Synopsis and Information Collection of Key Environmental Assessment Activities Associated with the Yukon Portion of the Alaska Gas Pipeline Route (1983-present)

Prepared for

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Executive Summary

The following study was undertaken in response to Environment Canada Pacific and Yukon Region's strategic requirement to consolidate post-Foothills pipeline review environmental issues, concerns, and mitigation recommendations along the Alaska Gas Pipeline route in advance of the potential submission of a project proposal in 2007 or 2008. The study aimed to achieve the following objectives:

- To summarize environmental concerns along the proposed pipeline route as identified through key environmental assessment (EA) activities undertaken since 1983 with a focus on Environment Canada's mandate;
- To summarize mitigation recommendations relating to these environmental concerns;
- To identify any additional environmental concerns or information gaps that may not have been addressed through key EA activities post-1983; and,
- Provide recommendations for further work to address any outstanding environmental concerns or information gaps.

The study was undertaken primarily through reviews of environmental baseline studies for major projects, EA records and files housed at various government departments, communication with various government representatives responsible for EA in the territory, and review of various reports and studies of relevance to the pipeline corridor.

Environmental issues and concerns pertaining to both specific areas and ecosystem components were summarized and organized according to their geographical situation along the pipeline corridor as follows:

1) Yukon/Alaska border – White River
2) White River – Quill Creek
3) Quill Creek – Haines Junction
4) Haines Junction - Whitehorse
5) Whitehorse – Teslin
6) Teslin – Junction 37

Mitigation recommendations for environmental issues and concerns identified in the corridor through prior EA activities were also listed according to type of development activity, geographical situation or EC.

Relatively few key environmental assessment activities have occurred in the Alaska Gas Pipeline corridor in the 23 years since the Foothills review. The only significant project for which the actual EA - or studies conducted in preparation for the EA process - have made significant contributions to knowledge about environmental conditions along the

corridor has been reconstruction of the north Alaska Highway under the Shakwak Project. The relevant work pertains to the section of the Alaska Highway between Jarvis River and Dry Creek No. 2 and is mostly up-to-date, with in-depth baseline studies having been conducted from 1994 up until the present.

Other projects have helped to further understanding of environmental conditions along the corridor, although to a lesser degree. These include the reconstruction of the Alaska Highway at various sections located between Haines Junction and Watson Lake and forestry operations carried out by Kaska Forest Resources in the Rancheria area.

The settlement of many First Nation land claims along the pipeline corridor has resulted in the development of strategic priorities for species and habitat management. In particular, the planning processes undertaken by the Champagne and Aishihik First Nations and Teslin Tlingit Council for wildlife and forestry management purposes have helped to consolidate and advance knowledge about environmental conditions in their respective traditional territories.

Continued research efforts and resource management programs undertaken by both government and First Nations have also added to the body of knowledge about valued environmental components (VECs) identified during the Foothills review in 1982.

In general, impact and mitigation based knowledge along the pipeline corridor has advanced in some key areas since 1982. However, there remain several key information gaps with respect to VECs and areas of special concern. The emergence of climate change and cumulative impacts issues – neither of which were well understood at the time of the Foothills review – may present the most significant challenge with respect to undertaking a complete EA for the Alaska Gas Pipeline route.

Arguably, the most significant EA-related activity occurring over the past 23 years is the dramatic shifting of the political framework in which EA is conducted in the Yukon. The settlement of First Nation land claims, devolution, and the enactment of the *Yukon Environment and Socioeconomic Assessment Act* (YESAA) have altered the political landscape to the extent that a new framework for valuation and prioritization of pipeline-related environmental issues may be warranted. A new dialogue could be initiated that better reflects the political and cultural realities in which a new pipeline would be assessed.

Based on these considerations, the following recommendations are being made:

1. A short-term, results/outcomes-based process to engage Yukon EA and resource managers from all levels of government in the discussion and prioritization of environmental issues and knowledge gaps along the pipeline corridor should be scoped and initiated.

2. The above-mentioned process should be implemented with the following objectives:

    - To rank or prioritize environmental issues according to areas of special concern and VECs;
    - To reach consensus on which priority VECs and areas of special concern require further research or information gathering in preparation for a pipeline EA;
    - To reach consensus as to the current state of knowledge and proven success with respect to mitigation approaches for VECs and activities relevant to the pipeline;
    - To produce a list of key knowledge gaps with respect to VECs and mitigation approaches; and,
    - To develop a terms of reference for a process to facilitate ongoing collaboration and information sharing.

3. For those VECs and special areas of concern for which information gaps – with respect to either mitigation or environmental baseline data - are identified, an expert intergovernmental working group and appropriate budget should be assigned to address these gaps to the extent possible.

4. Resources should be assigned to address the key information gaps identified through this study as follows:

    - Multidisciplinary environmental baseline information for the proposed Kluane Lake crossing and Ibex Valley;
    - Raptor habitat and presence along the corridor with the exception of Jarvis River – Dry Creek No. 2;
    - Sheep populations in Ibex Valley and Deadman Creek area;
    - Waterfowl habitat between Teslin and Junction 37;
    - Rare vegetation along the pipeline corridor with the exception of the Takhini salt flats and area between Jarvis River and Quill Creek, but including Slims River due the frequency of rare species; and,
    - Climate change and cumulative effects related to impacts and mitigation approaches along the entire pipeline route.

These recommendations may provide a useful starting point for discussion between various levels of government as to how best to combine resources – both financial and knowledge-based – to achieve their respective departmental objectives on the pipeline file.

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1.1 STUDY BACKGROUND

Between 1979 and 1982, the Alaska Highway Gas Pipeline Environmental Assessment Panel reviewed the plans of Foothills Pipe Lines to plan, construct, and operate a large-diameter, buried gas transmission pipeline and ancillary structures in southern Yukon. The Panel issued their final report in 1982, concluding that the Foothills project was generally sound from a planning and environmental perspective.

Although the project never proceeded, the numerous multi-disciplinary studies commissioned by Foothills in preparation for the pipeline made a substantial contribution to knowledge and understanding of environmental conditions through the pipeline corridor. Since 1982, a variety of other projects, studies, and development-related initiatives have added to this body of knowledge.

With renewed interest in the Alaska Gas Pipeline on both the political and industry fronts, Environment Canada Pacific and Yukon Region is preparing to identify key issues associated with its mandate in the assessment of a potential project proposal. The Department has identified a need to consolidate the environmental concerns, potential impacts and associated mitigation measures identified through projects and reviews occurring throughout the pipeline corridor after the 1982 review. The following study is the outcome.

1.2 STUDY OBJECTIVES

The objectives of the "Synopsis and Information Collection of Key Environmental Assessment Activities Associated with the Yukon Portion of the Alaska Gas Pipeline Route (1983 to present)" were as follows:

- To summarize environmental concerns along the proposed pipeline route as identified through key environmental assessment (EA) activities undertaken since 1983 with a focus on Environment Canada's mandate;
- To summarize mitigation recommendations relating to these environmental concerns;
- To identify any additional environmental concerns or information gaps that may not have been addressed through key EA activities post-1983; and,
- Provide recommendations for further work to address any outstanding environmental concerns or information gaps.

1.3 SCOPE AND INFORMATION SOURCES

For the purposes of the synopsis, "key EA activities" along the corridor route were defined as:

- Linear projects that involved the clearing or construction of a minimum of five kilometers;
- Timber harvests in excess of 15,000 m^3;
- Comprehensive environmental baseline studies conducted for projects (regardless of size); and,
- Comprehensive studies related to land use planning or resource management.

Linear developments that took place within an established corridor, such as improvements to an existing section of highway or installation of telecommunications infrastructure, were initially scoped in but subsequently determined to be of little value from an EA standpoint.

Sources of EA-related information pertaining to the pipeline corridor included:

- Environmental assessment files housed by the Department of Energy, Mines, and Resources, Department of Environment, and Department of Highways and Public Works;
- Baseline studies housed at the Department of Community Services, Department of Environment and Department of Highways and Public Works;
- Major studies or guidelines available at the Department of Energy, Mines, and Resources main library, Department of Highways and Public Works, and Department of Environment;
- First Nation-initiated fish and wildlife management plans (generally available on-line); and
- Contacts with key individuals in Yukon resource management and/or EA.

Where a comprehensive environmental baseline study had been completed for a project, this was deemed to constitute the EA-related information pertaining to the project. Where a background study had not been undertaken, EA files were located and reviewed for relevant information.

1.3.1 Report Organization

1.3.1.1 Geographical Areas

In the event that a pipeline is constructed, the permitting and accompanying environmental assessment process is likely to proceed on a section-by-section basis, as has been the case for large-scale linear projects such as the Alaska Highway

reconstruction. For ease of reference, key environmental assessment-related activities for the pipeline corridor are organized according to geographical location as follows:

1) Yukon/Alaska border – White River
2) White River – Quill Creek
3) Quill Creek – Haines Junction
4) Haines Junction - Whitehorse
5) Whitehorse – Teslin
6) Teslin – Junction 37

Readers should note that information for a specific location listed in the headings above will be found where the location is listed first. For example, key environmental concerns pertaining to the White River can be found under the second heading.

1.3.1.2 Environmental Assessment Related Activities

For each section of the pipeline corridor, major projects, studies, or other relevant land or resource management-related initiatives undertaken since 1982 are highlighted.

1.3.1.3 Key Environmental Issues or Concerns

Environment Canada's mandate is to preserve and enhance the quality of the natural environment, including water, air and soil quality, flora and fauna. Key environmental issues and concerns were grouped according to six major ecosystem components that incorporate the Department's mandate as follows:

1) General
2) Wildlife
3) Waterfowl
4) Fisheries
5) Hydrology
6) Vegetation

For each key environmental issue or concern listed under each ecosystem component, the original information source is indicated. Soil and air components were excluded from the current review as there has been minimal information collected on these to date (please see Section 4.2.6).

1.3.1.4 Environmental Impact Mitigation

Mitigation recommendations for issues and concerns identified during the course of EA review are displayed in table format in Appendix A. Mitigation recommendations are organized according to development activity, geographical location, and ecosystem component.

