup habitat availability during borrow site construction will be disturbance of broods and moulting flocks. Direct habitat loss might affect nesting habitat for a few scaup within the footprint of the borrow sites. The potential significance of habitat avoidance because of disturbance depends on the proximity of the proposed borrow sites to moulting and brood-rearing areas and on activities at the borrow sites in summer. Summer activity will be minimal, resulting in little or no effect on birds.

Scaup – Operations

Operations will reduce the area of greater scaup effective nesting habitat by an amount similar to the area reduced during construction. Available effective nesting habitat will continue to be abundant in the RSA during this project phase.

Groups 1 and 3

Sensory disturbance of moulting flocks and broods during operations could be important. Disturbance could cause scaup to temporarily avoid favoured moulting, brood-rearing and feeding lakes.

Group 2

The most important potential effects on scaup habitat availability of borrow sites during operations are expected to be disturbance of broods and moulting flocks. However, levels of disturbance are expected to be much lower during operations than during construction.

Scaup – Decommissioning and Abandonment

Groups 1 and 3

Sensory disturbance of moulting flocks and broods could be important during decommissioning and abandonment of infrastructure sites. Disturbance could cause scaup to temporarily avoid favoured moulting, brood-rearing and feeding lakes.

Group 2

The most important potential effects on scaup habitat availability during decommissioning and abandonment are expected to be disturbance of broods and moulting flocks, though levels of disturbance are expected to be much lower during decommissioning than during construction.

Peregrine Falcon

The largest potential effects of Groups 1 to 3 infrastructure in the production area on peregrine falcon habitat availability during all phases are adverse, low magnitude, local in extent and long term (see Table 10-68, shown previously).

Peregrine Falcon – Construction

Group 1 and 3

Direct loss of feeding habitat and disturbance of prey populations and feeding areas are the most important potential effects of infrastructure sites during construction. Effects will not be widespread because direct habitat loss will be localized at the proposed infrastructure sites. Peregrine falcons might avoid some areas temporarily because of disturbance.

Group 2

Disturbance will be the most important potential effect on peregrine falcons of borrow sites. Two of the proposed borrow sites are near the Caribou Hills, which provide habitat for cliff-nesting raptors, possibly including peregrine falcons. Construction will cause some direct habitat loss and disturbance of prey populations and peregrine falcon feeding areas, though the effects will not be widespread because direct habitat loss will be localized at the proposed borrow sites. Peregrine falcons might avoid some hunting areas temporarily because of aircraft disturbance.

Peregrine Falcon – Operations

Group 1 and 3

Disturbing prey populations and feeding areas are the most important potential effects of infrastructure sites during operations. Disturbance will not be widespread, but peregrine falcons and their prey might avoid some areas temporarily because of disturbance.

Group 2

The most important potential effects at borrow sites during operations are related to disturbance. Disturbance levels are expected to be very low compared with

construction. Two of the proposed borrow sites are near the Caribou Hills, which provide habitat for cliff-nesting raptors, possibly including peregrine falcons. There might also be some disturbance of prey populations and feeding areas, and peregrine falcons might avoid some hunting areas temporarily because of disturbance.

Peregrine Falcon – Decommissioning and Abandonment

Effects during decommissioning will be similar to, but likely lower than for construction.

Groups 1 and 3

Disturbing prey populations and feeding areas are the most important potential effects of infrastructure sites during decommissioning and abandonment. Disturbance will be greatest around the proposed infrastructure sites, and peregrine falcons and their prey might avoid some areas temporarily because of disturbance.

Group 2

The most important potential effect of borrow sites during decommissioning and abandonment is potential disturbance of nesting peregrine falcons. Disturbance levels are expected to be very low and much less than during construction.

Whimbrel

The largest potential effects of Groups 1 to 3 infrastructure in the production area during all phases on whimbrel habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-68, shown previously). Table 10-72 shows the change in whimbrel habitat from construction and operation of infrastructure sites in the production area.

Table 10-72: Change in Whimbrel Habitat – Infrastructure Sites, Production Area

Habitat Value	Nesting		Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
High	-137	-114	-185	-156
Moderate	-164	-156	-216	-205
Effective	-301	-270	-401	-361

Whimbrel – Construction

Construction of production area infrastructure sites will reduce the amount of available effective nesting and foraging habitat in the RSA for whimbrel. Large areas of effective nesting and foraging habitat in the RSA will not be affected.

Groups 1 and 3

During construction, relatively few nesting whimbrels will be affected by direct habitat loss and alteration within the footprint of the infrastructure sites. Disturbance also could cause avoidance of some nesting and feeding areas, though the potential losses of habitat availability will likely affect only a few birds and will not reduce the regional population.

Group 2

Few nesting whimbrels will be affected by direct habitat loss and alteration within the footprint of the borrow sites during construction. Construction disturbance could cause whimbrels to avoid some nesting and feeding areas, though the potential loss of habitat availability will likely affect only a few birds and will not affect the regional population.

Whimbrel – Operations

Operations will affect a similar amount of habitat as construction.

Groups 1 and 3

Relatively few nesting and feeding whimbrels might avoid otherwise suitable nesting and feeding areas near the proposed infrastructure sites because of disturbances during operations. However, the potential loss of habitat availability will likely affect only a few birds and will not change the regional population.

Group 2

Disturbance at the gravel sites during operations could cause whimbrels to avoid some nesting and feeding areas, though the level of disturbance is expected to be much less during operations than during construction. The potential loss of habitat availability will likely affect only a few birds and will not affect the regional population.

Whimbrel – Decommissioning and Abandonment

Groups 1 and 3

Some disturbance will occur during decommissioning and abandonment of infrastructure sites. The potential effects will likely only limit habitat availability locally and for relatively few whimbrels. Regional population reductions are not predicted.

Group 2

Disturbance during decommissioning and abandonment could cause whimbrel to avoid some nesting and feeding areas, though the level of disturbance from the borrow sites during decommissioning is expected to be very low.

Arctic Tern

The potential effects of Groups 1 to 3 infrastructure in the production area during all phases on Arctic tern habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-68, shown previously).

Arctic Tern – Construction

Groups 1 and 3

During construction, important potential project effects on Arctic tern habitat availability at the proposed infrastructure sites are:

- destruction and disturbance of nesting colonies from June to August
- disturbance at favoured feeding areas from June to August

Arctic terns nest and forage throughout the production area, but the proximity of nesting colonies and productive feeding areas to the proposed infrastructure sites has not been investigated. During the 2001 and 2002 surveys, the highest densities of Arctic terns were recorded on the outer Mackenzie Delta and to the northwest, north and northeast of Parsons Lake. Potential effects are likely to be less important away from those locations, such as at the infrastructure sites associated with the Inuvik area facility or at Inuvik.

Group 2

As with Group 1, disturbance of colonies and feeding areas will be potential effects between June and August.

Arctic terns nest and forage throughout the outer delta and Parsons Lake area. However, the proximity of nesting colonies and productive feeding areas to the proposed borrow sites is not known.

Arctic Tern – Operations

Groups 1 and 3

Potential project effects on Arctic tern habitat availability during operations are similar to effects during construction, though disturbance from human activities will be much lower.

Group 2

There will be no new effects on terns from the continued presence of the relatively inactive borrow sites during operations.

Arctic Tern – Decommissioning and Abandonment

All Groups

Effects on Arctic terns during decommissioning will be similar to, and likely lower for, construction.

10.3.9.2 Pipeline Corridor Infrastructure

Planned for construction along the pipeline corridor (see Volume 2, Project Description) are:

- 2.5 km of all-weather permanent roads
- 8.5 km of all-weather temporary roads
- 28 km of winter roads
- 17 barge landing sites
- 12 airstrips
- 14 helipads

Sixty-two borrow sites are planned for excavation along the pipeline corridor (Volume 2, Project Description).

Infrastructure sites planned for construction along the pipeline corridor include:

- 16 temporary camps
- one existing camp
- 24 stockpile sites
- 22 fuel storage sites
- two communication centres

Many infrastructure sites are combined camp and storage sites (see Volume 2, Project Description).

Baseline Conditions

Volume 3, Section 10, Wildlife, presents an overview of baseline wildlife communities in the pipeline corridor. No specific baseline information is available for birds on the infrastructure sites because the site locations were not known when the field surveys were conducted. However, several sites were surveyed and reported.

Group 1

Infrastructure components providing land and air-based access to the infrastructure sites and the right-of-way were not assessed because alignment drawings were unavailable during the survey. Twenty-three barge landing sites were assessed by reconnaissance-level wildlife inspections.

Where roads and barge landings are planned for construction along the pipeline corridor (see Volume 3, Section 10, Wildlife):

- barren-ground caribou were found only in the Travaillant Lake area
- woodland caribou were found at Little Chicago, Norman Wells and Blackwater River
- moose were found at Inuvik, Campbell Lake, Little Chicago, Fort Good Hope, Little Smith Creek, Ochre River, Camsell Bend and Fort Simpson
- barren-ground grizzly bear were found at Campbell Lake and Camsell Bend
- marten were found at Tulita, Little Smith Creek, Blackwater River, Ochre River, Camsell Bend, Trail River, Fort Simpson and Liard River
- lynx were found at Little Smith Creek and Camsell Bend
- beaver were not found

Group 2

Reconnaissance-level wildlife inspections of potential borrow sites in the three settlement regions along the proposed pipeline corridor were carried out in 2002. The inspections included 22 sites in the Gwich'in Settlement Area, 54 sites in the Sahtu Settlement Area and 59 sites in the Deh Cho Region (see Volume 3, Section 10, Wildlife).

