4.3 Proposed Action Alternative Analysis — Routine Operations

4.3.1 Physiography and Geology

The interaction between geologic processes and the continued operations of the TAPS would impact the local environment adjacent to the TAPS. The impacts may be further complicated by the current warming trend of the climate that may affect the TAPS. Because the TAPS has been in operation for more than 25 years, most of the current impacts have been observed (see Section 3.2) and have become part of the existing environment. In the following paragraphs, additional impacts from continuing the operation of the TAPS for the proposed action are described.

> **Impacts of Proposed Action on Physiography and Geology**
>
> The impacts on physiography and geology are expected to be localized near the TAPS. Impacts of mass wasting processes would be mitigated as in the past.

Activities that would impact the physiography and geology include (1) creating new or expanding existing operation material sites (OMSs) to mine sand, gravel, and quarry stones; (2) using the material to maintain workpads, access roads, and to protect the pipeline from shore erosion; and (3) conducting any relocation of the pipeline, if needed. Most of these activities would be carried out for maintenance. The impacts to the physiography and geology would result from changes to landforms and removal of geological material. As compared to the scale of the landscape crossed by the TAPS, the change to landforms caused by the construction and operation of the pipeline would be insignificant. The removal of geologic material would also be very small relative to the availability of the material, and the removal would be spread over a few new and 69 old OMSs across 800 mi. Therefore, the impacts on the physiography and geology are expected to be very localized near the TAPS.

Modification of the geological processes along the TAPS would continue under the proposed action alternative. Historically, soil erosion, ponding, flooding, and thawing of permafrost near workpads, access roads, and quarries occurred locally. These processes would continue to occur on a localized scale near the TAPS.

Under the proposed action, the impact of mass wasting processes on the pipeline would continue and expand, especially on sloped areas, as evidenced at various sites along the southern ROW (see examples listed in Section 3.3.2).

Historically, the effects of mass wasting processes on the TAPS have been mitigated through rerouting a section of pipeline; using passive thermal-transfer devices (pipes to remove heat from the soil in winter) for the vertical support members; using insulated boxes and refrigeration for buried pipes at locations where the underlying soils are thaw-unstable; applying wood chips on workpads for insulation; using "smart pigs" to detect anomalous curvature of underground pipeline; and instituting vigilant surveillance, monitoring, and maintenance. Under the proposed action, similar types of mitigation measures would continue. The impacts of any mass wasting processes on pipeline integrity would be mitigated as in the past.

4.3.2 Soils and Permafrost

Excavations for pipeline rerouting, corrosion digs, valve replacements, buried pipe repairs, and pipeline coating refurbishment are part of routine maintenance for the TAPS. Historically, excavation has destroyed local surface vegetation and impacted the soils and permafrost, producing drainage, surface subsidence, ponding, and slope stability problems. The impacts have been local,

Impacts of Proposed Action on Soils and Permafrost

The impacts on soils and permafrost caused by routine maintenance activities (i.e., excavation, disturbance) would be localized and would not increase significantly in magnitude or number from those experienced historically from pipeline operations. With the continuous warming trend in Alaska, the risk of earthquake-triggered liquefaction and landslides would be expected to increase. These events, although very unlikely, could potentially threaten the integrity of the TAPS.

occurring immediately adjacent to the ROW and access roads (Map 4.3-1). Under the proposed action, these types of excavations would continue (Table 4.3-1). Their associated impacts would be about the same as those seen historically, and the affected areas would be of the same localized scale.

In addition to the effects of the excavation itself, the environment has been affected by the use of heavy equipment and trucks in upgrading pump stations (see Section 4.2.2.6.3) and maintaining slopes, VSMs, and workpads. The impacts have been local and include the destruction of vegetation cover and an increase in soil erosion and siltation. Under the proposed action, these types of impacts would continue. They would continue to be localized and would not increase significantly in number or magnitude.