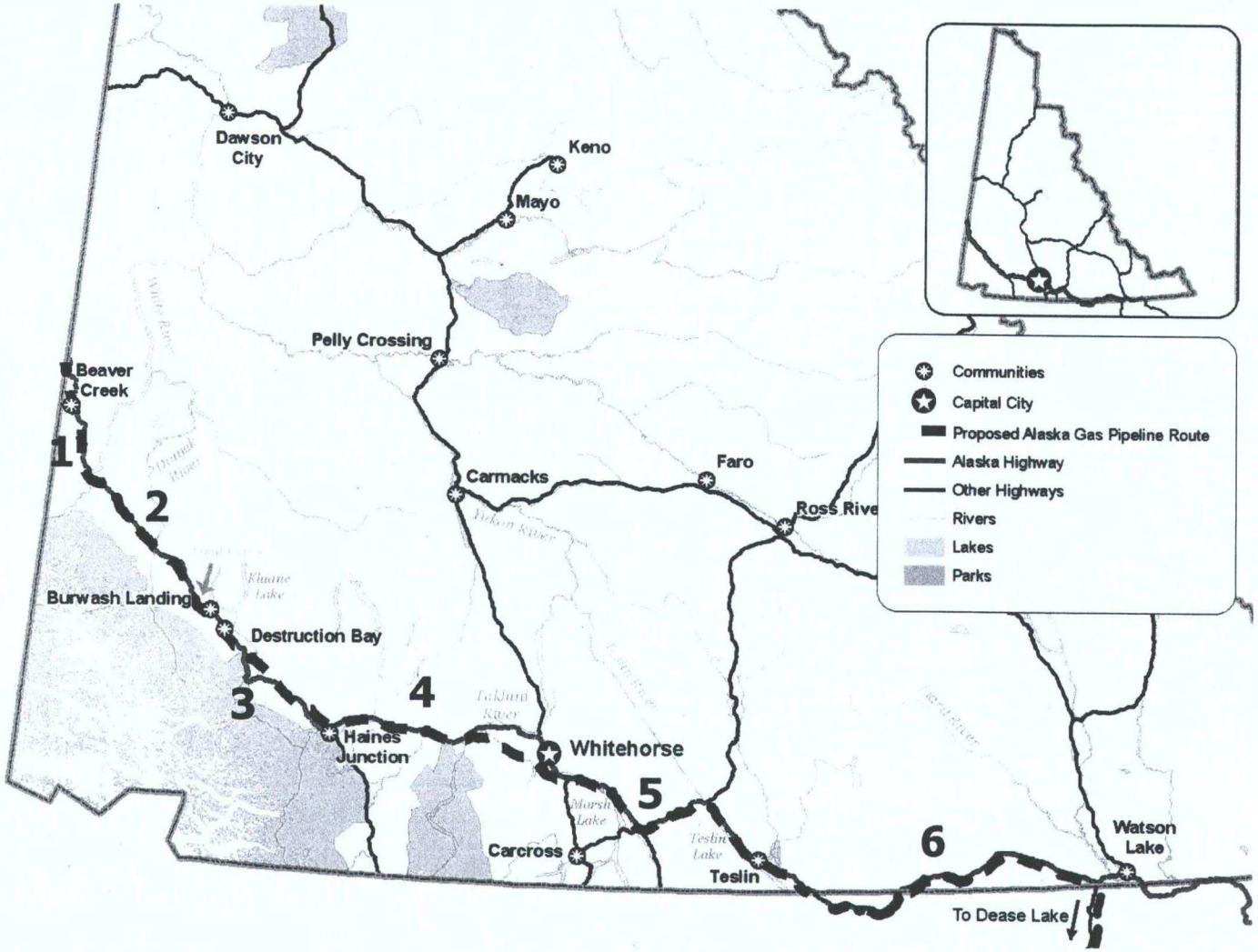

Figure 1. Alaska Highway and Proposed Alaska Gas Pipeline Route – Six Geographical Sections

2.0 Synopsis of Environmental Assessment Activities and Findings: General

2.1 Political Context for Post-1982 Environmental Assessment in the Yukon

There have been significant changes with respect to the administration of lands and management of natural resources in the Yukon Territory since 1982. As these changes have a direct bearing on the scope and application of environmental assessment (EA), they are briefly highlighted in the following section.

2.1.1 Environmental Assessment Legislation and Land Administration

In 1984, the Government of Canada adopted the *Environmental Assessment and Review Process Guidelines Order* (EARPGO) for applicable projects on federal lands. This act was subsequently replaced by the *Canadian Environmental Assessment Act* (CEAA) in 1995. In the Yukon, the Northern Affairs Program of the Department of Indian Affairs and Northern Development (DIAND) was responsible for applying EARPGO and CEAA to applicable projects occurring on lands and waters under federal jurisdiction or where a project received federal funding.

Until 2003, most of the lands overlapping the pipeline route fell under the jurisdiction of DIAND. Accordingly, applicable projects received either an EARPGO or CEAA screening. Level I and II CEAA screenings were undertaken by the DIAND Land Use Section and Environment Directorate, respectively. Two notable exceptions to this rule were the territorial lands contained within the boundaries of incorporated communities and First Nation settlement lands. As the territorial government was not bound by legislation to conduct environmental assessments for activities occurring on its lands, many projects within municipal boundaries were subject to internal review or community-specific development bylaws and regulations but not a formal assessment process. A similar situation existed for the lands under First Nation jurisdiction.

After the devolution of federal lands and administrative powers to the Government of Yukon in 2003, the *Yukon Environmental Assessment Act* (YEAA) – essentially CEAA "mirror" legislation - was enacted and applied to all lands under territorial jurisdiction. CEAA continued to apply on post-devolution federal lands in the Yukon. In late 2005, the *Yukon Environmental and Socioeconomic Assessment Act* (YESAA) came into full force and provided a single EA regime to be applied to all applicable projects in the Yukon and to territorial, federal and First Nation governments. While there is an exception to continue the use of CEAA for National Energy Board projects, YESAA is now in full effect for EA activities in the Yukon.

2.1.2 *First Nation Land Claims*

The settlement of Yukon First Nation land claims has also led to significant changes with respect to the management of lands and resources along the pipeline route. The first of the Yukon land claims settlements came into effect in 1995 for four Yukon First Nations which had earlier signed Final and Self Government Agreements. Two of these initial four were First Nations whose traditional territories included parts of the proposed pipeline route - the Champagne and Aishihik First Nations and Teslin Tlingit Council of Haines Junction and Teslin, respectively.

The coming into effect of land claims agreements for other First Nations located along the pipeline route – specifically the Kluane, Ta'an, Kwanlin Dun, and Carcross/Tagish First Nations – occurred between 2002 and 2006. The remaining two – the White River First Nation of Beaver Creek and Liard First Nation of Watson Lake – have not concluded their land claims settlements and remain under the federal *Indian Act*.

The Final and Self Government Agreements provide First Nations with land ownership, guaranteed access to fish and wildlife resources, and cooperative management rights over natural and cultural resources in their traditional territories. They also allow for the establishment of Special Management Areas (SMAs) to assist in the stewardship of highly valued natural and/or heritage resources.

Chapter 12 of the Umbrella Final Agreement (UFA) set out a template for the development of the YESAA legislation that now applies on all Yukon lands: federal, territorial, First Nation and private. Chapter 16 of the UFA also established the Yukon Fish and Wildlife Management Board as the territorial body presiding over conservation and management of Yukon's fish, wildlife, habitat, and wildlife users. In the traditional territories of settled First Nations, local Renewable Resource Councils (RRC) operate with a similar but more regionally focused mandate.

Wildlife and forestry management plans for both the Teslin Tlingit Council and Champagne and Aishihik traditional territories were developed several years after the signing of their respective Final Agreements. Presumably, the more recently settled First Nations along the pipeline corridor will follow suit.

2.2 Environmental Impacts Associated with Linear Developments

Linear developments such as pipelines have environmental impacts that are experienced at both a local and regional scale. Many of these impacts relate more to a specific activity than geographic location or specific ecosystem component (EC). The following section highlights the environmental impacts generally associated with linear developments with specific reference to highway construction in the Yukon as carried out by the Yukon Department of Highway and Public Works.

With few exceptions, the impacts and mitigation approaches for highway reconstruction are applicable to pipeline construction. For those impacts for which mitigation has presented unusual challenges for the Yukon Department of Highways and Public Works, additional background is provided.

2.2.1 Clearing, Stripping and Earth Moving

Clearing of right-of-ways, stripping of organic material, and excavation and earthwork carry with them a host of environmental impacts, including the following:

- Sedimentation of watercourses due to erosion of disturbed soils.
- Fragmentation and loss of wildlife habitat.
- Disturbance of wildlife.
- Disturbance or destruction of rare plant populations.
- Forest fires from clearing debris disposal.
- Permanent loss of organic material.
- Introduction of deleterious substances to soils and watercourses.

For the most part, these impacts can be successfully mitigated using standard best practices. Please refer to Tables 2 and 6 in Appendix A for mitigation approaches recommended for and/or adopted by the Yukon Department of Highways.

2.2.2 Camps and Maintenance Areas

One of the most significant environmental impacts felt from development activities in the Yukon is the incursion of a workforce into relatively pristine areas. Camps and maintenance yards house the people and equipment that are required to undertake highway construction. With them they bring a number of potential environmental impacts, including the following:

- Habitat fragmentation and loss for resident wildlife.
- Contamination of waterbodies and soils.
- Attraction of wildlife to food wastes and garbage.
- Increased recreational activity in wildlife habitat.
- Depletion of wildlife resources due to increased hunting and fishing.
- Disturbance to rare plant communities.
- Improved access into sensitive habitat.

Again, the majority of these impacts can be successfully mitigated using standard best practices. Please refer to Tables 2, 6, and 7 in Appendix A for mitigation approaches recommended for and/or adopted by the Yukon Department of Highways.

2.2.3 *Watercourse Crossings and In-Stream Activities*

Highway construction involves the erection and/or demolition of structures which are used to convey water under the road surface, typically through a bridge or culvert. The floodplains of alluvial creeks are also utilized as sources of granular materials in areas where upland sources are minimal, such as in the Kluane Lake area. The primary environmental impacts related to watercourse crossings and in-stream activities include:

- Sedimentation of watercourses from use of heavy equipment in-stream, removal or riparian vegetation, and disturbance of banks.
- Loss of fisheries habitat and invertebrate communities that support fish.
- Decrease in fisheries productivity and survival rates.
- Fish stranding and mortality.
- Creation of barriers to fish migration.
- Introduction of deleterious substances, including gasoline, lubricants, coolants, etc.
- Alteration of hydraulic conditions and accompanying downstream effects including channel instability and erosion.

For the most part, these impacts can be successfully mitigated using best practices. Please refer to Tables 2, 6, and 7 in Appendix A for mitigation approaches recommended for and/or adopted by the Yukon Department of Highways.

In recent years, the Department has experienced unusually high water events and accompanying failure of diversion channels and in-stream settling works despite careful consideration of design flows and use of environmental best practices. These incidents have called attention to the increasing difficulty of making accurate predictions about hydrological patterns for glacially fed watercourses in the Yukon.

Due to the minimal hydrological monitoring now carried out along the pipeline corridor, the careful formulation and application of estimated flood flows to the design of watercourse crossings is critical. With climate change anticipated to substantially alter the hydrologic regime in the southern Yukon in the future, adaptive design and management tools will need to be developed for application to a broad spectrum of infrastructure, including transportation networks and pipelines.

2.2.4 *Revegetation*

After construction activities are complete, areas of disturbed ground are generally revegetated in an effort to minimize erosion of soils and possible sedimentation of watercourses. Although revegetation is a mitigation practice, it carries with it a number of secondary impacts such as:

- Introduction of invasive non-native species;
- Alteration of the composition of floristic communities;
- Attraction of wildlife to highway corridors and predisposition to vehicle collisions.