Evidence of the following wildlife was found at borrow sites along the pipeline corridor:

- woodland caribou evidence was found at 59 sites
- moose evidence was found at all sites planned for construction
- barren-ground grizzly bear evidence was found at 41 sites
- marten evidence was found at five sites
- lynx evidence was found at three sites
- beaver evidence was found at 11 borrow sites

Barren-ground caribou evidence was not found.

Group 3

Reconnaissance-level wildlife inspections of potential facility sites in the three settlement regions along the proposed pipeline corridor were carried out in 2002. The inspections included six sites in the Gwich'in Settlement Area, 14 sites in the Sahtu Settlement Area and 10 sites in the Deh Cho Region (see Volume 3, Section 10, Wildlife).

Where infrastructure sites will be constructed along the pipeline corridor:

- evidence of barren-ground caribou was found only in the Travaillant Lake area
- woodland caribou evidence was found at Little Chicago, Norman Wells, Blackwater River, McGill Station, Trout Lake, the Alberta-Northwest Territories boundary, Wildboy Trail and Wiebe camp
- moose evidence was found at Inuvik, Campbell Lake, Little Chicago, Fort Good Hope, Little Smith Creek, Ochre River, Camsell Bend, Fort Simpson, McGill Station and Trout Lake
- barren-ground grizzly bear evidence was found at Campbell Lake, Smith Creek, Camsell Bend and McGill Station
- marten evidence was found at Tulita, Little Smith Creek, Blackwater River, Ochre River, Camsell Bend, Trail River, Fort Simpson, Liard River and Trout Lake
- lynx evidence was found at Little Smith Creek, Camsell Bend and Trout Lake
- beaver evidence was found at Trout Lake

Pipeline Corridor Infrastructure Effects

Construction of infrastructure sites could potentially change wildlife habitat availability through vegetation clearing resulting in direct habitat change, sensory disturbance altering habitat effectiveness, altered human and predator access resulting in change in habitat effectiveness, and air and dust emissions changing vegetation health.

The effects of pipeline corridor infrastructure operations on wildlife habitat availability relate primarily to altered human and predator access that might affect habitat effectiveness, and changes to vegetation health from air emissions.

Decommissioning and abandonment of infrastructure facilities, roads and borrow sites could potentially alter wildlife habitat availability through sensory disturbance altering habitat effectiveness and air and dust emissions changing vegetation health.

Barren-Ground Caribou

A summary of potential effects of Groups 1, 2 and 3 infrastructure on barren-ground caribou habitat along the pipeline corridor is in Table 10-73.

The potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during all phases on barren-ground caribou habitat availability are adverse, low magnitude, local in extent and far future in duration.

Table 10-74 shows the results of barren-ground caribou habitat models developed for the Gwich'n Settlement Area in the pipeline corridor.

Table 10-73: Effects of Groups 1 to 3 Infrastructure on Barren-Ground Caribou Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Far future
	Operations	Adverse	Low	Local	Far future
	Decommissioning and abandonment	Adverse	Low	Local	Far future
Sensory disturbance	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Far future
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

Table 10-74: Change in Barren-Ground Caribou Habitat – Infrastructure Sites, Gwich'in Settlement Area

Habitat Value	Winter Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
Very high	0	0
High	0	0
Moderate	-408	-166
Effective	-408	-166
NOTE: Effective habitat is the sum of very high, high and moderate habitat values		

Barren-Ground Caribou – Construction

Construction of infrastructure sites will result in a small amount of habitat loss representing 0.38% of effective barren-ground caribou winter foraging habitat in the Gwich'in Settlement Area part of the pipeline corridor RSA.

Group 1

Over 28 km of winter roads will be built to service well pads, camps, borrow sites, barge landings and other construction areas. Winter roads will be designed to avoid rutting and damage of arctic tundra. The zone of influence from disturbances might extend up to 500 m from activity centres. Road construction will involve vegetation clearing with potential effects on lichen, the primary food for barren-ground caribou.

Sensory disturbance during construction might change barren-ground caribou habitat effectiveness. Disturbance during construction will include noise and movements of vehicles, helicopters, digging and excavating equipment, and human presence. As a result, sensory disturbances during construction will result in a decrease in habitat availability near infrastructure sites and winter and all-weather roads.

Increased human and predator access could change barren-ground caribou habitat effectiveness in areas where roads are planned for construction. It is not likely that caribou will quickly habituate to construction disturbances because hunting occurs throughout the production area and a natural aversion to humans already exists. However, wolves have been known to use little used linear corridors for hunting routes, so barren-ground caribou habitat effectiveness could be altered by increased numbers of predators post-decommissioning.

Dust altering vegetation health could result from road and barge landing site construction primarily through dust production at a very local level at a few locations. However, mitigation measures will endeavour to reduce the amount of dust produced, thereby reducing the effects on vegetation health.

Group 2

Vegetation clearing, excavation and access road development at borrow sites will result in direct habitat loss. About 39 borrow sites along the pipeline corridor are within known or suspected barren-ground caribou range. Based on an estimated size of 10 ha, development of these sites could result in a loss or alteration of vegetation cover over a total area of about 390 ha. Additional habitat losses will result from access road development to the borrow sites, but granular resource extraction will likely result in little loss of caribou habitat.

Sensory disturbance related to human activity and noise from equipment operations, blasting and crushing operations is expected to displace caribou from adjacent habitats when granular resources are being extracted. The likely severity of these responses is not known. Although the behavioural responses of barren-ground caribou to pipeline development and related disturbances have been studied quite extensively in Alaska during the calving and post-calving periods, the reaction of wintering caribou to these types of disturbances has not been well documented. The zone of influence from disturbances might extend up to 500 m from activity centres.

Increased human access could change barren-ground caribou habitat effectiveness in areas where borrow sites are planned for excavation. Dust altering vegetation health could result from borrow site construction primarily through dust production.

Group 3

During construction, habitat availability could be influenced by both vegetation cleared for construction of facility sites and by sensory disturbance of caribou near infrastructure sites. Although any losses of key foraging habitat at infrastructure sites would contribute to the potential habitat loss caused by the project, infrastructure sites are relatively small, and resulting losses will comprise a very small proportion of the known winter ranges of this herd.

Increased human presence could change barren-ground caribou habitat effectiveness near infrastructure facilities.

Vegetation health during construction at infrastructure sites could be affected by dust at a very local level at a few locations.

Barren-Ground Caribou – Operations

Sensory disturbance will be substantially less during operations than during construction because human activity will be much less. As a result, effects of sensory disturbance during operations are expected to be low.

Operation of infrastructure sites will result in a small amount of habitat loss representing 0.15% of effective barren-ground caribou winter foraging habitat along the pipeline corridor RSA.

Group 1

Infrastructure components that are expected to remain in use during project operations include permanent or temporary all-weather access roads to compressor stations or other permanent facilities, airstrips, helipads and camps for housing maintenance personnel. This is not expected to involve visits at more than weekly intervals, with access predominantly by helicopter. Most temporary

roads will be decommissioned, blocked, and start undergoing reclamation during operations. Human activity will be limited to periodic inspection and maintenance work because most of the facilities are designed to operate remotely. However, wolves have been known to use little used linear corridors for hunting routes, so barren-ground caribou habitat effectiveness could continue to be altered by increased numbers of predators post-decommissioning. Effects of sensory disturbance related to operations activities would be very localized, e.g., landing and take-off of helicopters at facility sites, so effects on habitat use by caribou are expected to be very limited.

Group 2

During operations, most of the borrow sites will be abandoned and reclaimed. Adverse effects on habitat availability for barren-ground caribou are expected to gradually decline following reclamation and abandonment of borrow sites. Incremental habitat losses during operations are expected to be small.

Effects of sensory disturbance and human presence at remaining borrow sites on barren-ground caribou during operations are expected to be low because levels of human activity will be lower than during project construction, and incremental habitat losses during operations are expected to be comparatively small.

Group 3

During operations, many of the stockpile sites, fuel storage sites, camp sites and staging and marshalling sites will no longer be operational and will be undergoing reclamation. Most permanent facilities are associated with communities or existing facilities. An exception is the Little Chicago compressor station, where it is expected that an airstrip or helipad and camp accommodations for maintenance crews will be maintained.

The amount of sensory disturbance on barren-ground caribou at remaining camps, stockpile sites and fuel storage sites is expected to be low. Vegetation clearing will no longer be occurring. However, habitat effectiveness might still be altered by human presence and sensory disturbance.