The buried pipeline has also affected adjacent permafrost by heat transfer. Heat from the warm oil in the pipeline creates thaw bulbs (areas where the frozen soil is melted) along the ROW. The sizes of the thaw bulbs depend on the throughput of the pipeline. The shrinking and growing of thaw bulbs could promote frost heaving and settlement, respectively, near the TAPS. The current throughput of the pipeline is about 1.1 million bbl/d (TAPS Owners 2001a). If the throughput in the pipeline were to decline to 0.3 million bbl/d, the heat input into the subsurface would decline. The thaw bulbs that have developed around the buried pipe would shrink because the pipeline temperature would decrease with decreasing throughput. Shrinkage of the thaw bulbs could then promote permafrost aggradation. Ground ice could grow, producing frost heave in some areas, especially in areas where fine-grained soil is dominant in the subsurface. Historically, the decline in throughput has had an insignificant impact on the integrity of the pipeline due to contraction of the thaw bulbs. Continued monitoring and maintenance would identify areas where heave might exceed operational standards, and repairs could be made accordingly. If the throughput of the pipeline were to be increased from 1.1 to 2.1 million bbl/d, the thaw bulbs could expand. The expansion and contraction of the thaw bulb is a local phenomenon.

The general retreat of glaciers along the TAPS and increased near-surface soil and permafrost temperature in the southern part of the TAPS ROW may indicate a trend of a warming climate in the last 25 years along the TAPS (see Section 3.12.7). In an area near the southern margin of the permafrost (MP 735–736), previous permafrost has thawed (Keyes 2002). General warming along the TAPS would promote increasing average temperature of the soils, melting of ground ice, release of meltwater, and lowering of the permafrost table. The resulting effects may lower the mechanical strength of frozen to nonfrozen soil and promote solifluction, debris flows, rock falls, potential landslides, differential settlement, liquefaction, and alternation of local hydrology. These processes would continue to impact the integrity of the TAPS, if not carefully monitored and managed. In addition, the increased soil temperature would compound the impacts from any soil disturbance and expansion of the thaw bulbs with increased throughput of the pipeline.

The integrity of the structures of the TAPS, including the VSMs, may be affected by the consequences of the warming of Alaska. However, the extent and the magnitudes of the impacts vary spatially, ranging from insignificant to credible. The extent of impact depends on many factors, including the expected magnitude of the warming in the next 30 years, the thermal regime of the permafrost, the geologic material in the subsurface, groundwater conditions, topography, the engineering practices used in constructing the TAPS, and the maintenance and monitoring programs used by APSC. Changes to natural systems caused by climate changes may also magnify the adverse impacts of earthquakes were they to occur. On the basis of these factors and the experience gained in the last 25 years, it is concluded that the impact of the warming on the VSMs is of limited extent. Most of the impacts can be mitigated through regular monitoring and maintenance.

When the impact of warming on the VSMs is evaluated, the TAPS can generally divided into three types of pipeline segments. One type of segment is where the VSMs are on stable permafrost where only minor maintenance is needed. This situation applies to the VSMs in the northern part of the TAPS (north of the Brooks Range), where the temperature of the permafrost is more than a few degrees below the freezing point (and the potential of major earthquake-triggered events is small). The warming of the permafrost, in the range of 2° to 4°C over a few decades to a century, would not make a significant impact or cause enough deformation on the foundation of the VSMs to threaten their integrity during the 30 years of grant renewal. Also, because these segments are not in earthquake-prone areas, a relatively long time period would be needed to produce an impact. A timely corrective action, if necessary, could be performed through regular maintenance activities.

The second type of segment is where the VSMs are on relatively warm permafrost (−1°C to −3°C). This situation includes those segments of TAPS from south of the Brooks Range to the Alaska Range. In the last 25 years, warming has had small impact on the stability of the VSMs because the influence of the warming was offset by the mitigating function of the VSM heat pipes. Regular maintenance in the past has proven to be effective and sufficient to correct VSM problems. Because the impact of the warming on the VSMs is going to be slow and because these areas are not expected to experience major earthquakes, the impact on the VSMs of the warming over the grant renewal period is expected to be minor and could be mitigated through regular maintenance. In this region, one case (the Treasure Creek site at MP 442) that requires continuous mitigation was documented. The site is on a steep slope and might have been disturbed by previous mining activities. Deep-seated melting has been found on the site.