The Yukon Department of Highways and Public Works has devoted considerably study to its revegetation activities, mostly in response to concerns about impacts to the Chisana, Kluane, and Southern Lakes caribou herds during the Shakwak Project. Vaartnou (1993, 1995) undertook numerous studies on behalf of the Yukon Government to determine the best possible seed mixes for highway reconstruction in the Chisana caribou herd area. Generally speaking, forage species were excluded from mixes applied in these areas. Catherine Kennedy produced a seminal guideline on revegetation in 1993 that still provides the basis for the Department's seeding specifications.

In the 1990s, the Department was unable to include native seeds in its seed mixes due to a variety of factors, primarily the unavailability of native species in sufficient commercial quantities. In 2000/2001, the Department was able to source sufficient quantities of native violet wheatgrass to specify this species in its seed mix. Since then, enough varieties and quantities of Yukon native seed have become commercially available to allow for the Department to specify only Yukon native seeds in their revegetation mixes. (Note: Although of a native variety, the seeds are typically grown in Alberta and British Columbia).

With the increasing use of native seeds, the seeding process itself has evolved as well. In 2000, all highway reconstruction projects were revegetated using seed and fertilizer. A successful revegetation trial was carried out in the Champagne area in 2003 in which the vegetation was allowed to re-establish naturally with no seed or fertilizer. Around the Williscroft Creek area of Kluane Lake in 2005, only fertilizer was applied. It is anticipated that when the Shakwak Project reaches the sensitive Sheep Mountain area, the natural vegetation will be allowed to re-establish without seed or fertilizer.

Exceptions to this practice may be made at sites where erosion is a particular concern such as watercourse crossings. In these circumstances, agronomics could be used in small quantities to quickly establish a vegetative cover. In general, fertilizer is not applied in conjunction with native seed because it is considered to give the non-native species a competitive advantage.

3.0 Synopsis of Environmental Assessment Activities and Findings: Site-Specific

3.1 YUKON/ALASKA BORDER – WHITE RIVER

From the Yukon/Alaska border to the White River, the proposed Alaska Gas Pipeline corridor primarily follows the existing Alaska Highway right-of-way. Beaver Creek is the only community situated within this portion of the pipeline route.

3.1.1 Environmental Assessment-Related Activities

3.1.1.1 Projects

Since 1982, major projects in this section of the pipeline corridor have been limited to the Shakwak Project, a United Stated Federal Highways Administration (FHWA) funded reconstruction of the Alaska Highway from the Alaska/British Columbia border near Haines to the Yukon/Alaska border near Beaver Creek. In 1992, the Yukon Government assumed responsibility for the project from Public Works Canada. The Shakwak Project is nearing completion, with approximately 20 km of road improvements and three bridge replacements remaining.

Alaska Highway reconstruction under the Shakwak Project commenced in 1992 at the Yukon/Alaska border and progressed south, reaching the White River in 1997/98. The Beaver Creek bridge was replaced under the Shakwak Project in 2004/5.

3.1.1.2 Studies

As part of the permitting and review process for the Shakwak Project, some environmental studies were completed for this section of the corridor. The most noteworthy of these is a comprehensive 1994 report conducted by Sentar & Associates for the area between Quill Creek and Dry Creek No. 2. Environmental screening reports for the sections between Dry Creek No. 2 and the Alaska border were completed by Public Works Canada in the early 1990s. These yield very little useful information or recommendations, however.

The Shakwak Special Areas Maintenance Guidelines completed in 2001 provide a site-specific inventory of environmental and maintenance related concerns for the Destruction Bay and Beaver Creek highway sections (both located within this section of the corridor).

Regional land use planning for the greater Kluane area – including the area between Beaver Creek and White River - occurred between 1987 and 1991. The resulting Greater

Kluane Regional Land Use Plan was never formally adopted by either the federal or territorial governments. Nonetheless, the document has served as a useful reference for development in the region. A number of background wildlife and other resource-related studies were conducted as part of the planning initiative.

3.1.2 Key Issues and Concerns

3.1.2.1 General

- White River First Nation has yet to conclude land claims negotiations. They remain a band administered under the *Indian Act*.

3.1.2.2 Wildlife

- The Chisana caribou herd is known to range between the Donjek River and Yukon-Alaska border. The Chisana can be expected to winter along the entire highway corridor area north of the White River in pockets of suitable habitat (Sentar, 1994).
- This area has a high density of moose (PWC, 1992).

3.1.2.3 Waterfowl

- Moose Lakes area is important habitat for waterfowl (Sentar, 1994).
- There are a series of pothole lakes on both sides of the highway that are used by migrating species in the spring and fall (Public Works Canada, 1992).

3.1.2.4 Fisheries

- Grayling spawning areas in the vicinity of the highway at Sanpete tributary km 1893.4 and Mirror Creek tributary at km 1949.6 (Aquatic Resources Ltd., 1992).
- Arctic grayling are the most widespread species encountered in this section. Other species include lake chub, northern pike, longnose suckers, round whitefish, lake whitefish, sculpins, and burbot (Aquatic Resources Ltd., 1992).

3.1.2.5 Hydrology

- This portion of the corridor traverses the White River and Tanana River valleys, both part of the Yukon River drainage. Rivers and creeks in the area are generally slow and meandering. No site-specific issues or concerns were raised.

3.1.2.6 Vegetation

- From the White River to Dry Creek No.2, two vegetation communities have the most potential to support rare plants: open black spruce bog consistent with presence of permafrost, and riparian vegetation along lake margins and creek

drainages co-occurring with upland black spruce/Labrador tea-feathermoss (Sentar, 1994).

3.2 WHITE RIVER – QUILL CREEK

From the White River to Quill Creek (located several kilometers north of Burwash Creek), the proposed Alaska Gas Pipeline corridor closely follows the existing Alaska Highway right-of-way as it extends southeast through the Shakwak Valley. There are no communities situated within this portion of the pipeline corridor; however, there are several highway lodges.

3.2.1 Environmental Assessment-Related Activities

3.2.1.1 Projects

Since 1982, major projects between White River and Quill Creek along the pipeline corridor have been limited to Alaska Highway reconstruction under the Shakwak Project. Highway reconstruction started at the White River in 1997 and was completed at the Quill Creek end by 2004. The Koidern #1 and Edith Creek bridges were replaced in the mid-1980s by Public Works Canada. The White River bridge was replaced in 1997 and the Donjek River bridge is scheduled to be replaced in the summer of 2006.

3.2.1.2 Studies

As part of the permitting and review process for the Shakwak Project, some environmental studies were completed for this section of the corridor. The most noteworthy of these is a comprehensive 1994 report conducted by Sentar & Associates for the area between Quill Creek and Dry Creek No. 2. An accompanying fisheries assessment was undertaken for Public Works Canada by Aquatic Resources Ltd.

The Shakwak Special Areas Maintenance Guidelines completed in 2001 provide a site-specific inventory of environmental and highway maintenance-related concerns for the Destruction Bay and Beaver Creek maintenance sections (both located within this portion of the corridor).

Regional land use planning for the greater Kluane area – including the region between White River and Quill Creek - occurred between 1987 and 1991. The resulting Greater Kluane Regional Land Use Plan was never formally adopted by either the federal or territorial governments. Nonetheless, the document has served as a useful reference for development in the region. A number of background wildlife and other resource-related studies were conducted as part of the planning initiative.

3.2.2 Key Issues and Concerns

3.2.2.1 General

- This portion of the corridor lies within the traditional territories of the White River First Nation and Kluane First Nation. The White River First Nation has yet to finalize their land claims; Kluane First Nation signed Final and Self Government Agreements in 2004.
- Kluane Wildlife Sanctuary borders the highway corridor to the west throughout this portion of the Shakwak Valley.
- The Asi Keyi Natural Environment Park and Pickhandle Lakes Habitat Protection Area located in this portion of the corridor are Special Management Areas established under the Kluane First Nation Final Agreement in 2004.

3.2.2.2 Wildlife

- The ranges of the Kluane and Chisana caribou herds are located within this segment of the Shakwak corridor. The Kluane caribou herd migrates across the Alaska Highway between Burwash Landing and Swede Johnson Creek; the Chisana herd is encountered between the Donjek River and Yukon-Alaska border. The Kluane herd is encountered along the highway corridor during the spring and fall migration; however, the Chisana herd is known to congregate along the highway corridor north of the White River in pockets of suitable habitat (Sentar, 1994).
- Golden eagles and bald eagles are common nesting species throughout this area. Majority of the golden eagle nesting sites are on the east side of highway and located on steep mountain slopes. Bald eagle nest sites were located adjacent to waterbodies. Pickhandle Lake complex is known to be a key golden eagle nesting area. Other potential raptor sites were identified between the Icefield Ranges viewpoint to 2 kilometers south of Donjek River, Andrew Lake, and Koidern #2 crossing (Sentar, 1994).

3.2.2.3 Waterfowl

- Most significant wetlands in the area include Swede Johnson Creek complex, Lake Creek area, and Pickhandle Lake complex. Contrary to work conducted in the 1970s and early 1980s, Sentar's work and a 1991 Ducks Unlimited study determined that on the basis of overall waterfowl use, the order of importance for these wetlands is as follows: Lake Creek, Swede Johnson, and Pickhandle (Sentar, 1994).
- Outlet of Kluane Lake was rated as nationally significant by the Yukon Waterfowl Technical Committee for its use by thousands of ducks, geese, and swans in the spring (Renewable Resources, DIAND, and Champagne and Aishihik First Nations, 1998).

3.2.2.4 *Fisheries*

- Chum and chinook salmon are known to ascend the Kluane, Donjek, and White Rivers in the fall. Chum have also been reported in the Koidern River. These are all very significant watercourses from a fisheries perspective (Sentar, 1994).
- Grayling and slimy sculpin are widely distributed and associated species, occurring in both mid-sized and large creeks and rivers (Sentar, 1994).
- Northern pike have been located in streams associated with the Pickhandle Lake complex (Sentar, 1994).

3.2.2.5 *Hydrology*

- No specific issues or concerns were raised.

3.2.2.6 *Vegetation*

- Rare plants identified 2 km south of White River lodge (*Carex eburnae*), 8 km south of Icefield Ranges viewpoint (*Vicia americana*), and immediately north of Donjek River crossing (*Salix Chamissonis*)(Sentar, 1994).

3.3 QUILL CREEK – HAINES JUNCTION

From Quill Creek (located several kilometers north of Burwash Creek) to Haines Junction, the proposed Alaska Gas Pipeline corridor again follows the Alaska Highway right-of-way. However, there are several key route deviations. At Congdon Creek, the pipeline route crosses Kluane Lake, joining up again with the highway in the vicinity of Christmas Creek. At Kloo Lake, the pipeline bears in an easterly direction towards Pine Lake, bypassing Haines Junction altogether.

The communities of Burwash Landing and Destruction Bay are found in this section of the pipeline corridor.

3.3.1 Environmental Assessment-Related Activities

3.3.1.1 *Projects*

Since 1982, major projects in the Quill Creek to Haines Junction portion of the pipeline corridor have been limited to Alaska Highway reconstruction under the Shakwak Project. Highway reconstruction started in the Jarvis River and Burwash area in 2001 and proceeded north and south towards the Sheep Mountain area. Design work has started for the Duke River and Slims River bridges which are slated for replacement in the next few years. The Congdon and Williscroft Creek bridges were replaced in 1989 by Public Works Canada.