Barren-Ground Caribou – Decommissioning and Abandonment

Reclaimed sites will undergo successional replacement of pioneer herbaceous communities. This will result in gradual recovery of habitat capability. However, lichens, the preferred winter food source for caribou, will regenerate very slowly and might not return to baseline conditions for 50 to 100 years.

Group 1

Use of access roads during monitoring programs during decommissioning and abandonment could cause some sensory disturbance to caribou. However, most

site visits will likely occur in summer when caribou are not in the production area. Wolves have been known to use little used linear corridors for hunting routes, so barren-ground caribou habitat effectiveness could continue to be altered by increased numbers of predators post-decommissioning.

Group 2

Adverse effects on barren-ground caribou habitat availability are expected to gradually decline following reclamation and abandonment of borrow sites.

The effects of decommissioning of Group 2 infrastructure components along the pipeline corridor on barren-ground caribou habitat availability are predicted to be low magnitude.

Group 3

Sensory disturbance might occur during decommissioning activities, resulting in a reduction of barren-ground caribou habitat effectiveness at remaining infrastructure sites. Dust could affect vegetation health during decommissioning, though any adverse effects on habitat availability for barren-ground caribou are expected to gradually decline following reclamation and abandonment of infrastructure sites.

Woodland Caribou

The potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during construction on the availability of woodland caribou habitat are adverse, low magnitude, local in extent and far future in duration (see Table 10-75).

Results of woodland caribou habitat models developed for the North Taiga Plains and South Taiga Plains ecological zones in the pipeline corridor are presented in Table 10-76.

All models assume that construction is continuous in duration, that it occurs over all infrastructure sites concurrently, and that all individuals of a population are affected. For these reasons, the modelled amount of habitat change is an overestimate for any given moment in time. Much of the modelled reduction of habitat depends on sensory disturbance. The actual amount of habitat loss from sensory disturbance will depend on the location, geographic extent, duration and intensity of activities during construction and operations at the various types of infrastructure sites. In addition, for woodland caribou, infrastructure sites represent a small area relative to their home range.

Table 10-75: Effects of Groups 1 to 3 Infrastructure on Woodland Caribou Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Far future
	Operations	Adverse	Low	Local	Far future
	Decommissioning and abandonment	Adverse	Low	Local	Far future
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Far future
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

Table 10-76: Change in Woodland Caribou Habitat – Infrastructure Sites, Pipeline Corridor

Habitat Value	Winter Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
Gwich'in Settlement Region		
Very high	-3,205	-229
High	955	-221
Moderate	1,585	84
Effective	-665	-366
Sahtu Settlement Area		
Very high	-18,069	-1,065
High	7,969	-693
Moderate	-2,090	220
Effective	-12,190	-1,538
Deh Cho Region		
Very high	-5,101	-127
High	171	-366
Moderate	-22,603	-1,011
Effective	-27,553	-1,504
NOTE: Effective habitat is the sum of very high, high and moderate habitat values		

Woodland Caribou – Construction

Construction of infrastructure sites will result in a loss of 0.10% of effective woodland caribou foraging habitat in the Gwich'in Settlement Area, 0.80% in the Sahtu Settlement Area and 1.66% in the Deh Cho Region of the pipeline corridor RSA.

Group 1

The effects on habitat availability and the resulting habitat loss for woodland caribou during construction of roads, barge landings and airstrips are similar to those described for barren-ground caribou.

Group 2

Fifty-six of the 62 borrow sites along the pipeline corridor could be within the range of woodland caribou. Based on an estimated size of 10 ha, development of these sites could result in loss or alteration of vegetation cover over a total area of about 560 ha, not including additional habitat losses that would result from access road development to the borrow sites. The effects of borrow site development on woodland caribou are expected to be similar to those described for barren-ground caribou. The major difference is that, unlike barren-ground caribou, woodland caribou could be resident year around and could be exposed to disturbances from summer operation of borrow sites.

Group 3

The effects on habitat availability and the resulting habitat loss for woodland caribou during construction of camps, stockpile sites and fuel storage sites are similar to those described for barren-ground caribou.

Woodland Caribou – Operations

Operation of infrastructure sites will result in a loss of 0.06% of effective woodland caribou foraging habitat in the Gwich'in Settlement Area, 0.10% in the Sahtu Settlement Area and 0.09% in the Deh Cho Region of the pipeline corridor RSA.

Group 1

Most temporary roads will be decommissioned, blocked and start undergoing reclamation during operations. There will be no further vegetation clearing associated with transportation components during operations. Infrastructure components expected to remain in use during operations include permanent or temporary all-weather access roads to compressor stations or other permanent facilities, airstrips, helipads and camps for housing maintenance personnel. Many of these are associated with communities or existing facilities. Because most of the facilities are designed to operate remotely, human activity will be limited to periodic inspection and maintenance work, which is not expected to involve visits

at more than weekly intervals, with access predominantly by helicopter. Effects of sensory disturbance related to these activities would be very localized, e.g., landing and take-off of helicopters at facility sites. The amount of traffic on remaining all-weather and winter roads will also be decreased. However, wolves have been known to use little used linear corridors for hunting routes, so woodland caribou habitat effectiveness could continue to be altered by increased numbers of predators post-decommissioning.

Group 2

The effect of borrow site construction on habitat availability for woodland caribou will be similar to that described for the barren-ground caribou.

Group 3

Vegetation clearing and use of most of the infrastructure sites will be limited to construction, so effects on caribou during project operations are expected to be limited, and effects on habitat use by caribou are expected to be very limited and similar to that described for barren-ground caribou.

The effects of operation of Group 3 infrastructure components along the pipeline corridor on woodland caribou habitat availability are predicted to be adverse, low magnitude, local in extent and long term.

Woodland Caribou – Decommissioning and Abandonment

Reclaimed sites will undergo successional replacement of pioneer herbaceous communities. This will result in gradual recovery of habitat capability, though lichens, the preferred winter food source for caribou, will regenerate very slowly and might not return to baseline conditions for 50 to 100 years.

Group 1

Effects of decommissioning on woodland caribou will be similar to those described for barren-ground caribou. No measurable adverse effects on woodland caribou habitat availability are expected following reclamation and abandonment of infrastructure sites.

Group 2

Effects on woodland caribou during decommissioning and abandonment of borrow sites will be similar to that described for barren-ground caribou.

Group 3

Effects on woodland caribou during decommissioning and abandonment of infrastructure sites will be similar to that described for barren-ground caribou.

Moose

A summary of potential effects of Group 1, 2 and 3 infrastructure on moose habitat along the pipeline corridor is in Table 10-77. Change in habitat availability is presented in Table 10-78.

Table 10-77: Effects of Groups 1 to 3 Infrastructure on Moose Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Positive	Low	Local	Long term
Sensory disturbance	Construction	Adverse	Moderate	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

Much of the modelled reduction of habitat depends on sensory disturbance. The actual amount of habitat loss caused by sensory disturbance will depend on the location, geographic extent, duration and intensity of activities during construction and operations at the various types of infrastructure sites. In addition, for moose, infrastructure sites represent a small area relative to their home range.

Moose – Construction

The potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during construction on moose habitat availability are adverse, moderate magnitude, local in extent and long term.

Construction of infrastructure sites will result in a loss of 0.36% of effective moose habitat in the Gwich'in Settlement Area, 0.50% in the Sahtu Settlement Area and 0.42% in the Deh Cho Region of the pipeline corridor RSA.

Table 10-78: Change in Moose Habitat – Infrastructure Sites, Pipeline Corridor

Habitat Value	Winter Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
Gwich'in Settlement Region		
Very high	-468	-439
High	-4,385	-412
Moderate	1,277	2,776
Effective	-3,576	-1,925
Sahtu Settlement Area		
Very high	-5,063	-4,065
High	-2,428	-822
Moderate	-2,630	-1,905
Effective	-10,121	-6,792
Deh Cho Region		
Very high	-1,789	-464
High	545	-165
Moderate	-5,494	-4,585
Effective	-6,738	-5,215
NOTE: Effective habitat is the sum of very high, high and moderate habitat values		

Group 1

Seventeen barge landing sites are planned for construction. The locations of these sites beside the Mackenzie River will potentially conflict with riparian habitat zones that provide important winter habitat and movement corridors for moose.

Habitat loss for moose will result from clearing of vegetation for infrastructure sites and associated access roads. Disturbance during construction will include noise and movements of vehicles, helicopters, digging and excavating equipment, and human presence. As a result, sensory disturbances during construction will decrease habitat availability effectiveness near infrastructure sites, including winter and all-weather roads.

Increased human and predator access could change moose habitat effectiveness in areas where roads are planned for construction. However, mitigation measures should effectively reduce concerns (see Section 10.3.2, Overview of Project Design and Mitigation). It is also not likely that moose will quickly habituate to construction disturbances because hunting occurs throughout the pipeline corridor and a natural aversion to humans already exists. However, wolves have been known to use little used linear corridors for hunting routes, so moose habitat effectiveness could be altered by increased numbers of predators post-decommissioning.

Dust altering vegetation health could result from road and barge landing site construction primarily through dust production. However, mitigation measures will endeavour to reduce the amount of dust produced, thereby reducing the effects on vegetation health.