The third type of segment is where the VSMs are on sporadic and patchy permafrost in the southern part of the TAPS (Copper River Lowland and the Chugach Mountains regions). This segment is characterized by relatively warm permafrost (−1°C to 0°C), a high potential for impact by major earthquakes, and widespread glacial fluvial and glacial lacustrine sandy sediment. The Chugach Mountains region is also characterized by rough terrain. If warming continues for the next 30 years, it could change local permafrost and groundwater conditions sufficiently to result in mechanically weaker soils. Significant precipitation events as well as earthquakes might have substantial impact on soil stability and, thus, VSM integrity. The potential of impacts caused by the warming in this region (through potential liquefaction and landslides) is credible and is discussed in the EIS (later in Section 4.3.2; also see 4.3.3). The effect of thawing of permafrost is manifested in several sites in this region, including at PS 11 at MP 685.9, Klutina Hill at MP 698.1, Squirrel Creek at MP 717, and PS 12 at MP 735 (see also Sections 3.3.2.1 and 3.3.2.2).

The potential for liquefaction of soils and landslide is closely related to the water or moisture content of soils. As a frozen soil is subjected to warming and the contained ground ice melts, the liquid water content in the soil increases. If the water is prevented from draining because of the presence of underlying permafrost or other reasons, the soil becomes saturated and its mechanical strength is weakened. This weakening can be significant in soils composed of loosely packed silt or flocculated clay with a high content of ground ice. When saturated, noncohesive, sandy soils are shaken by strong ground motions during an

TABLE 4.3-1 Potential Impacting Factors of the Proposed Action on Soil and Permafrost

- Replacing or repairing buried, refrigerated portions of the pipeline
- Replacing or repairing buried valves at the rate of no more than 5 valves per year
- Installing new impressed-current rectifiers and repairing, replacing, or improving 6 to 10 anode grid beds per year
- Refurbishing pipeline coating for up to a total of 5 mi
- Maintaining workpad slopes
- Removing sand, gravel, and quarry rock from borrow sites at a rate of approximately 100,000 yd^3 per year
- Repairing, replacing, and installing river training structures

earthquake, liquefaction may result. Similarly, saturated soils on slopes are weak mechanically. The permafrost table under those saturated soils could provide a potential plane for a landslide to occur. A landslide could be additionally facilitated by ground shaking in an earthquake. Both soil liquefaction and landslides could threaten the integrity of the TAPS.

With the warming trends in the last several decades in Alaska, permafrost, in general, is expected to degrade. During the design of the TAPS, APSC conducted detailed analyses of all pipeline slopes and assessed the slope stability and liquefaction potential of all slopes (APSC 1974). In the analyses, the effect of the warming trends along the TAPS ROW was not explicitly considered. The thawing due to heat transfer from the pipeline and the ground surface disturbance was calculated with the assumption of a 30-year time span. With the operational life of the pipeline extended for another 30 years, additional thawing of the permafrost, especially in the southern portion of the TAPS, would be likely. On slopes with fine-grained geologic material, soil water generated from the thawing might not be able to drain fast enough, and thus the pore pressure could increase. Also, new critical surfaces for sliding might emerge. These two factors could potentially cause a previously stable slope to become unstable, especially slopes that have been assigned a design safety factor of 1 or close to 1 under dynamic loading conditions. Furthermore, if a major earthquake occurred near these areas at a time when the water content of the soil was high, the probability of a landslide cannot be ignored. If a landslide occurred, its failure plane or planes could be below the elevations of the pipeline. Under such conditions, the pipe could be carried down the slope with the slide. Therefore, it is concluded that the risk for landslides along the TAPS can increase in the next 30 years.

For the liquefaction issue, liquefaction can occur both on slopes (greater than 2 degrees) and in flat areas (less than 2 degrees) in saturated, loose noncohesive soils (sands) under intensive shaking (a major earthquake). On sloping ground, liquefied soils tend to move down slope. In flat areas, liquefaction of soils results in a loss of strength. Structures that use the soils for support might fail.