3.3.1.2 Studies

As part of the permitting and review process for the Shakwak Project, some environmental studies were completed for this section of the corridor. The most noteworthy of these is a comprehensive 2000 report conducted by Access Consulting Group for the area between Quill Creek and Jarvis River. A comprehensive fisheries assessment for waterbodies between Jarvis River and Quill Creek was also completed by LGL Limited.

The Shakwak Special Areas Maintenance Guidelines completed in 2001 provide a site-specific inventory of environmental and highway maintenance-related concerns for the Destruction Bay and Haines Junction maintenance sections (both located within this portion of the corridor).

Regional land use planning for the greater Kluane region, including this section of the pipeline corridor, occurred between 1987 and 1991. The resulting report – the Greater Kluane Regional Land Use Plan – was never formally adopted by either the federal or territorial governments. Nonetheless, the document has served as a useful reference for development in the region. A number of background wildlife and other resource-related studies were conducted as part of the planning initiative.

More recently, a number of resource management plans have been developed pursuant to the Champagne and Aishihik First Nations Final Agreement. The most pertinent of these to the pipeline route is the Champagne and Aishihik Traditional Territory Strategic Forest Management Plan developed by the Alsek Renewable Resources Council, Champagne and Aishihik First Nations, and Government of Yukon in 1995.

3.3.2 Key Issues and Concerns

3.3.2.1 General

- The pipeline corridor abuts the boundaries of the Kluane Game Sanctuary and Kluane National Park through this section.
- The Sheep Mountain/Slims River delta is an ecological reserve under the International Biological Program (Access, 2000).
- Kluane First Nation established Special Management Area at Tachal Region of Kluane National Park as part of its Final Agreement in 2004.
- This segment of the pipeline route falls within the traditional territories of the Kluane First Nation and Champagne and Aishihik First Nation. The two First Nations have both signed Final and Self Government Agreements. Silver City/Cultus Bay is an area of overlap; generally speaking, the Slims River divides the two traditional territories.

3.3.2.2 *Wildlife*

- The migration corridor of the Kluane caribou herd across the Shakwak Trench is concentrated between the Duke River and Quill Creek. Peak migration periods are April/May and September-November. Primary concerns relate to migration disturbance and vehicle collisions (Access, 2000).
- Dall sheep utilize Sheep Mountain as their primary winter range; Williscroft Creek is secondary. Lambing season – April through mid-June – is a particularly sensitive time. Lambing is now generally common in the vicinity of a bluff adjacent to the highway. Sheep do not generally cross the highway corridor but periodically access a mineral lick below the highway at Sheep Mountain (Access, 2000).
- Key feeding areas for grizzlies are Silver Creek, Dutch Harbour – Congdon Creek, east fork of Nines Creek, and along Kluane River (Access, 2000).
- Moose reportedly utilize an island in the Slims River delta for calving and a corridor between Jarvis River and Sulphur Lake for seasonal movements (Access, 2000).
- Sharp tail grouse subpopulations and lekking areas in Duke River Meadows and Burwash airport, and the vicinity of Copper Joe Creek (Access, 2000).
- Boreal owls, Gyrfalcons, Peregrine and Golden Eagle are the major birds of prey species of concern in this area. Past and present nesting sites have been identified between Jarvis River and Burwash Creek, but key raptor nesting areas were identified at Silver Creek, Slims River Delta, and Sheep Mountain (Access, 2000).
- Duke River Meadows is a traditional subsistence area for Kluane First Nation and of high habitat value to ground squirrels (Access, 2000).

3.3.2.3 *Waterfowl*

- Key waterfowl habitat areas in this section are located at Sulphur Lake and Kluane lakeshore between Topham Creek and Slims River (Access, 2000).

3.3.2.4 *Fisheries*

- Jarvis River and Christmas Creek are of high habitat value and are the only streams suitable for Arctic grayling spawning and rearing in this area (LGL, 1999).
- The Sheep Mountain shoreline is known to support juvenile fish in the spring and is used by lake whitefish and lake trout during spawning season (LGL, 1999).
- Copper Joe Creek and Lewis Creek outlets to Kluane Lake are considered rearing and possible spawning habitat and the lake shoreline in the vicinity of these creeks is important to local fishers (LGL, 1999).
- Slims River, Duke River, Copper Joe Creek and Burwash Creek are considered migratory and holding habitat for fish (LGL, 1999).

3.3.2.5 *Hydrology*

- Primary issue in this section of the Shakwak corridor is the braided glacial outfed streams emptying into Kluane Lake. These include: Silver Creek, Williscroft Creek, Congdon Creek, Nines Creek, Mines Creek, Bock's Brook, Lewis Creek, Copper Joe Creek, Burwash Creek, and Sakiw Creek. These watercourses are characterized by rapid onset peak flows and corresponding channel avulsions, and have been an ongoing maintenance concern since initial highway construction (Access, 2000).

3.3.2.6 *Vegetation*

- The Slims River delta is the most sensitive section with respect to vegetation. The floodplain is home to a number of unique plant communities that have adapted to the periodic flooding and the unusually saline soil conditions. Most of the rare plant species known in this section occur in the Slims River, Sheep Mountain and Kluane lakeshore areas (Access, 2000).
- Several rare plant species are also known to occur in the vicinity of Silver Creek, Cultus Bay, Hungry Lake, and a wetland area east of Christmas Creek. Major concerns re highway construction are the disturbance of small populations of rare plant species (Access, 2000).
- Kluane lakeshore from Silver Creek to Goose Bay is potential habitat for a number of rare Yukon species, including *Aster yukonensis* and *Carex maritima.*
- Duke River Meadows is home to regionally rare plant species, including *Helictotrichon hookeri* (Access, 2000).

3.4 HAINES JUNCTION – WHITEHORSE

From the south end of Pine Lake, the pipeline and highway right-of-way follow a parallel path through to Canyon Creek and Mendenhall subdivision. The pipeline corridor deviates from the highway through the easternmost section of the Takhini Valley into the Ibex River valley, bypassing the City of Whitehorse almost entirely. The pipeline route approaches the Alaska Highway again west of the Wolf Creek residential area.

Haines Junction and Whitehorse are the only incorporated communities in this portion of the pipeline corridor. West of Whitehorse, there are residential areas at Canyon Creek, Champagne, Mendenhall, Takhini River, and Ibex Valley.

3.4.1 Environmental Assessment-Related Activities

3.4.1.1 Projects

Since 1982, major projects in the Haines Junction - Whitehorse section of the pipeline corridor have been primarily Alaska Highway reconstruction carried out by the Government of Yukon. There has been logging in the Marshall Creek area, but volumes have been relatively small.

Highway reconstruction started in the Champagne area in 2000 and proceeded west towards Haines Junction, concluding in 2005. Fish passage improvements are slated for Marshall Creek in 2006. The Mendenhall River bridge was replaced in 2002 with a large multiplate culvert. The Government of Yukon undertook an extensive bioengineering project at Mendenhall in order to fulfill its habitat compensation obligations with the Department of Fisheries and Oceans (DFO).

Prior to that, Public Works Canada reconstructed the Alaska Highway between the Takhini River and Mendenhall River in 1984/85. The Cracker Creek bridge was replaced with a multiplate culvert in 1986.

3.4.1.2 Studies

As part of the permitting and review process for the Alaska Highway reconstruction in this area, a fairly comprehensive environmental study was completed by Stanley Associates for Public Works Canada in 1982. The Stanley work covers sections of the Alaska Highway section between the Takhini River interpretive pullout and Haines Junction.

Regional land use planning for the greater Kluane region - including part of the area between Haines Junction and Whitehorse - occurred between 1987 and 1991. The resulting Greater Kluane Regional Land Use Plan was never formally adopted by either the federal or territorial governments. Nonetheless, the document has served as a useful reference for development in the region. A number of wildlife and other resource-related studies were conducted in support of the planning initiative.

More recently, a number of resource management plans have been developed pursuant to the Champagne and Aishihik First Nations Final Agreement. The most pertinent of these to the pipeline route is the Champagne and Aishihik Traditional Territory Strategic Forest Management Plan developed by the Alsek Renewable Resources Council, Champagne and Aishihik First Nations, and Government of Yukon in 1995. An Aishihik Integrated Fish and Wildlife Management Plan and Alsek Moose Management Plan were also developed in the late 1990s.

The Government of Yukon developed management plans in the 1990s for two key species of concern in this area: bison and elk.

3.4.2 Key Issues and Concerns

3.4.2.1 General

- This area is situated within the traditional territories of the Champagne and Aishihik First Nation, Kwanlin Dun First Nation, Ta'an Kwach'an First Nation, and Carcross/Tagish First Nation. All four First Nations have signed Final and Self Government Agreements.
- Kusawa Park is a Special Management Area established pursuant to the Kwanlin Dun Final Agreement in 2005 and will be co-managed with Carcross/Tagish First Nation and Champagne and Aishihik First Nations.

3.4.2.2 Wildlife

- The Dezadeash River lowland is important habitat for grizzly bear, moose, and a variety of other species (DIAND, 1998).
- Herd of Dall sheep in the Shaneinbaw Lake area north of Champagne (Renewable Resources, 2001).
- There have been sporadic sightings of Sharp-tailed grouse between the Takhini River bridge and Mendenhall River, Aishihik River crossing, and between Pine Lake and Haines Junction (Stanley, 1982).
- Resident Dall sheep populations are found in the Ibex River valley, Sifton, Dezadeash, and Ruby Ranges, and the Morraine Lake area (Stanley, 1982).
- The Ibex valley woodland caribou herd range in the Ibex valley (Stanley, 1982; UMA, 2000).
- The Champagne area provides good habitat for coyotes, fox, and possibly lynx (Stanley, 1982).
- This portion of the pipeline segment intersects the southernmost extent of the Aishihik caribou and bison herds. Both herds are concentrated mostly north of the highway corridor but have been known to graze in the area in the past (Government of Yukon,).
- The Takhini elk herd ranges in this area (UMA, 2000).

3.4.2.3 Waterfowl

- In general, waterfowl production in this segment is considered to be a function of a large number of small wetlands than outstanding qualities of specific wetlands. Wetlands in the vicinity of the Takhini River and Champagne area provide superior habitat for waterfowl (Stanley, 1982).

3.4.2.4 *Fisheries*

- Marshall Creek has one of the most unique and diverse populations of fish in the Kluane region, with species including rainbow trout, grayling, and Dolly Varden (DFO, 2002).
- The Takhini River and its tributaries is extremely important for fisheries – it is a spawning, nursery and rearing and migration route for chinook salmon, and a spawning area for chum salmon. Arctic grayling nursery, rearing and summer habitat; lake trout rearing area, lake whitefish rearing area and summer habitat (Stanley,1982).
- Stoney Creek – nursery and rearing area for chinook, rearing for Arctic grayling.
- Mendenhall is nursery and rearing area for chinook, rearing and summer habitat for Arctic grayling, whitefish (Stanley, 1982).
- Cracker Creek, Aishihik River, and Marshall Creek are important grayling habitat. Cracker is utilized by rainbow trout and Marshall is rearing and summer habitat for Dolly Varden (Stanley,1982).