The effects of construction of Group 1 infrastructure components along the pipeline corridor on moose habitat availability are predicted to be adverse, low magnitude and local in extent. The pathway of greatest duration is human and predator access, which is long term.

Group 2

Vegetation clearing, excavation and access road development at borrow sites will result in habitat loss.

Sensory disturbance from human activity and noise from equipment operations, blasting and crushing operations is expected to displace moose from adjacent habitats when granular resources are being extracted.

Increased human access could change moose habitat effectiveness in areas where borrow sites are planned for excavation.

Dust production from borrow site construction could affect vegetation health at a very local level at a few locations.

Group 3

During construction, habitat availability could be influenced by vegetation cleared for construction of facility sites and by sensory disturbance of moose near infrastructure sites. However, the extent of clearing at the sites is considered to be relatively low. Depending on the quality of habitat lost relative to that available elsewhere in the production area, vegetation clearing will likely result in little loss of habitat availability for moose.

Increased human presence could change moose habitat effectiveness near infrastructure facilities.

Dust production from infrastructure site construction could affect vegetation health at a very local level at a few locations.

Moose – Operations

The effect on moose habitat availability will be substantially less than during construction because human activity will be less than during construction and successional replacement of herbaceous communities that initially become established at abandoned borrow sites with shrub communities will provide increased foraging opportunities for moose.

The potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during operations on the availability of moose habitat are adverse, low magnitude, local in extent and long term.

Operation of infrastructure sites will result in a loss of 0.19% of effective moose habitat in the Gwich'in Settlement Area, 0.33% in the Sahtu Settlement Area and 0.33% in the Deh Cho Region of the pipeline corridor RSA.

Group 1

Most temporary roads and barge landings will be decommissioned, blocked, and start undergoing reclamation during operations. There will be no further vegetation clearing associated with transportation components during operations. Human activity will be limited to periodic inspection and maintenance work because most of the facilities are designed to operate remotely. This is not expected to involve visits at more than weekly intervals, with access predominantly by helicopter. The amount of traffic on remaining all-weather and winter roads will also decrease. However, wolves have been known to use little used linear corridors for hunting routes, so moose habitat effectiveness could continue to be altered by increased numbers of predators through decommissioning and abandonment.

Group 2

Most of the borrow sites will be abandoned and reclaimed during operations. Adverse effects on moose habitat availability are expected to gradually decline following reclamation and abandonment of borrow sites. Incremental habitat losses during operations are expected to be small.

Effects on moose of sensory disturbance and human presence at remaining borrow sites during operations are expected to be low, and human activity will be substantially less than during project construction.

Group 3

During operations, many of the stockpile sites, fuel storage sites, camp sites and staging and marshalling sites will no longer be operational and will be undergoing reclamation. The amount of sensory disturbance on moose at remaining camps, stockpile sites and fuel storage sites is expected to be low. Vegetation clearing will no longer be occurring, though habitat effectiveness might still be altered by human presence and sensory disturbance.

Moose – Decommissioning and Abandonment

All Groups

The potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during decommissioning and abandonment on moose habitat availability are adverse, low magnitude, local in extent and long term.

Effects of decommissioning and abandonment on moose would be similar to those described for caribou. Reclaimed sites will undergo successional replacement of pioneer herbaceous communities with shrub communities and finally forest communities. Moose are expected to use woody browse as soon as it becomes available within 5 to 10 years, but it could take several decades before effective cover is re-established.

Grizzly Bear

Results of barren-ground grizzly bear habitat models developed for the Inuvialuit Settlement Region, Gwich'in Settlement Area, Sahtu Settlement Area and Deh Cho Region in the pipeline corridor are in Table 10-79. Models estimate the amount of winter denning habitat, spring foraging habitat and fall foraging habitat for barren-ground grizzly bear.

Table 10-79: Change in Grizzly Bear Habitat – Infrastructure Sites, Gwich'in Settlement Area

Habitat Value	Denning		Spring Forage		Fall Forage	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
Gwich'in Settlement Area						
Very high	0	0	-53	-4,182	0	0
High	-251	-247	51	-3,575	-2	-8
Moderate	155	0	-667	515	-85	-98
Effective	-96	-247	-669	-7,242	-87	-106
Sahtu Settlement Area						
Very high	-9,722	-7,705	-16,059	-15,290	-15,996	-15,224
High	2,697	3,500	-24,056	-19,114	-21,691	-17,002
Moderate	-4,668	-300	7,036	16,606	10,150	18,434
Effective	-11,693	-4,505	-33,079	-17,798	-27,537	-13,792
Deh Cho Region						
Very high	-9,182	-7,730	-3,524	-2,157	-3,184	-1,843
High	2,930	5,150	-12,302	-11,214	-574	-799
Moderate	-1,559	-1,134	-15,914	-11,350	-12,251	-10,376
Effective	-7,811	-3,714	-31,740	-24,721	-16,009	-13,018

NOTES:
Effective habitat is the sum of very high, high, and moderate habitat values
Total area of LSA = ha

All models assume that construction is continuous in duration, that it occurs over all infrastructure sites concurrently, and that all individuals of a population are affected. For these reasons, the modelled amount of habitat change is an overestimate for any given moment in time. Much of the modelled reduction of habitat depends on sensory disturbance. The actual amount of habitat loss caused by sensory disturbance will depend on the location, geographic extent, duration and intensity of activities during construction and operations at the various types of infrastructure sites. In addition, for barren-ground grizzly bear, infrastructure sites represent a small area relative to their home range.

Grizzly Bear – Construction

Construction of infrastructure will result in the loss of 0.05% of effective barren-ground grizzly bear fall foraging habitat, 0.05% of denning habitat and 0.19% of spring foraging habitat in the Gwich'in Settlement Area RSA.

In the Sahtu Settlement Area RSA, construction of infrastructure will result in the loss of 1.42% of effective northern interior grizzly fall foraging habitat, 1.63% of denning habitat and 1.5% of spring foraging habitat. In the Deh Cho Region RSA, construction will result in a loss of 1.02% of effective northern interior grizzly fall foraging habitat, 1.63% of denning habitat and 1.12% of spring foraging habitat.

Group 1

Vegetation clearing during road construction could cause loss of grizzly foraging habitat. These effects will be short in duration because their foraging habitat is mostly early successional shrub species. Decreases in foraging habitat availability might affect bears on an individual level and are not likely to have effects at the regional scale.

Dust production from road and barge landing site construction could affect vegetation health at a very local level at a few locations.

Sensory disturbance by roads could cause abandonment of nearby dens, with subsequent loss of denning habitat and avoidance of foraging habitat. In some instances, disruption of foraging activities and displacement of barren-ground grizzly bears has been recorded at distances up to 4 km from industrial developments. The zone of influence from sensory disturbance might extend up to 500 m from activity centres. Although some associated construction activities such as staging and surveying might take place during snow-free periods, most clearing and construction will occur in mid to late winter when barren-ground grizzly bears are in hibernation.

Grizzly bears have no known predators in the Northwest Territories other than humans. Roads could affect grizzly habitat effectiveness by providing human access to areas previously inaccessible.

The potential effects of Group 1 infrastructure along the pipeline corridor during construction on grizzly bear habitat availability are adverse, moderate magnitude, local in extent and long term (see Table 10-80).

Group 2

Barren-ground grizzly bears use borrow sites for both foraging and denning. The extent of vegetation clearing at borrow sites is considered low at about 10 ha per site. Depending on the quantity and quality of foraging and denning habitat lost relative to that available elsewhere in the production area and regionally, granular resource extraction will likely result in a loss of foraging and denning habitat availability for barren-ground grizzly bears.

Table 10-80: Effects of Group 1 Infrastructure on Grizzly Bear Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Positive	Low	Local	Long term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term
Altered human and predator access	Construction	Adverse	Moderate	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

Dust from borrow site construction could affect vegetation health and grizzly bear foraging habitat at a local level at a few locations.

Reconnaissance-level surveys were not conducted along the pipeline corridor, although it has been suggested that grizzly bear population density increases in more northerly locations in the Northwest Territories. Most development and use of borrow sites will occur under frozen soil conditions in mid to late winter when barren-ground grizzly bears are in hibernation. Many of the proposed borrow sites are associated with eskers, which have high potential as denning habitat for barren-ground grizzly bears in the Northwest Territories. The principal issue with respect to barren-ground grizzly bear habitat will be the potential loss of active

den sites and the related concern of the welfare of bears that could be inadvertently displaced from dens in winter. Displaced bears can face severe physiological and metabolic stress and potential mortality. Although surveys can be conducted immediately before construction to locate den sites, dens are often difficult to locate in forested habitats.

Sensory disturbance during borrow activities could change barren-ground grizzly bear habitat effectiveness. There is also some uncertainty about the distance at which winter industrial activities can take place without causing bears to desert their winter dens.

The potential effects of Group 2 infrastructure along the pipeline corridor during construction on grizzly bear habitat availability are adverse, moderate magnitude, local in extent and long term (see Table 10-81).