3.4.2.5 *Hydrology*

- Study area traverses the Yukon, Takhini, and Dezadeash river valleys within the Yukon, Takhini and Alsek drainage basins. No site-specific issues or concerns have been identified.

3.4.2.6 *Vegetation*

- The primary areas of sensitivity with respect to vegetation include the dry or wet meadows. The wet meadows of concern are poorly drained with soils high in salts and are considered the rarest of the sensitive sites between Watson Lake and Haines Junction. These wet meadows are located primarily in the area between the Takhini River interpretive pullout and Takhini River bridge (Stanley, 1982).
- There are also wet non-saline meadows located along this part of the corridor that occur on lacustrine soils of former lakes or ponds or adjacent to present day lakes generally populated by sedge communities. These are potential habitat for plants that are considered rare in the Yukon and may be at the northern limit of their geographical ranges (Stanley, 1982).
- Sites on well-drained glacial soils with southern aspect and exposure to frequent winds have a distinct prairie-like vegetation community. These vegetation communities are quite susceptible to erosion when disturbed. This complex is prevalent in the Champagne area (Stanley, 1982).

3.5 WHITEHORSE – TESLIN

The proposed Alaska Gas Pipeline corridor bypasses the City of Whitehorse almost entirely, instead running through the Fish Lake area and paralleling the highway again southeast of the city behind the Wolf Creek country residential subdivision. The pipeline route intersects the Mount Sima ski hill and Mary Lake and Cowley Creek country residential subdivisions. From the South Klondike Highway junction to Teslin, the route roughly parallels the Alaska Highway.

The City of Whitehorse and outlying residential areas between Whitehorse and Jakes Corner comprise the majority of development in this section of the pipeline corridor.

3.5.1 Environmental Assessment-Related Activities

3.5.1.1 Projects

Since 1983, major projects in the Whitehorse – Teslin section of the pipeline corridor have been limited mostly to country residential developments within the Whitehorse area – including Mary Lake and Cowley Creek subdivisions. As most of this work occurred on lands administered by the Government of Yukon prior to devolution, many of these projects were not subject to a formal EA.

The Government of Yukon did undertake preparatory studies and investigations for these country residential developments as set out in the applicable City of Whitehorse subdivision bylaw (presently the Subdivision Control Bylaw). However, most of the baseline studies addressed site engineering issues such as geotechnical and hydrogeological investigations. Only for the most recently proposed Whitehorse Copper country residential area has a wildlife/habitat baseline study been undertaken.

Highway reconstruction in this section has been relatively minimal, with most work consisting of highway improvements such as the pavement overlay between M'Clintock bridge and Whitehorse between 2003 and 2005. Hydroelectric and telecommunications projects have been mostly confined to established right-of-ways. Based on discussions with land managers within the Government of Yukon, it appears that the Mt. Sima ski hill was never formally assessed.

3.5.1.2 Studies

As part of the permitting and review process for the Alaska Highway reconstruction in this area, a major environmental study was completed by Stanley Associates for Public Works Canada in 1982. The study covered the portions of the Alaska Highway between Teslin River bridge and the community of Teslin.

The Southern Lakes Caribou Recovery Program was launched in 1992 through a partnership between the six Southern Lakes area First Nations and the governments of Yukon, British Columbia, and Canada. The continuation of the program formed part of the First Nation's Final Agreement.

Regional land use planning for the Teslin area commenced in 2001 but a final plan has yet to be completed. More recently, a number of resource management plans have been developed pursuant to the Teslin Tlingit Council Final Agreement. These include the 2005 Draft Strategic Forest Management Plan for the Teslin Tlingit Traditional Territory and the 2003 Teslin Integrated Fish and Wildlife Management Plan. These documents identify key environmental issues and information gaps in the area.

3.5.2 Key Environmental Issues and Concerns

3.5.2.1 General

- This portion of the pipeline corridor lies within the traditional territories of the Kwanlin Dun First Nation, Ta'an Kwach'an First Nation, Carcross/Tagish First Nation, and Teslin Tlingit Council. All First Nations have signed Final and Self Government Agreements.
- The Lewes Marsh Habitat Protection Area is a Special Management Area created pursuant to the Kwanlin Dun First Nation Final Agreement in 2005. The SMA is co-managed by Kwanlin Dun First Nation, Carcross/Tagish First Nation, and Ta'an Kwach'an First Nation.

3.5.2.2 Wildlife

- Along Teslin Lake there are highly visible areas of moose and sheep habitat (TTC et al., 2003).
- There is a band of Dall sheep resident in the Deadman Creek area (TTC et al., 2003).
- The Morley Bay area is late winter and summer habitat for moose and generally important to a small population of stone sheep is known in the Cap Mountain/Canyon Mountain area (Stanley, 1982).
- The area encompasses the ranges of two of the three Southern Lakes caribou herds, specifically the Carcross/Squanga herd and Atlin herd. The area around Marsh Lake/Jakes Corner is part of the critical winter habitat of the Carcross/Squanga herd (Southern Lakes Caribou Recovery Program, 1996).
- Squanga Lake is prime beaver and marten habitat (Renewable Resources, 1995).

3.5.2.3 Waterfowl

- The Lewes Marsh and M'Clintock Bay are critical habitat for migrating waterfowl in the spring. Tundra and Trumpeter swans, along with ducks and

geese, stop in April and May and support a local population of predatory species including gray wolves, coyotes, and Bald eagles (Environment Yukon, 2006).
- The outlet of Teslin Lake is important habitat to waterfowl species (TTC et al., 2003).

3.5.2.4 Fisheries

- Squanga whitefish and bull trout found in Shilsky and Daughey Lakes are listed as species of concern under the Species at Risk legislation (TTC et al., 2003).
- The Teslin River and its tributaries support migrating adult and juvenile chinook salmon rearing. These include Ten Mile Creek, Lone Tree Creek, Deadmans Creek, and Brooks Brook (Stanley, 1982).
- The Teslin River is extremely important for fisheries – it is a spawning, nursery and rearing area for chinook salmon, and a migration route for chum salmon. Also important habitat for Arctic grayling and lake whitefish nursery, rearing, and summer habitat area (Stanley, 1982).

3.5.2.5 Hydrology

- This segment of the pipeline corridor traverses the Yukon and Teslin River valleys and the Yukon and Teslin drainage basins. No site-specific issues or concerns were identified.

3.5.2.6 Vegetation

- Little to no information pertaining to site-specific vegetation concerns were found.

3.6 TESLIN – JUNCTION 37

The proposed Alaska Gas Pipeline corridor parallels the Alaska Highway from Teslin to the junction with Highway 37. From there, the pipeline would head south into British Columbia. The only communities located within this portion of the corridor are Teslin and Swift River. There are several small highway lodges located in this section as well.

3.6.1 Environmental Assessment-Related Activities

3.6.1.1 Projects

Since 1983, major projects in the Teslin – Junction 37 section of the pipeline corridor have been limited to Alaska Highway reconstruction and timber harvesting in the Rancheria area. Hydroelectric and telecommunications projects have been mostly confined to previously developed corridors. For example, a fibre optic line was installed between Teslin and Watson Lake in 2004 along the highway right-of-way.

In the late 1980s to early 1990s, Public Works Canada (PWC) was responsible for geotechnical and preparatory work for highway construction between Junction 37 and Morley Lake. After PWC devolved its responsibilities in 1993, the Government of Yukon completed highway construction was between Dodo Lakes (approximately 10 kilometers west of Junction 37) and Swift River between 1993 and 1996.

Small scale forestry activities in the Rancheria Valley took place throughout the 1980s and 1990s. Larger scale operations were undertaken by Kaska Forest Resources in the Little Rancheria area in the late 1990s.

3.6.1.2 Studies

As part of the permitting and review process for the Alaska Highway reconstruction in this area, a major environmental study was completed by Stanley Associates for Public Works Canada in 1982. The study covered the portion of the highway between Junction 37 and Morley Lake.

Regional land use planning for the Teslin area commenced in 2001 but a final plan has yet to be completed. More recently, a number of resource management plans have been developed pursuant to the Teslin Tlingit Council Final Agreement. These include the 2005 Draft Strategic Forest Management Plan for the Teslin Tlingit Traditional Territory and the 2003 Teslin Integrated Fish and Wildlife Management Plan. These documents provide an overview of key wildlife issues and information gaps for the area.

The Little Rancheria caribou herd has been the subject of considerable study in recent years by the Government of Yukon. This is partly in response to the late 1990s Kaska Forest Resources (KFR)'s logging activity in the area and accompanying concerns about habitat loss and disruption of the herd.

A number of studies and environmental screenings were conducted in advance of establishing long-term forestry tenure agreements with commercial logging operations in the southeast Yukon. There are some references to the Rancheria area, although for the most part the areas of interest for logging fell outside the pipeline corridor. DIAND Environment Directorate completed a Level I screening of the KFR Timber Harvest Agreement in 2003. The Little Rancheria caribou herd habitat was a primary focus of this work.

3.6.2 Key Issues and Concerns

3.6.2.1 General

- This portion of the corridor goes through the traditional territory of the Teslin Tlingit Council and Liard First Nation. The Teslin Tlingit Council have signed a Final and Self Government Agreements; the Liard First Nation has not.

- The Teslin Tlingit Council created the Nisutlin River Delta National Wildlife Area as a Special Management Area pursuant to its Final Agreement in 1995.

3.6.2.2 *Wildlife*

- The Nisutlin River delta is important habitat to moose and other furbearing species (TTC et al., 2005).
- There is a small herd of woodland caribou that range along in the Swan Lake area (TTC et al., 2003).
- There are stone sheep ranges to both the north and south of corridor within the study area at Tootsee Ridge, Beaver Creek, and Cassiar Mountains. These are generally in the Rancheria area (Stanley, 1982).
- The area is home to the ranges of a small populations of mountain caribou, specifically Swift River valley which is winter range for an unknown population, and Little Rancheria, which is winter range for a large population (Stanley, 1982).
- There is well utilized aquatic furbearing mammal habitat in close proximity to the highway in the Rancheria and Swift River lowlands (Stanley, 1982).

3.6.2.3 *Waterfowl*

- The Nisutlin River delta is a major waterfowl staging area on the Pacific flyway (TTC et al., 2003).
- There are important wetlands at Morley Bay (TTC et al., 2003).
- In general, waterfowl production in this segment is considered to be a function of a large number of small wetlands than outstanding qualities of specific wetlands (Stanley, 1982).
- There is notably good waterfowl habitat in the area between Big Creek and Rancheria lowlands, Swift River, Swan Lake, and Smart River (Stanley, 1982).

3.6.2.4 *Fisheries*

- The Rancheria watershed is home to a variety of species including Arctic grayling, Dolly Varden, slimy sculpin and longnose sucker, mountain and round whitefish and burbot (Stanley, 1982).
- Dolly Varden migrate and are believed to spawn in the Rancheria River; Big Creek is considered rearing and summer habitat for the species (Stanley, 1982).
- Swift River and other tributaries to the Teslin watershed support migrating adult and juvenile chinook salmon rearing. These include Logjam Creek, Smart River, Ten Mile Creek, Lone Tree Creek, Deadman Creek, and Brooks Brook (Stanley, 1982).
- Swift River is considered an important habitat for spawning and rearing of fish populations, including Dolly Varden, Arctic grayling, and whitefish (Stanley, 1982).

- Logjam Creek is a migration, spawning, nursery and rearing habitat for chinook salmon. Smart River is a migrating and spawning area for chinook. Both are important habitat for Arctic grayling as well (Stanley, 1982).

3.6.2.5 *Hydrology*

- This segment of the pipeline corridor traverses the Teslin, Swift and Rancheria River valleys and the Teslin and Liard drainage basins. No site-specific issues or concerns were raised.

3.6.2.6 *Vegetation*

- Little to no information pertaining to site-specific vegetation concerns were found.

4.0 Current State of Knowledge

4.1 GENERAL

Since the completion of the Foothills Pipeline environmental review in 1982, very few major projects have occurred within the Alaska Gas Pipeline corridor. There have been a multitude of minor projects involving primarily small-scale forestry, residential accesses, utilities, mining, and highway maintenance. In most cases, the environmental assessments (EAs) conducted for this scale of activity reveal very little in the way of site-specific environmental concerns or issues. The standard terms and conditions of regulatory permits and licenses are generally deemed to be sufficient to mitigate the impacts associated with these minor projects.

The only significant post-1982 development activity for which in-depth environmental baseline study has been undertaken is the reconstruction of the north Alaska Highway under the Shakwak Project, particularly the segment located between Jarvis River and Dry Creek No. 2. To a lesser degree, background study completed in advance of the reconstruction of the Alaska Highway in sections between Watson Lake and Haines Junction provided new information about environmental concerns through this part of the corridor. Commercial logging activities undertaken by Kaska Forest Resources (KFR) in the late 1990s and early 2000s were subject to comprehensive environmental reviews but these only pertain to the Rancheria area and are otherwise situated outside of the pipeline corridor.

The settlement of First Nation land claims throughout the pipeline corridor has resulted in a greater emphasis being placed on regional habitat and wildlife management issues in recent years. Various planning processes undertaken by Champagne and Aishihik First Nation and Teslin Tlingit Council for wildlife and forestry management purposes have helped to consolidate and advance knowledge about environmental conditions in these respective traditional territories. More recently settled First Nations – including Kluane, Kwanlin Dun, Ta'an Kwach'an, and Carcross/Tagish– will likely undertake their own planning processes in the coming years. These can be expected to continue to identify and prioritize key environmental issues for the Kluane Lake area, City of Whitehorse and surrounding environs, and Southern Lakes area.

4.2 VALUED ECOSYSTEM COMPONENTS

It was beyond the scope of this study to ascertain the current state of knowledge for each potential valued ecosystem component (VEC) present along the pipeline route. However, some general comments and observations can be made based on the literature reviewed and comments received during the course of investigation into EA activities.

These observations are grouped under the same headings used in the EA synopsis of Part 2.0.

4.2.1 Wildlife

The baseline studies conducted during the Foothills era still constitute much of the knowledge and information about wildlife habitat and distribution along the corridor. However, a variety of studies and programs carried out since 1982 have made significant contributions to knowledge about several VECs.

Considerable study has been devoted to the woodland caribou herds located along the pipeline corridor since 1982. The Southern Lakes Caribou Recovery Program and scientific studies of the Chisana, Kluane, and Little Rancheria herd have advanced understanding of the range and migration patterns of these species.

Dall sheep in the Kluane area have been the subject of considerable study, in part due to highway reconstruction activities through this area at Sheep Mountain. It appears that less is known about sheep populations that populate the south end of the Ruby Range and the mountains between Haines Junction and Teslin, particularly the Ibex Valley and Deadman Creek bands that are in close proximity to the corridor.

Key grizzly bear habitat has been well documented in the Kluane area of the Alaska Highway corridor. Moose habitat in the Haines Junction area has also been well studied. For the purposes of EA, these species could be considered omnipresent along the pipeline route.

Detailed raptor surveys were carried out for the Alaska Highway between Jarvis River and Dry Creek No. 2 as part of the Shakwak baseline work. A second volume of the 1982 Stanley study apparently contained raptor information for areas between Haines Junction and Watson Lake; however, the author has been unable to locate this volume. The usefulness of this volume is questionable given its publication date, however. No other comprehensive raptor baseline work was found during the records and literature search.

The Key Wildlife Areas Program carried out by the Yukon Department of Environment in recent years has also facilitated the consolidation of knowledge with respect to wildlife habitat and utilization throughout the Yukon, including the pipeline corridor. The maps developed by the department provide an excellent baseline of information.

4.2.2 Waterfowl

Since 1982, a variety of studies have been carried out on waterfowl populations in the pipeline corridor. Generally speaking, the areas of primary habitat importance to waterfowl are well known and studied. The captive breeding surveys carried out by

Canadian Wildlife Service and other studies conducted by Ducks Unlimited on the north Alaska Highway have provided considerable information about habitat and utilization between Haines Junction and Beaver Creek.

Areas of waterfowl significance between Whitehorse and Teslin, particularly the Lewes Marsh, M'Clintock Bay, and Nisutlin River Delta appear to be well studied and understood. Less information was found about waterfowl habitat between Teslin and Junction 37. However, this area was not been identified as being of significance to waterfowl in any of the literature reviewed either.

4.2.3 Fisheries

Baseline information with respect to fisheries habitat and utilization is substantially completed for the corridor. Both the Department of Fisheries and Oceans and Yukon Environment Fish and Wildlife Branch have extensive databases of habitat and fisheries utilization information for the vast majority of watercourses encountered along the pipeline route.

4.2.4 Hydrology

Hydrological monitoring has been scaled back dramatically in the pipeline corridor since 1982. As a result, there is less information available about the hydrological regime of even major watercourses located along the route, posing challenges for engineers and construction contractors alike.

With the impacts of climate becoming more prevalent, even the most conservative design approaches may fail to adequately account for anticipated fluctuations in the hydrologic regime. Climate change experts predict that there will be significant increases in both run-off and peak flows throughout the southern Yukon. The frequency and severity of extreme flood events will also increase.

4.2.5 Vegetation

Coordinated information about rare plants is generally lacking for the corridor, with the exception of the area between Jarvis River and Dry Creek No. 2 (covered by the Access and Sentar studies). The Sentar work was largely based on incomplete knowledge of Yukon flora, and much of it may be inaccurate. Further work could still be conducted in the Slims River area to ensure that this priority area is adequately understood and impacts successfully mitigated. The Takhini salt flats have been the subject of recent study.

4.2.6 Other

Air and soils are environmental components () that fall within the mandate of Environment Canada and will need to be considered during the course of a pipeline

review. Air and soil quality are rarely considered during the course of EA-related work in the Yukon. These are likely to be impacted by pipeline development on a very limited temporal and spatial scale. Standard "housekeeping" practices are generally understood and required on most development projects to minimize soil and air contamination. These are further protected through the provisions of the *Yukon Environment Act*.

The consideration of cumulative effects is legislated by both the Canadian Environmental Assessment Act (CEAA) and Yukon Environmental and Socioeconomic Assessment Act (YESAA). Only in recent years has cumulative effects assessment (CEA) been a component of EA in the Yukon. In some respects, the body of theoretical knowledge surrounding CEA has advanced further than the suite of tools and practical methods by which to implement the theory. For the most part, the majority of projects occurring within the Yukon do not pose any particular cumulative effects concerns for EA practitioners.

4.3 AREAS OF SPECIAL CONCERN

The Foothills review in 1982 helped to identify key areas of special environmental concern or significance along the pipeline corridor. Although most of the post-1982 EA activities throughout the corridor involved projects of insufficient scope to contribute substantially to knowledge about environmental conditions, two of the key exceptions – specifically the Shakwak Project and KFR commercial timber harvest – apply to areas of special concern.

In preparation for the Shakwak Project, multidisciplinary environmental assessment studies have been carried out for those sections of the north Alaska Highway between Jarvis River and Dry Creek No. 2 over the past 12 years. These studies encompassed a number of areas of special concern such as the Slims River delta, Sheep Mountain, and Duke River and Pickhandle Lakes wetland complex.

Comprehensive environmental baseline studies conducted for the KFR assessments also describe the broad range of environmental conditions in the proposed logging area. For the most part, the KFR project area does not overlap with the corridor. However, the portion of the winter range of the Little Rancheria caribou herd which poses a special concern with respect to pipeline development is captured.

4.4 MITIGATION APPROACHES

It was beyond the scope of this study to ascertain the current level of understanding among Yukon resource managers with respect to mitigation for specific VECs or areas of special concern. However, some general comments and observations can be made based on the files and literature reviewed during the course of the EA synopsis.

The impacts of highway reconstruction – most (if not all) of which are applicable to pipeline development – are generally well understood and successfully mitigated in the Yukon. The experience of the Shakwak Project in the sensitive Kluane Region, particularly Sheep Mountain and Slims River delta, will be invaluable to resource managers and EA practitioners should the pipeline project proceed. Shakwak essentially provides a reference point for the mitigation practices and approaches that could be applied successfully to pipeline construction.

Due to the Yukon's relative inexperience with oil and gas development projects, there may be mitigation practices and approaches that are generally unknown or untested in the Yukon. The experience of nearby jurisdictions such as northern Alberta and British Columbia may provide valuable insight for Yukon resource and EA managers as to the most effective and up-to-date practices that can be applied to pipeline construction.

Effective mitigation practices and approaches that could be applied to a pipeline may also arise from continued research efforts of wildlife and habitat biologists both within and outside the Yukon, as well as regional or species-specific management planning within the territory. Many of the issues and recommendations evolving out of planning processes pertain more to landscape-level management than the mitigation of site-specific impacts. Nonetheless, they offer a valuable context in which to place site-specific mitigation.

4.5 KEY INFORMATION GAPS

4.5.1 Valued Ecosystem Components

Based on the EA synopsis and literature search, there are specific VECs for which the existing baseline information may prove to be insufficient for the purposes of a detailed environmental review. These VECs are as follows:

- Raptor presence and habitat along the corridor with the exception of Jarvis River – Dry Creek No. 2;
- Sheep populations in Ibex Valley and Deadman Creek;
- Waterfowl habitat between Teslin and Junction 37; and,
- Rare vegetation along the pipeline corridor with the exception of the Takhini salt flats and area between Jarvis River and Quill Creek. (The Slims River delta could be further studied due to the high frequency of rare species found here.)

4.5.2 Areas of Special Concern

Based on the EA synopsis and literature search, there are two areas of special concern located along the pipeline route for which the existing baseline information may prove

to be insufficient for the purposes of a detailed environmental review. These areas are as follows:

- Proposed crossing of Kluane Lake; and,
- Ibex Valley.

The EA work conducted in advance of Shakwak Project reconstruction between Jarvis River and Quill Creek in 2001 provides an excellent example of the type of multidisciplinary, comprehensive EA review that could be undertaken for these two areas of special concern.