Table 10-81: Effects of Group 2 Infrastructure on Grizzly Bear Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Positive	Low	Local	Long term
Sensory disturbance	Construction	Adverse	Moderate	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term

Group 3

Systematic denning surveys have not been conducted along the pipeline corridor because of difficulty locating active bear dens in boreal habitats. Incidental sightings of barren-ground grizzly bears and suspected barren-ground grizzly bear denning habitat have been recorded, though they are not sufficient to ensure avoidance of den sites during construction.

Although the likelihood that barren-ground grizzly bear dens will be encountered during pipeline construction is very low, the risk to individual bears displaced from dens in winter is great. Sensory disturbance during construction could cause habitat avoidance by barren-ground grizzly bears, though most construction at infrastructure facilities will occur in winter when bears are denning. Displaced bears face severe physiological and metabolic stress and potential mortality.

Increased human presence could change grizzly habitat effectiveness near infrastructure facilities.

Reconnaissance-level surveys indicate that barren-ground grizzly bears occur at infrastructure sites in summer, possibly to use food resources. No evidence of denning was observed near infrastructure sites. However, the extent of clearing at the sites is considered relatively low (see barren-ground caribou assessment preceding). Depending on the quality of foraging and denning habitat lost relative to that available elsewhere in the lease area and regionally, vegetation clearing will likely result in little loss of habitat availability for barren-ground grizzly bears.

Dust from infrastructure site construction could affect vegetation health and grizzly bear foraging habitat at a local level at a few locations.

The potential effects of Group 3 infrastructure along the pipeline corridor during construction on grizzly bear habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-82).

Table 10-82: Effects of Group 3 Infrastructure on Grizzly Bear Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Positive	Low	Local	Long term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

Grizzly Bear – Operations

Sensory disturbance will be less during operations than during construction, so effects on barren-ground grizzly bears of sensory disturbance at infrastructure sites are expected to be low.

Modelling results indicate a loss of 0.06% of effective barren-ground grizzly fall foraging habitat because of operations at all infrastructure sites in the Gwich'in Settlement Area of the pipeline corridor, 0.13% of denning habitat and 2.10% of spring foraging habitat. Modelling results indicate a loss of 0.71% of effective northern interior grizzly fall foraging habitat because of operations at all infrastructure sites in the part of the pipeline corridor in the Sahtu Settlement Area, 0.63% of denning habitat and 0.80% of spring foraging habitat.

A loss of 0.83% of effective northern interior grizzly fall foraging habitat is predicted because of operations for all infrastructure sites in the Deh Cho Region of the pipeline corridor, 0.59% of denning habitat and 0.87% of spring foraging habitat.

Group 1

Because most of the facilities are designed to operate remotely, most temporary roads will be decommissioned, blocked and start undergoing reclamation. Human activity will be limited to periodic inspection and maintenance work. This is not expected to involve visits at more than weekly intervals, with access predominantly by helicopter. Effects of sensory disturbance related to these activities would be very localized, e.g., landing and take-off of helicopters at facility sites. Effects on barren-ground grizzly bear habitat use are therefore expected to be very limited.

The potential effects of Group 1 infrastructure along the pipeline corridor during operations on grizzly bear habitat availability are adverse, low magnitude, local in extent and long term.

Group 2

Adverse effects on the availability of dens and forage, such as Arctic ground squirrel for grizzly bears, might not decline following reclamation and abandonment of borrow sites if granular materials are exhausted at these sites. The level of impact will depend on the availability of intact borrow sites, e.g., eskers, in the project study area and regionally.

Effects of sensory disturbance on barren-ground grizzly bears during operations are expected to be low because during operations, most of the borrow sites will be abandoned and reclaimed, with a subsequent reduction in human activity, although several sites will likely remain active during operations for road and well pad maintenance.

Once borrow sites are abandoned, vegetation communities will start to regenerate, and grizzly bear habitat might improve over what was available during baseline, because the shrub species they prefer are early successional species.

The potential effects of Group 2 infrastructure along the pipeline corridor during operations on grizzly bear habitat availability are adverse, low magnitude, local in extent and long term.

Group 3

During operations, many of the stockpile sites, camp sites and staging and marshalling sites will no longer be operational and will be undergoing reclamation. The amount of sensory disturbance on barren-ground grizzly bears at remaining camps, stockpile sites and fuel storage sites is expected to be low. Vegetation clearing will no longer be occurring. Increased human presence could change grizzly bear habitat effectiveness near infrastructure facilities.

The potential effects of Group 3 infrastructure along the pipeline corridor during operations on grizzly bear habitat availability are adverse, low magnitude, local in extent and long term.

Grizzly Bear – Decommissioning and Abandonment

As reclaimed sites undergo successional replacement of pioneer herbaceous communities with shrub communities and finally forest communities, the capability of these habitats will change. Use of reclaimed sites by barren-ground grizzly bears is expected to be greatest during the initial period following decommissioning, when availability of herbaceous forage and berry-producing shrubs provide attractive foraging opportunities. The value of reclaimed sites as foraging habitat will likely decline as communities dominated by tall shrubs and saplings replace these pioneer communities.

Group 1

Monitoring programs during site decommissioning could cause some sensory disturbance to bears, especially in spring, summer and fall, though most site visits will likely be brief and will probably not disturb bears.

The potential effects of Group 1 infrastructure along the pipeline corridor during decommissioning on the availability of grizzly bear habitat are adverse, low magnitude, local in extent and long term.

Group 2

Monitoring programs during site decommissioning and abandonment could cause some sensory disturbance to bears, especially in spring, summer and fall, though most site visits will likely be brief and will probably not disturb bears.

Adverse effects on the availability of dens and forage, such as Arctic ground squirrel, might not decline following reclamation and abandonment of borrow sites if granular materials are exhausted at these sites. The level of impact will depend on the availability of intact borrow sites, such as eskers, within the project study area and regionally. However, removal of granular material from eskers could reduce the availability of suitable denning habitat in the future. In other instances, the extent of suitable denning habitat in the area might not be limiting and bears would not experience long term loss of habitat.

The potential effects of Group 2 infrastructure along the pipeline corridor during decommissioning on grizzly bear habitat availability are adverse, low magnitude, local in extent and long term.

Group 3

Sensory disturbance and human presence during the decommissioning of camps, stockpile sites and fuel storage sites could further reduce habitat effectiveness for barren-ground grizzly bears.

Dust might affect vegetation health and grizzly bear foraging habitat at a local level at a few locations.

Adverse effects on barren-ground grizzly bear habitat availability are also expected to gradually decline following reclamation and abandonment of infrastructure sites. Reclaimed sites will undergo vegetation regrowth, either through natural succession or planting. Depending on the characteristics and species composition of the re-established community, reclamation should result in the recovery of habitat capability for barren-ground grizzly bears in previously suitable habitats.

The potential effects of Group 3 infrastructure along the pipeline corridor during decommissioning on grizzly bear habitat availability are adverse, low magnitude, local in extent and long term.

Marten

The potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during all phases on marten habitat availability are adverse, low magnitude, local in extent and far future in duration (see Table 10-83).

A summary of potential effects of Group 1, 2 and 3 infrastructure on marten habitat along the pipeline corridor is in Table 10-84.

Marten habitat models were developed for the Transition Forest, North Taiga Plains and South Taiga Plains ecological zones for infrastructure sites along the pipeline corridor.

Marten – Construction

Modelling results indicate a loss of 0.05% of effective marten habitat in the Gwich'in Settlement Area because of construction of all infrastructure sites along the pipeline corridor, 0.17% in the Sahtu Settlement Area and 0.12% in the Deh Cho Region.

Table 10-83: Effects of Group 1 to 3 Infrastructure on Marten Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Far future
	Operations	Adverse	Low	Local	Far future
	Decommissioning and abandonment	Adverse	Low	Local	Far future
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

Table 10-84: Change in Marten Habitat – Infrastructure Sites, Pipeline Corridor

Habitat Value	Winter Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
Gwich'in Settlement Area		
High	-667	-666
Moderate	188	160
Effective	-479	-506
Sahtu Settlement Area		
High	-4,951	-2,214
Moderate	1,195	283
Effective	-3,756	-1,931
Deh Cho Region		
High	-524	-292
Moderate	-2,615	-854
Effective	-3,139	-1,146
NOTE: Effective habitat is the sum of high and moderate habitat values		

Group 1

Many of the proposed infrastructure sites are at potential barge landing sites. The locations beside the Mackenzie River result in potential conflict with riparian habitat zones that provide important marten habitat. Marten prefer old-growth and second-growth stands for natal dens and foraging habitat (see Volume 3, Section 10, Wildlife), so the effects of vegetation clearing for roads have the potential to be long-lasting because it will affect marten prey availability.

Any effects of dust on vegetation health will be experienced by marten prey populations first, followed by delayed effects on marten. Although the effects of dust will have a longer lasting effect on marten, any effects will be localized.

Sensory disturbance during construction of roads and barge landings might change marten habitat effectiveness.

Increased human and predator access could affect marten habitat effectiveness by allowing access to areas which were previously inaccessible for hunting and trapping.

Group 2

Habitat loss will result from clearing of vegetation for borrow sites, although the amount of habitat lost should be minimal when compared with that available along the pipeline corridor.