4.5.3 Climate Change

Climate change presents perhaps the most significant information gap with respect to environmental issues along the pipeline corridor. In the most practical sense, more information is needed on the site-specific implications of an altered hydrologic regime for the safe design and construction of watercourse crossings. The impacts of melting permafrost in the discontinuous permafrost zones located along the corridor – primarily along the north Alaska Highway – will also need to be considered. Adaptive management and engineering approaches to adequately mitigate these impacts will need to be developed.

4.5.4 Cumulative Effects

Due to the relative inexperience of Yukon EA practitioners and resource managers with projects of the magnitude of the Alaska Gas Pipeline, careful advance consideration will need to be given to how best to qualify, quantify, and mitigate for cumulative effects in a meaningful way during a potential environmental review. The cumulative effects thresholds work conducted for the oil patch of northeast British Columbia and species-specific thresholds developed for application to the oil sands development in northern Alberta may provide useful models in this respect.

5.0 Conclusion and Recommendations

This study, in addition to others conducted in recent years, has helped summarize current environmental issues and concerns along the corridor. There is now a need to move past the information collection phase and into a phase of discussion and collaborative thinking around these issues. These recent investigations could provide an excellent starting point for developing a broader framework that reflects the interdisciplinary and intergovernmental nature of how the assessment and permitting of a major pipeline would be carried out in the Yukon.

Simply put, the political and cultural context for EA, resource management, and land administration through the pipeline corridor has changed so dramatically in the last 23 years that multiple unilateral approaches from various levels of government to the same issue will no longer suffice. Particularly in light of the increased recognition and use of traditional knowledge as a tool in resource management and EA, the written record as described in EA files and literature must not be confused for the "complete" record of environmental conditions along the pipeline corridor.

The concept of traditional knowledge applies to some extent to non-First Nation resource managers as well. The corporate memory of individuals who have been closely involved with wildlife and natural resource management in the Yukon since the early 1980s can not be adequately captured through literature and records reviews. Rather, it needs to be engaged in a focused manner.

Establishing an open dialogue between natural resource managers and EA practitioners at all levels of government would shed further light not only on how much and what kind of information exists, but more importantly – whether that information pertains to the issues that really *matter*. Addressing these issues up-front could help to ensure that if and/or when a project proposal is submitted to the appropriate regulatory agencies and assessment bodies, a culture conducive to expeditious and effective assessment of such a major project will have been at least partly formed in the Yukon.

Based on these considerations, the following recommendations are being made:

1. A short-term, results/outcomes-based process to engage Yukon EA and resource managers from all levels of government in the discussion and prioritization of environmental issues and knowledge gaps along the pipeline corridor should be scoped and initiated.

   Note: The work initiated by the Northern Climate Exchange and Environment Canada in the late 1990s with respect to the development of a knowledge-based matrix about climate

change impacts and adaptation may be a useful model. The process need not be unwieldy; a multi-day workshop or workshop series could likely achieve this objective.

2. The above-mentioned process should be implemented with the following objectives:

    - To rank or prioritize environmental issues according to areas of special concern and VECs;
    - To reach consensus on which priority VECs and areas of special concern require further research or information gathering in preparation for a pipeline EA;
    - To reach consensus as to the current state of knowledge and proven success with respect to mitigation approaches for VECs and activities relevant to the pipeline;
    - To produce a list of key knowledge gaps with respect to VECs and mitigation approaches; and,
    - To develop a terms of reference for a process to facilitate ongoing collaboration and information sharing.

3. For those VECs and special areas of concern for which information gaps – with respect to either mitigation or environmental baseline data - are identified, an expert intergovernmental working group and appropriate budget should be assigned to address these gaps to the extent possible.

4. Resources should be assigned to address the key information gaps identified through this study as follows:

    - Multidisciplinary environmental baseline information for the proposed Kluane Lake crossing and Ibex Valley;
    - Raptor habitat and presence along the corridor with the exception of Jarvis River – Dry Creek No. 2;
    - Sheep populations in Ibex Valley and Deadman Creek area;
    - Waterfowl habitat between Teslin and Junction 37;
    - Rare vegetation along the pipeline corridor with the exception of the Takhini salt flats and area between Jarvis River and Quill Creek, but including Slims River due the frequency of rare species; and,
    - Climate change and cumulative effects related to impacts and mitigation approaches along the entire pipeline route.

    Note: Recommendation 4 should only be implemented if consistent with the outcomes of the process outlined in Recommendations 1 and 2.

In setting out a proposed set of next steps, these recommendations do not imply that Environment Canada Pacific and Yukon Region should be the only party responsible for implementation. Rather, these recommendations may provide a useful starting point for discussion between various levels of government as to how best to combine resources – both financial and knowledge-based – to achieve their respective departmental objectives on the pipeline file.

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Appendix A. Environmental Impact Mitigation

Table 1. Mitigation Recommendations for Highway Reconstruction

Activity	Impacts	Recommended Mitigation	Source
Borrow sources/quarries	Habitat loss; disturbance to wildlife; sedimentation of watercourses; disturbance of wildlife; loss of organic layer; erosion of soils.	• Maintain minimum 30 meter tree screens between ROW and borrow source or quarry. • Limit haul roads to one for each borrow source or quarry site. • Develop excavations of no greater than 5 meters high, with slopes not exceeding 2:1. • Stockpile stripped organics and waste material for subsequent reclamation. • Develop borrow areas and quarries in progressive stages to avoid over-clearing and over-stripping. • Ensure adequate geotechnical testing in order to properly delineate pit areas. • Develop borrow sources or quarry plans to avoid water table. • Consult with other affected parties to determine end use for sites where water table can not be avoided. • Avoid developing sites with high visibility or that coincide with wildlife utilization.	Access (2000)
Camps	Habitat loss; wildlife disturbance; attraction of wildlife; increased hunting and fishing pressure.	• Use existing disturbed areas for construction camps. • Locate camps away from environmentally sensitive areas. • Camps should be maintained in a neat and tidy condition. • A solid waste and sewage management plan should be developed for each camp. • Camp and service areas should be cleaned up and maintained.	Access (2000)
		• Food wastes should be incinerated daily.	Sentar (1994)
Clearing	Habitat loss; risk of wildfire from burning debris; loss of riparian vegetation; sedimentation of watercourses.	• Use existing disturbed areas for waste spoil piles. • Protect trees, shrubs, plants and other features that will remain post-construction. • Take necessary precautions to keep fires from spreading. • Hand clear areas within 10 meters of ordinary high water mark. • Ensure that rare plants are identified and appropriate mitigation measures employed.	Access (2000)
Materials storage and handling	Contamination of soils	• Contractors storing fuel in excess of 4000 L should require a fuel storage and handling plan as well as spill contingency plan.	Sentar (1994)

Table 1 cont'd. Mitigation Recommendations for Highway Reconstruction

Feature	Impacts	Recommended Mitigation	Source
Revegetation	Establishment of invasive non-native species; attraction of wildlife to seeded areas.	• Organics should be stockpiled. • Areas scheduled for revegetation should be graded to reflect natural character of surrounding landscape and should be left in a roughened state to facilitate better catch. Compacted areas should be scarified to minimum depth of 150 mm using rippers or teeth on bucket of cat. • Seeded areas should receive application of a complete fertilizer and mulch at time of planting and if possible, a follow-up application next growing season. • Soils should be tested to determine the appropriate fertilizer and soil amendments. • Planting of trees and shrubs should be incorporated into each revegetation plan where practical. • Should consider blocking off access to revegetated sites until they are satisfactorily established. • Revegetated areas should be monitored for a period of five years until established.	Sentar (1994)

Table 2. General Mitigation Recommendations for Ecosystem Components

Feature	Impacts	Recommended Mitigation	Source
Caribou	Loss of habitat; disruption to migration; general disturbance; attraction to new food sources i.e. seeding; vehicle collisions; reproductive stress.	• Erect signage forewarning public, particularly at identified crossings. • Minimize right-of-way clearing and corresponding revegetation. • Revegetation mixes should exclude legumes. • Minimize use of road salts in sanding mixtures. • Minimize physical barriers such as deep fills and cuts. • Implement long-term monitoring program.	Access (2000)
		• Place new alignments in poorest wildlife habitat. • Revegetate abandoned roadbed if it is more than 100 meters away from new alignment to create feeding areas that would reduce caribou use of ROW. • Clear the minimum width required for sight distance and maintenance requirements to minimize perceptual barriers for crossing and need for revegetation. • Allow regrowth to be as tall as possible within safety and maintenance constraints. Taller vegetation would reduce forage value of road ROW. • Use existing clearings for camps, borrow pits, and related areas and avoid key habitats in developing new areas. • Burn slash in accordance with accepted practice, ensuring that adequate fire control measures are in place. • Yukon Fish and Wildlife Branch should be contacted for advice to avoid potential disturbance when caribou are encountered.	Sentar (1994)
		• Uphold hunting restrictions by project personnel. • Post warning signs in areas of caribou activity and maintain accurate records of caribou-vehicle collisions. • Remove any access to previously reclaimed linear access features that might be created during upgrading.	
		• Conduct forestry operations during the winter when the ground is frozen and there is adequate snow coverage to reduce damage to caribou winter forage (lichens).	Renewable Resources (1995)
Moose	Loss of habitat; disturbance; vehicle collisions; reproductive stress.	• Implement a 200 meter buffer on all known or discovered mineral licks, dens, and connecting corridors. • Minimize physical barriers to moose movement, such as linear slash piles.	DIAND (2003)
		• Leave a minimum of 120 meters of standing timber between cut blocks and meadow areas that are moose habitat.	DIAND (1998)

Table 2 contd. General Mitigation Recommendations for Ecosystem Components

Feature	Impacts	Recommended Mitigation	Source
Dall sheep	Vehicle collisions; habitat loss; disturbance and displacement; reproductive stress.	• Erect signage forewarning drivers. • Design roadway to maximize line of sight; fences. • Minimal use of road salts and forage species in revegetation efforts. • Removal of dangerous salt licks and provision of alternate ones. • No removal of mineral licks unless to deflect sheep from road dangers. • Construction timing windows from late June – late September. • Restriction of off-road vehicle use. • No highway pull-outs in proximity to sheep habitat.	Access (2000)
Raptors	Loss of habitat; displacement from nests; disturbance; reproductive stress.	• Where scheduling fails to avoid sensitive times, areas of known active nest sites should be searched thoroughly. These sites should be monitored to observe response of adult and fledgling birds. • Minimize potential for raven occurrence through incineration of garbage. • Prohibit firearms in construction camps. • If blasting must occur in confined areas within 2.7 km of actively nesting raptors, should consider applying overburden to "pad" blasts • Limit construction-related helicopter activity in vicinity of known, active raptor nests. • Store hazardous materials away from wetland areas. • Construction staff working in the vicinity of active raptor nest sites should be given a one-day orientation session that outlines how to identify raptors and minimize impacts.	Sentar (1994)
		• Establish buffers around nests. Buffers should vary depending on species, time of year, nesting phenology, and species vulnerability. • Avoid construction during sensitive times. • Avoid alteration or disruption to nesting trees and cliffs. • Protect key nesting sites or provide alternative nesting sites.	Access (2000)
		• If nests are found during pre-inspection or any follow-up inspections, nests will be protected by retaining leave areas 100 meters in diameter to conceal the nest and provide perching sites.	DIAND (1998)
Waterfowl	Loss of habitat; displacement and disturbance; migration disruption; reproductive stress.	• Clear minimum width compatible with sight distance and maintenance requirements. • Promote rapid and complete revegetation of ROWs. • Allow growth to obtain as tall a height as possible without compromising highway design, safety or maintenance.	Sentar (1994)