Any effects of dust on vegetation health, sensory disturbance and increased human access on marten habitat availability for Group 2 infrastructure will be similar to effects of Group 1 infrastructure.

Group 3

Habitat loss will result from clearing of vegetation for infrastructure sites. Marten prefer old growth and second-growth stands for natal dens and foraging habitat (see Volume 3, Section 10, Wildlife), so the effects of vegetation clearing for camps, stockpile sites and fuel storage sites have the potential to be long-lasting because it will affect marten prey availability.

Marten – Operations

The total effect on marten habitat availability will be less than during project construction because levels of human activity will be substantially less than during construction and successional replacement of herbaceous communities that initially become established within abandoned borrow sites with shrub communities will provide increased foraging opportunities for marten.

Modelling results indicate a loss of 0.05% of effective marten habitat in the Gwich'in Settlement Area because of operation of all infrastructure sites along the pipeline corridor, 0.09% in the Sahtu Settlement Area and 0.05% in the Deh Cho Region.

Group 1

Many of the infrastructure sites, including barge landings and associated access roads, will be decommissioned and reclaimed following construction. Human activities during this period will be limited to periodic use of certain barge landings and access roads as part of project maintenance activities. The infrequent nature and low intensity of these disturbances is not expected to displace marten from suitable habitat adjacent to infrastructure sites, so effects are considered neutral.

Habitat loss will result from clearing of vegetation for access roads, though there will be no further vegetation clearing during operations.

Group 2

Most of the borrow sites will be abandoned and reclaimed during operations. No further sensory disturbance, dust, human and predator access, or vegetation clearing should occur, with subsequently lower impacts on marten.

Group 3

Many of the infrastructure sites, including stockpile sites, fuel storage facilities and camps, will be decommissioned and reclaimed following construction. Human activities during this period will be limited to periodic use of certain barge landings and access roads as part of project maintenance. The infrequent nature and low intensity of these disturbances is not expected to displace marten from suitable habitat beside infrastructure sites, effects are considered low for marten.

Marten – Decommissioning and Abandonment

All Groups

Sensory disturbance during decommissioning could result in temporary, localized displacement of marten from adjacent habitats. No adverse effects on marten habitat availability are expected following reclamation and abandonment of infrastructure sites. No adverse effects on marten habitat availability are expected following reclamation and abandonment of borrow sites.

Reclaimed sites will undergo successional replacement of pioneer herbaceous communities with shrub communities and finally forest communities. Marten are expected to begin making use of reclaimed habitats as soon as a dense shrub layer is established, providing overhead cover and foraging opportunities. High quality marten habitat is associated with mature and old-growth forests containing large

woody structures such as trees, snags and deadfall, suitable for denning. It is expected that it will take more than 100 years for these conditions to become established on reclaimed sites because forest succession proceeds slowly at northern latitudes.

Lynx

A summary of potential effects of Groups 1, 2 and 3 infrastructure on lynx habitat along the pipeline corridor is in Table 10-85.

Results of lynx habitat models developed for the Inuvialuit Settlement Region, Gwich'in Settlement Area, Sahtu Settlement Area and Deh Cho Region for infrastructure sites along the pipeline corridor are in Table 10-86.

Lynx – Construction

The potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during construction on lynx habitat availability are adverse, low magnitude, local in extent and long term.

Modelling results indicate a loss of 8.58% of effective lynx habitat in the Gwich'in Settlement Area because of construction of all infrastructure sites along the pipeline corridor, 0.20% in the Sahtu Settlement Area and 0.13% in the Deh Cho Region.

Table 10-85: Effects of Groups 1 to 3 Infrastructure on Lynx Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Negative	Low	Local	Short term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

Table10-86: Change in Lynx Habitat – Infrastructure Sites, Pipeline Corridor

Habitat Value	Winter Foraging	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
Gwich'in Settlement Area		
High	-537	-243
Moderate	-1,493	-615
Effective	-2,030	-858
Sahtu Settlement Area		
High	-3,231	-1,490
Moderate	-1,298	-822
Effective	-4,529	-2,312
Deh Cho Region		
High	-842	-451
Moderate	-2,847	-949
Effective	-3,689	-1,400
NOTE: Effective habitat is the sum of high and moderate habitat values		

Group 1

Construction activities might cause some disturbance and temporary displacement of lynx from habitats beside permanent access roads, airstrips, helipads and other required infrastructure sites. Lynx might be reluctant to cross roads with high traffic volumes and noise levels (Clevenger et al. 2001), resulting in a loss of habitat availability because of sensory disturbance. However, it is expected that the intermittent nature of these disturbances will not result in measurable loss of habitat effectiveness.

Any effects of dust on vegetation health will be experienced by snowshoe hare populations first, followed by delayed effects on lynx, which prey on snowshoe hare.

Sensory disturbance during construction of roads and barge landings might change lynx habitat effectiveness.

Increased human and predator access could affect lynx habitat effectiveness by allowing access to areas that were previously inaccessible for hunting and trapping. Lynx become increasingly rare as populations become more northerly, so they are not as heavily trapped in the Transition Forest Ecological Zone.

Group 2

Vegetation clearing will result in changes in habitat availability for lynx during construction. Development of borrow sites will involve stripping natural vegetation and unsuitable overburden overlying granular deposits. The major concerns associated with habitat loss will be loss of suitable den sites and loss of foraging habitat. These requirements differ, with lynx selecting den sites in mature forests or burns with an abundance of deadfall and coarse woody debris. These habitats appear to be relatively common in the project area. Prime foraging habitats include the dense, shrubby stands that provide optimum habitat for hares. These habitats are also common in the project area.

Periods of peak activity noise and human activity might displace lynx from habitats beside the borrow sites. Noise will be from operation of bulldozers, trucks, loaders, crushers and, in some instances, blasting.

Any effects from dust on vegetation health will be experienced by snowshoe hare populations first, followed by delayed effects on lynx, which prey on snowshoe hare.

Group 3

Lynx will be exposed to changes in habitat availability during construction because of vegetation clearing and sensory disturbance. The major concerns associated with habitat loss are loss of suitable den sites and loss of foraging habitat. These requirements differ, with lynx selecting den sites in mature forests or burns that contain an abundance of deadfall and coarse woody debris. These habitats appear to be relatively common in the project area. Prime foraging habitats include the dense, shrubby stands that provide optimum habitat for hares. These habitats are also common in the project area.

Similar to Group 2 infrastructure, lynx might be displaced from habitats near infrastructure sites by disturbance from construction activity.

Lynx – Operations

The potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during operations on the availability of lynx habitat are adverse, low magnitude, local in extent and long term.

Modelling results indicate a loss of 3.64% of effective lynx habitat in the Gwich'in Settlement Area because of operations at all infrastructure sites along the pipeline corridor, 0.10% in the Sahtu Settlement Area and 0.05% in the Deh Cho Region.

Group 1

Operations activities might cause some disturbance and temporary displacement of lynx from habitats beside permanent access roads, airstrips, helipads and other required infrastructure sites. Lynx might be reluctant to cross roads with high traffic volumes and noise levels (Clevenger et al. 2001), resulting in a loss of habitat availability caused by sensory disturbance. However, it is expected that the intermittent nature of these disturbances will not result in measurable loss of habitat effectiveness.

Group 2

The total effect on lynx habitat availability will be less than during project construction because levels of human activity will be substantially less than during construction, and successional replacement of herbaceous communities that initially become established within abandoned borrow sites with shrub communities will provide increased foraging opportunities for snowshoe hare, the primary prey species for lynx.

Group 3

Effects of infrastructure sites on lynx habitat availability will be much less during operations than during construction. This is because most of the infrastructure sites will be abandoned and reclaimed following construction, and levels of human activity will be limited to periodic use of infrastructure facilities required for operations.

Lynx – Decommissioning and Abandonment

The potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during decommissioning and abandonment on lynx habitat availability are adverse, low magnitude, local in extent and long term.

Sensory disturbance during decommissioning could result in temporary, localized displacement of lynx from adjacent habitats. No adverse effects on lynx habitat availability are expected following reclamation and abandonment of infrastructure sites. In some cases, availability of topsoil might reduce the initial effectiveness of re-vegetation efforts, though it is expected that over time these sites will support vegetation communities that could be used by lynx. Because of the dependence of lynx on snowshoe hares as a food source, lynx are expected to benefit from shrub communities that will form relatively early in the successional process. As forest communities replace shrub communities on these sites, foraging opportunities might decline, but habitat suitability for reproduction and denning is expected to increase.

Beaver

The potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during all phases on beaver habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-87).

Table 10-87: Effects of Groups 1 to 3 Infrastructure on Beaver Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Medium term

Beaver – Construction

Group 1

It is unlikely that loss of riparian habitat from development of infrastructure sites will have adverse effects on beaver because the Mackenzie River and its major tributary channels are low capability habitat for beaver. Infrastructure sites other than barge landings will typically be developed on well-drained sites and will not directly affect beaver habitat.

The infrastructure component with the greatest potential to affect beaver habitat is access road construction. It is expected that construction of access roads will entail numerous watercourse crossings, potentially resulting in direct or indirect loss of beaver habitat.