Table 2 contd. General Mitigation Recommendations for Ecosystem Components

Feature	Impacts	Recommended Mitigation	Source
Waterfowl cont'd	Loss of habitat; displacement and disturbance; migration disruption; reproductive stress.	• Stream entrainment and channelization can be addressed through careful placement of alignment to avoid and minimize impacts to stream flow. Impacts associated with damming of peatland drainages can be mitigated by installation of culverts. • Sedimentation can be avoided by scheduling construction for lower water levels and implementing proper sediment controls. • Habitat pollution due to material spills can be mitigated by deliberate storage of materials away from wetlands. • Construction noise mitigated by avoiding blasting during April 1-April 30; May 15-July 15 and Sept 15-Oct 15.	Sentar (1994)
		• Maintain a 1 kilometer buffer in the vicinity of waterfowl habitat.	Stanley (1982)
		• Locate highway camps a minimum of 500 meters away from waterfowl habitat. • Minimize construction in vicinity of key habitat during the spring.	Access (2000)
Fisheries	Loss of fisheries habitat and invertebrate communities that support fish; decrease in fisheries productivity and survival rates; fish stranding and mortality; creation of barriers to fish migration.	• Implement erosion control and stabilization measures such as terracing and revegetation to minimize potential for sedimentation. • Locate waste areas outside of stream crossings. • Avoid critical life stages for fish species present. • Consult closely with Department of Fisheries and Oceans to ensure fish passage requirements are met on a stream-by-stream basis. • Plan in-stream construction to minimize extent and duration of streambed and bank disturbance. • Educate heavy equipment operators to minimize movement of machinery near streams. • Utilize sediment traps, particularly where cuts will be made in ice-rich soils. • Culverts must adequately provide for fish passage.	Sentar (1994)
Vegetation	Loss of rare vegetation or vegetation complexes.	• Maintain cross-highway drainage conditions. • Conduct rare plant surveys prior to disturbance in braided stream channels. • Stockpile topsoil and other materials within borrow pits or other disturbed areas rather than on adjacent, disturbed ground. • Where areas of realignment cross level, open muskeg terrain, efforts should be made to determine natural drainage patterns. Efforts should be made to maintain surface and subsurface drainage across the alignment.	Sentar (1994)

Table 2 contd. General Mitigation Recommendations for Ecosystem Components

Feature	Impacts	Recommended Mitigation	Source
Vegetation cont'd	Loss of rare vegetation or vegetation complexes.	• Interpretation of large-scale air photos should be conducted to map occurrence of black spruce bog when they occur in a mosaic with other vegetation types. Culverts should be installed at these locations to limit upstream ponding and downstream paludification in these areas. • Construction activities in braided stream channels should be preceded by brief, site-specific floristic surveys to confirm presence or absence of rare plants that have potential to occur in these conditions.	Sentar (1994)
	Loss of rare vegetation or vegetation complexes; introduction of invasive non-native species.	• Minimize off-road construction traffic. • Use of previously disturbed areas for borrow and field camps. • In areas of known rare plants, identify, salvage, and transplant rare plant species. • Minimize disturbance to and maintain natural drainage courses. • Utilize seed mixtures appropriate to the objectives of non-invasive species and wildlife attraction.	Access (2000)

Table 3. Yukon/Alaska Border – White River: Site-Specific Mitigation Recommendations

Feature	Impacts	Recommended Mitigation	Source
Caribou	Disruption to migration activities	• Schedule construction activity from April to November to avoid caribou migration north of White River.	Sentar (1994)
Raptors	Loss of habitat; displacement from nests; disturbance; reproductive stress.	• Avoid construction between 18 March and 15 September between Horsecamp Hill and White River. • Avoid blasting and use of heavy equipment from 18 March – September 15 in vicinity of borrow pits located between Horsecamp Hill and White River.	Sentar (1994)
Fisheries	Loss of fisheries habitat and invertebrate communities that support fish; decrease in fisheries productivity and survival rates; fish stranding and mortality.	• Schedule in-stream construction between June 15-March 31 for the fish species encountered in the smaller creeks between Dry Creek No. 2 and White River. • For smaller creeks between Dry Creek No. 2 and White River that have over-wintering potential; schedule in-stream construction between June 15 and August 31. • For larger streams between Dry Creek No. 2 and White River that may contain fall spawning species, schedule construction between November 15 and September 1.	Sentar (1994)

Table 4. White River – Quill Creek: Site-Specific Mitigation Recommendations

Feature	Impacts	Recommended Mitigation	Source
Raptors	Loss of habitat; displacement from nests; disturbance; reproductive stress.	• Avoid construction between 18 March and 15 September for Pickhandle Lake complex area, Andrew Lake area, Icefield Ranges viewpoint area – Hard Luck Creek. • Prior to construction near Donjek River, entire area less than 2.7 km east of highway between Icefield Ranges viewpoint and Hard Luck Creek should be investigated for active raptor nests. Special attention should be paid to potential for nesting peregrine falcons on banks of Donjek River. • Avoid blasting and use of heavy equipment from 18 March – September 15 in vicinity of borrow pits located between White River and Pickhandle Lake complex.	Sentar (1994)
Waterfowl	Migration disturbance; displacement.	• Avoid blasting near waterfowl habitat during periods of April 1-30 (spring migration), May 15-July 15 (nesting), and Sept 15-Oct 15 (fall migration).	Sentar (1994)
Vegetation	Loss or damage of rare plants.	• Consider conducting a survey of alignment in areas where *Vicia americana* and *Salix Chamissonis* were encountered during field surveys. • Conduct rare plant surveys prior to disturbance in braided stream channels.	Sentar (1994)

Table 5. Quill Creek – Haines Junction: Site-Specific Mitigation Recommendations

Feature	Impacts	Recommended Mitigation	Source
Caribou	Vehicle collisions; migration disruption; hunting pressures	• Construction timing windows of June – August between Duke River and Quill Creek to avoid migration. • No new roadside facilities i.e. pullouts between Burwash and Quill creeks. • Maintain highway corridor hunting ban.	Access (2000)
Dall sheep	Vehicle collisions; habitat loss; disturbance and displacement.	• Maintain unrestricted access to bluffs serving as escape terrain at Sheep Mountain. • Construction timing windows from late June – late September. • Minimal establishment of camps and quarries in Sheep Mountain area.	Access (2000)
Moose	Reproductive stress	• Avoid disturbance to calving on island in Slims River delta.	Access (2000)
Raptors	Disturbance; reproductive failure; abandonment of nests	• Avoid construction within a 2 km buffer of nesting sites from Feb. 15-June 30 at Sheep Mountain. • Avoid establishing camps and gravel quarries within the Sheep Mountain corridor. • Avoid construction activities from May 1-31 within 1 km of Harlans hawk nesting sites (6 active sites recorded) OR undertake construction prior to April 20. • Avoid construction activities from Feb. 20 – April 30 within 1 km of Great horned owl nesting site at Silver City OR undertake construction prior to Feb. 20. • At identified Boreal owl sites, erect nest boxes in suitable habitat at least 2 km away from ROW and monitor from Feb – May. • Avoid establishing camps and gravel quarries within 2 km of these sites.	Access (2000)
Sharp tail grouse	Habitat loss; disturbance and displacement; vehicle collisions.	• Avoid use of known lekking sites for camps and borrow areas. • Restrict highway pullouts in vicinity of lekking sites. • If possible, establish lekking theaters using berms in suitable habitat away from highway corridor.	Access (2000)
Waterfowl	Habitat loss; disturbance and displacement.	• Construction camps should be situated away from Sulphur Lake. • Locate highway camps a minimum of 500 meters away from waterfowl habitat. • Minimize construction in vicinity of key habitat during the spring.	Access (2000)
Hydrology	Failure of engineered structures.	• Kluane Lake tributaries can be unpredictable; design accordingly.	Access (2000)
Vegetation	Loss or damage of rare plant species.	• Identify, salvage and transplant rare plant species in Slims River delta that will be impacted by new alignment.	Access (2000)

Table 6. Haines Junction – Junction 37: Site-Specific Mitigation Recommendations

Location	Concern	Recommended Mitigation	Source
Aishihik and Champagne	Loss or damage to rare plant species	• Forested sites should be selected as borrow pits instead of dry meadow sites.	Stanley (1982)
Canyon Creek area	Bison grazing and vehicle collisions	• Do not revegetate with brome through this section of the Alaska Highway.	(YG, 1998)
Champagne	Hunting pressure on sheep	• Restrict motorized access to sub-alpine areas of Shaneinbaw Lake (near Champagne) during lambing season.	(YG, 2001)
Squanga Lake area	Disturbance and habitat loss for beaver and marten	• Maintain a minimum 30 meter riparian buffer around Squanga Creek and Lake.	(YG, 1995)
Rancheria	Disturbance of caribou	• Do not locate camps in the Little Rancheria valley portion of the Alaska Highway.	(YG, 1996)

Table 7. Standard Mitigation Practices for Highway Construction Activities in Yukon: Transportation Engineering Branch

Activity	Impacts	Mitigation Practice
Clearing, Stripping, and Excavation	Loss of organic cover; risk of forest fires; disturbance of wildlife and loss of habitat.	• The extent of clearing and stripping is limited to minimum amount required. • Stripped organic material is stockpiled and used in reclamation activities. • Contractor obtains burning permits from appropriate agencies prior to timber disposal. • Any significant wildlife encounters are immediately reported to the District Conservation Officer. • Appropriate reclamation is carried out as soon as possible.
Camps and Maintenance Areas	Attraction of wildlife to garbage; pollution of soils and watercourses; disturbance of wildlife.	• Garbage is incinerated daily or hauled to an authorized landfill. • Permits and water licenses required for sewage disposal where applicable. • Sensitive areas are restricted for motor vehicle use. • Environmental briefings are held for contractor staff to review hunting and fishing regulations and other environmental issues and concerns. • Equipment servicing is done on a surface designed to contain contaminated soils and minimize run-off. • All suspect contaminated soil is tested and treated in accordance with the *Yukon Contaminated Sites Regulations*.
Watercourses and In-Stream Activities	Loss of fisheries habitat; decrease in fisheries productivity and life expectancy; disruption of fish migration; sedimentation and introduction of deleterious substances.	• 10 meter vegetated buffers maintained around watercourses. • No equipment maintenance or fuel storage permitted within 30 meters of a watercourse. • Settling ponds are utilized for in-stream works. • Fish are salvaged in advance of dewatering activities. • Equipment is inspected prior to in-stream work to ensure no leaks or spills will occur. • Spill response kits are kept on site at all times. • Durable geotextile and riprap are utilized. • Fish screens are required for all water pumps.