Permanent roads involve permanent loss of aquatic and riparian habitat near the road crossings. Properly constructed winter roads, on the other hand, can often be developed with little loss of riparian habitat. Maintenance of permanent roads

frequently results in the need to remove beaver dams, with resulting loss of habitat. Winter roads can usually be constructed and maintained without de-watering beaver impoundments. Ice roads constructed along major river channels have little if any direct effect on beaver habitat.

Group 2

Several types of granular materials will be used throughout the project area. The major sources of granular fill are likely to be glaciofluvial deposits, such as eskers, and alluvial deposits, such as river floodplains. Changes in beaver habitat availability are more likely when gravel is extracted from alluvial floodplains beside watercourses that support beaver populations.

The principal concern is the loss of woody riparian vegetation that might be an important source of forage for beaver colonies. Whereas extensive shoreline clearing could change the home range of individual colonies, it is not likely to result in measurable effects at the population level.

Group 3

Dust from fuel storage facilities have the potential to affect beaver populations.

Beaver – Operations

Group 1

Infrastructure components that are expected to remain in use during operations include permanent or temporary all-weather access roads to compressor stations or other permanent facilities, airstrips, helipads and camps for housing maintenance personnel. Of these, the main component that might be expected to affect beaver habitat is maintenance of all-weather access roads. Even though most roads will be abandoned and reclaimed during operations, effects of increased human access to beaver trapping areas could be seen. However, because of the number of roads that will remain in operation, there will be few adverse effects.

Group 2

Although some sites will continue to be used during operations for maintenance purposes, effects of habitat loss will be greatly reduced and offset by habitat being re-established by progressive reclamation.

Group 3

Infrastructure components that are expected to remain in use during operations include camps for housing maintenance personnel. Most of the infrastructure sites are required to support construction and will be decommissioned once construction is completed.

The effects from operation of Group 3 infrastructure components along the pipeline corridor on beaver habitat availability are variable. Sensory disturbance and vegetation clearing pathways are predicted to be adverse, as are dust and human and predator access predicted to be adverse, low magnitude, local in extent and long term.

Beaver – Decommissioning and Abandonment

Group 1

Adverse low-magnitude effects on beaver habitat effectiveness are generally expected during decommissioning and abandonment of roads.

Group 2

Adverse low-magnitude effects on beaver habitat availability are expected following reclamation and abandonment of borrow sites. In some instances, removal of granular resources is expected to result in water-filled pits that could provide suitable habitat for beaver.

Group 3

Adverse low-magnitude effects on beaver habitat availability are expected following reclamation and abandonment of infrastructure sites. Although disturbed vegetation communities regenerate slowly at northern latitudes, regeneration is most rapid in riparian zones where fine-grained alluvial soils and favourable moisture regimes promote plant growth. Beaver is an early-successional species that will forage on willow and balsam poplar regrowth that is expected to appear on disturbed stream banks within five to 10 years.

Amphibians

Table 10-88 is a summary of potential effects of Group 1, 2 and 3 infrastructure on amphibian habitat along the pipeline corridor.

All amphibians and reptiles in the Northwest Territories are living at or very near the extreme northern limits of the species range in North America. Although the full extent of their special adaptations to northern climatic conditions is not known, the range of adaptations currently understood underscores the scientific and ecological importance of these northernmost populations (GNWT 2004).

Field surveys did not include amphibians. However, within the infrastructure sites, amphibians might be found in shallow water margins among vegetation. Breeding might start soon after ice melts from lakes and ponds but can be delayed until summer in northern latitudes. During the nonbreeding season they can be found in marshy or damp wooded areas, and some amphibians might over-winter in relatively dry sites, such as decaying stumps or anthills.

Table 10-88: Effects of Group 1 to 3 Infrastructure on Amphibian Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Altered human and predator access	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Change in vegetation health	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term

Amphibians – Construction

During peak construction, amphibians will be exposed to direct changes in habitat availability primarily because of vegetation clearing along the right-of-way. Surface material removal might lead to an immediate removal of riparian habitats directly along the right-of-way, resulting in a direct loss of amphibian habitat. Vegetation clearing of marshy and damp woody areas along the pipeline right-of-way can directly affect amphibian habitat availability. The clearing of downed woody debris, such as decaying stumps, might affect available overwintering sites for amphibians.

The dust resulting from surface material removal during construction is predicted to decrease wetland vegetation health and affect amphibian habitat availability.

Construction noises are not expected to measurably affect habitat effectiveness for these species. Sensory disturbances will be short term and localized, occurring at specific locations along the right-of-way, such as at construction spreads, and for a few days only.

Altered human access resulting from the pipeline right-of-way and associated infrastructure might affect amphibians if access destroys existing available habitat, such as potential breeding sites or adjacent marshy and damp woody areas.

The potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during construction on amphibian habitat availability are adverse, low magnitude, local in extent and medium term.

Amphibians – Operations

During peak operation of infrastructure components, amphibians might be exposed to the continuing effects of changes in habitat availability. The only adverse effect expected is that of air and dust emissions at camps, stockpile sites and fuel storage sites, which could have an adverse effect on vegetation health. During operations, riparian and wetland breeding and overwintering habitats and upland foraging areas will have been reclaimed to aquatic- and graminoid-dominated communities. With succession, wetland and riparian habitats will continue to improve in quality over time. Sensory disturbance from periodic maintenance and vehicle operations will not affect amphibians.

The potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during operations on amphibian habitat availability are adverse, low magnitude, local in extent and long term.

Amphibians – Decommissioning and Abandonment

The effects of climate change on reclamation and vegetation succession are not known, although the gathering pipelines and associated facilities area is likely to be warmer and drier, resulting in changes in watercourse levels and riparian vegetation.

The reclaimed right-of-way will undergo succession following decommissioning and abandonment, and wetland and riparian habitats will see continued improvements in quality over time.

Decommissioning and reclamation activities at camps, stockpile sites and fuel storage sites will increase sensory disturbance and dust, affecting amphibian habitat effectiveness, whereas reclamation activities should also result in recovery of riparian and early successional vegetation that might be of benefit to amphibians.

The potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during decommissioning on amphibian habitat availability are adverse, low magnitude, local in extent and short term.

Snow Goose

The potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during all phases on snow goose habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-89).

Table 10-89: Effects of Groups 1 to 3 Infrastructure on Bird Habitat Availability – Pipeline Corridor

Pathway	Phase When Impact Occurs	Effect Attribute			
		Direction	Magnitude	Geographic Extent	Duration
Vegetation clearing	Construction	Adverse	Low	Local	Far future
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term
Sensory disturbance	Construction	Adverse	Low	Local	Medium term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Altered human and predator access	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Short term
Change in vegetation health	Construction	Adverse	Low	Local	Long term
	Operations	Adverse	Low	Local	Long term
	Decommissioning and abandonment	Adverse	Low	Local	Long term

Snow Goose – Construction

Group 1 and 3

Potential effects on snow goose populations in the pipeline corridor are predicted only for infrastructure sites near islands in the middle and lower Mackenzie River where snow geese stage during their spring migration. The effects of direct habitat loss at infrastructure sites will be minimal, likely affecting staging habitat for relatively few geese. Disturbance, especially aircraft overflights, could be important and might cause some snow geese to avoid otherwise suitable areas. Following aircraft flight guidelines will limit potential effects.

Group 2

Potential effects on snow goose populations in the pipeline corridor are predicted only for those borrow sites near islands in the middle and lower Mackenzie River that snow geese use for staging in the spring. The effects of direct habitat loss will be minimal and will not likely affect snow goose staging habitat. Disturbance, especially aircraft overflights, could be important and might cause some snow geese to avoid otherwise suitable areas. Excavation noise could be important if borrow sites are near the Mackenzie River staging areas and if excavation occurs in May.

Snow Goose – Operations

All Groups

The most important potential project effect on habitat availability for snow geese along the pipeline is disturbance of staging snow geese at Mackenzie River islands in May. This disturbance is not expected to be important during peak operations.

Snow Goose – Decommissioning and Abandonment

All Groups

The most important potential project effect on habitat availability for snow geese along the pipeline is disturbance of snow geese staging on islands in the Mackenzie River in May. The amount of aircraft traffic during decommissioning has not yet been determined. Levels are likely to be lower than during construction, so the potential for disturbance is less than during the peak construction period.

The restoration of predevelopment vegetation, although long term, will marginally enhance snow goose habitat availability.

Scaup

The potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during all phases on scaup habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-89, shown previously). Table 10-90 shows the change in lesser scaup habitat from construction and operation of infrastructure sites along the pipeline corridor.

Table 10-90: Change in Lesser Scaup Habitat – Infrastructure Sites, Pipeline Corridor

Habitat Value	Nesting	
	Habitat Change – Construction (ha)	**Habitat Change – Operations** (ha)
High	0	0
Moderate	-1	-1
Effective	-1	-1
NOTE: Effective habitat is the sum of high and moderate habitat values		

Scaup – Construction

Almost no lesser scaup effective nesting habitat will be lost during construction of pipeline corridor infrastructure. Because vegetation data was available only for

terrestrial vegetation communities, only nesting habitat was modelled. The potential effects on habitat availability for greater and lesser scaup along the pipeline are:

- disturbance of flocks of flightless, moulting scaup from late June through mid August
- disturbance of broods in July

All Groups

Disturbance that results in the avoidance of favoured moulting areas could affect up to several thousand scaup. Aircraft disturbance is expected to be greatest during peak construction, though mitigation measures will limit such disturbance.

Scaup – Operations

As with construction, pipeline corridor infrastructure operations will reduce the amount of effective nesting habitat for lesser scaup by a very small amount. The potential for disturbance is lower during operations than during construction.

All Groups

Aircraft disturbance is not expected to be as high during peak operations as during construction.

Scaup – Decommissioning and Abandonment

All Groups

Potential effects will be similar to, and likely lower for, construction.

Peregrine Falcon

The potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during all phases on peregrine falcon habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-89, shown previously).

Peregrine Falcon – Construction

Groups 1 and 3 – Infrastructure Sites

Peregrine falcon nesting and foraging habitat does exist along the pipeline corridor. Pipeline construction where the pipeline is near nesting cliffs or bluffs along the Mackenzie River might displace nesting peregrine falcons.

Some foraging areas might be disturbed, but it is expected to be periodic and of short duration, such as during aircraft overflights. Some peregrine falcon prey species might be dispersed to other areas by aircraft disturbance. When nest sites are close to an airstrip, flight paths should be designed to avoid the nest.

Group 2

Borrow sites near nesting cliffs or bluffs along the Mackenzie River might displace nesting peregrine falcons. If there are borrow sites near active peregrine falcon nest sites, project activity could result in abandonment of the nest. Some foraging areas might be disturbed, but it is expected to be periodic and of short duration, such as during aircraft overflights. Peregrine falcons might avoid some feeding areas temporarily because of disturbance.

Peregrine Falcon – Operations

All Groups

Some foraging areas might be disturbed, but it is expected to be periodic and of short duration, such as during aircraft overflights. Some peregrine falcon prey species might be dispersed to other areas by aircraft disturbance. There will be essentially no additional habitat loss from vegetation clearing during operations. Sensory disturbance is expected to be minimal. Peregrine falcons might avoid some areas temporarily because of disturbance. Any effects on nesting peregrine falcons caused by the possible location of a borrow site near an active nest site will be addressed during construction.

Peregrine Falcon – Decommissioning and Abandonment

All Groups

Potential effects will be similar to, and likely lower for, construction.

Lesser Yellowlegs

The potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during all phases on the availability of lesser yellowlegs habitat are adverse, low magnitude, local in extent and long term (see Table 10-89, shown previously). Table 10-91 shows the change in lesser yellowlegs habitat from construction and operation of infrastructure sites along the pipeline corridor.

Lesser Yellowlegs – Construction

The habitat model predicts that construction of pipeline corridor infrastructure will reduce the amount of available effective nesting habitat for lesser yellowlegs. However, large areas of effective nesting habitat in the RSA will be unaffected by construction.

Table 10-91: Change in Lesser Yellowlegs Habitat – Infrastructure Sites, Pipeline Corridor

Habitat Value	Nesting	
	Habitat Change – Construction (ha)	Habitat Change – Operations (ha)
High	-59	-74
Moderate	-314	-382
Effective	-373	-456
NOTE: Effective habitat is the sum of high and moderate habitat values		

All Groups

Potential project effects on lesser yellowlegs habitat availability are:

- direct loss of nesting and feeding habitat resulting from vegetation clearing
- disturbance of nesting and feeding areas by aircraft and human activities

Effects are likely to reduce habitat availability for only a few birds near the pipeline. The loss of habitat availability will not reduce lesser yellowlegs populations because suitable lesser yellowlegs habitat is widespread throughout the RSA. Aircraft and human disturbance are expected to be greatest during peak construction.

Lesser Yellowlegs – Operations

All Groups

Operations will reduce the area of available nesting habitat for lesser yellowlegs by an amount similar to that during construction. Potential effects will be similar to, and likely lower for, construction.

Lesser Yellowlegs – Decommissioning and Abandonment

Potential effects will be similar to, and likely lower for, construction.

Arctic Tern

The largest potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during all phases on Arctic tern habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-89, shown previously).

Arctic Tern – Construction

Group 1

Important potential project effects of transportation components on Arctic tern habitat availability on the pipeline are:

- destruction and disturbance of nesting colonies in June, July, and August
- disturbance of favoured feeding areas from June through August

Arctic terns nest and forage throughout the Mackenzie Valley, though during the June 2001 aerial surveys they were seen only in the Gwich'in Settlement Area and Sahtu Settlement Area.

Direct habitat loss and alteration will be restricted to the pipeline right-of-way, but potential disturbance effects will encompass a larger area. If Arctic tern nesting colonies are near the pipeline or surrounding disturbance, there is a potential for adverse effects on the local population. Disruption of favoured feeding areas also could be important, but there are probably more available feeding areas than suitable colony sites. The loss or disturbance of feeding habitat is not expected to limit Arctic tern populations in the Mackenzie Valley, but might locally affect numbers of individuals. Disturbance and direct habitat loss are expected to be greatest during peak construction.

Group 2

Potential effects from borrow sites on Arctic tern habitat availability along the pipeline route are similar to those of transportation, but no specific information on the proximity of Arctic tern nesting colonies to the proposed borrow sites is currently available.

Direct habitat loss and alteration will be restricted to the borrow sites, but potential disturbance effects will encompass a larger area. If Arctic tern nesting colonies are near borrow sites or surrounding disturbance, there is a potential for adverse effects on the local population.

Group 3

Construction effects of facility sites will be similar to those of transportation.

Arctic Tern – Operations

All Groups

No Arctic tern habitat will be cleared during pipeline operations. Sensory disturbance near the borrow sites is expected to be periodic and of short duration, such as during aircraft overflights. Any Arctic tern nesting colonies that are near infrastructure sites still in use, or that are within an area of disturbance, will be habituated to disturbance during construction when activities are much higher.

Arctic Tern – Decommissioning and Abandonment

All Groups

Effects during decommissioning are expected to be similar or lower than during operations for all infrastructure groups

Boreal Chickadee

The potential effects of Groups 1 to 3 infrastructure along the pipeline corridor during all phases on boreal chickadee habitat availability are adverse, low magnitude, local in extent and long term (see Table 10-89, shown previously). Table 10-92 shows the change in boreal chickadee habitat from construction and operation of infrastructure sites along the pipeline corridor.

Table 10-92: Change in Boreal Chickadee Habitat – Infrastructure Sites, Pipeline Corridor

Habitat Value	Nesting	
	Habitat Change – Construction (ha)	**Habitat Change – Operations** (ha)
High	-144	-144
Moderate	-507	-507
Effective	-651	-651
NOTE: Effective habitat is the sum of high and moderate habitat values		

Boreal Chickadee – Construction

Construction of pipeline corridor infrastructure will decrease effective nesting habitat for boreal chickadees by a small amount. The boreal chickadee's nesting and foraging habitats are similar, so no habitat model was prepared specifically for foraging habitat.

All Groups

Potential project effects on habitat availability for boreal chickadees are:

- direct loss of nesting and feeding habitat resulting from vegetation clearing
- disturbance of nesting and feeding areas by human activities

The effects are likely to reduce habitat availability for a few boreal chickadees near the pipeline, but are not expected to reduce their populations because suitable habitat for boreal chickadee is widespread throughout the Mackenzie Valley.

Boreal Chickadee – Operations

Operation of the pipeline corridor infrastructure will reduce the area of boreal chickadee effective nesting habitat by the same amount as construction. Effective nesting habitat will continue to be abundant.

All Groups

There will be little additional vegetation clearing during operations. Sensory disturbance is expected to be much less than during construction. The effects are not likely to reduce habitat availability for chickadees near the infrastructure sites.

Residual effects are expected to be lower than during construction.

Boreal Chickadee – Decommissioning and Abandonment

All Groups

There will be no further loss of vegetation during decommissioning. Restoration of predevelopment vegetation will be gradual, and there will be some disturbance. Disturbance of nesting and feeding areas by aircraft and human activities might affect habitat availability for boreal chickadees. Levels of disturbance during decommissioning are expected to be low.

Residual effects following implementation of the preceding mitigation techniques are expected to be similar or lower than during construction.

10.3.10 Significance of Effects

In the previous section, the characteristics of the residual effects of the project were described in terms of direction, magnitude, geographic extent and duration. These characteristics are used to determine the significance of the effects on wildlife habitat. Volume 1, Section 2, Assessment Method, provides discussion about the rationale for determining significance. An adverse residual effect was considered significant if the effect was either:

- moderate or high magnitude and extended into the far future, i.e., more than 30 years after project decommissioning and abandonment
- high magnitude and regional in extent

The significance of the effects for each project component and the combined project is presented in this section. Tables provide the results of the effect assessment and indicate if an effect is significant.

No significant effects are predicted.