In the design of the pipeline (APSC 1974, Appendix Volume 3, Geotechnical Aspects, Section 4), the areas of potential liquefied soils for the flat ground areas were estimated to be local and limited. The impact on buried pipe was considered to be less severe than that of equivalent seismic fault movement that was established to be safe. The original design met criteria for a liquefiable body of small or large size. However, sand bodies of various sizes are common because of the abundance of fluvial and lake deposits along the TAPS (e.g., in the Copper River basin and various other basins within U-shaped glacial valleys). If liquefaction occurred in a sand body of intermediate dimensions, local overstressing could develop and threaten the integrity of the pipeline (APSC 2001e, Design Basis Update DB-180, 3rd ed., Rev. 3).

In sloped areas, one of several protective measures to reduce the liquefaction threat was to bury the pipeline below a liquefiable soil layer. It is generally accepted that frozen soil is non-liquefiable. However, a previously frozen soil may thaw because of the effects of the continuous warming trends in Alaska. Under certain geologic and hydrologic conditions, the previously non-liquefiable soil might become liquefiable because of the thawing. Currently, APSC is conducting a study to review and re-evaluate potential liquefaction hazards for the TAPS after 25 years of operation. Results of that study were not yet available at the time this EIS was being prepared.

Since the pipeline has been operating, no earthquake-triggered landslides or liquefaction events have been reported. This lack of such events might be attributed primarily to the fact that areas with soils prone to liquefaction or landslides were avoided to the maximum extent possible during the selection of the route of the TAPS. Other minor factors might include that (1) prior to the November 3, 2002, earthquake, no very strong earthquake had occurred near the TAPS in the last 25 years (see Section 3.4), and (2) mitigation measures were implemented to minimize the degradation of permafrost along the TAPS. However, if the warming trend in Alaska continues for the next 30 years of the proposed renewal period, the risk of encountering liquefaction and landslides would be expected to increase.

Accidental spills and leaks can impact the environment, including soils and the permafrost layer along the pipeline. A detailed evaluation of potential spills under different scenarios is provided in Section 4.4.4.1.

4.3.3 Seismicity

Since the TAPS was built, the three largest earthquakes that have been recorded in east or southern Alaska had moment magnitudes (see Section 3.4) of 7.5 (1979), 7.8 (1988), and 7.9 (1987) (AEIC 2001). The epicenter of each of the three earthquakes was more than 190 mi southeast of Valdez. No damage was done to the TAPS by these earthquakes. An earthquake with a moment magnitude of 7.9 and an epicenter about 90 mi south of Fairbanks occurred on November 3, 2002. Some damage to VSMs occurred in the vicinity of MP 588; however, no leaks were detected. It is reasonable to assume that future earthquakes of that magnitude in the same general areas would be unlikely to cause more significant damage to the TAPS. The TAPS digital strong motion accelerometers and automatic shutdown systems required by Stipulation 3.4.1.2 operated and initiated a prompt shutdown of the TAPS for inspection. The TAPS was restarted three days later. However, it is uncertain whether an earthquake as large and as close as the Great Alaska Earthquake of 1964 (also known as the Good Friday Earthquake, 9.2 moment magnitude) would damage the TAPS. The epicenter of the Great Alaska Earthquake was about 60 mi west of Valdez, and the quake caused extensive ground cracks and landslides in the Chugach Mountains and the southern edge of the Copper River Lowland area (Ferrians 1966). If an earthquake-triggered landslide or ground cracking occurred in an area crossed by the TAPS, the integrity of the pipeline would likely be threatened. The pipeline was not designed to withstand a landslide, although previous landslide areas were avoided to the extent possible, and additional engineering practices were used to reduce the risk of landslides when the pipeline was constructed. (See Appendix B, Exhibit D, Stipulations 3.4 and 3.5.)

Seismicity-Related Impacts

Earthquake-triggered landslides and soil liquefaction are credible threats to the integrity of the pipeline if another earthquake as large and as close as the Great Alaska Earthquake of 1964 were to occur.

Similarly, earthquakes might also have the potential to trigger liquefaction (see Section 4.3.2) and cause the loss of support of the pipeline. Both cases might result in release of oil from the pipeline to the surrounding environment.

4.3.4 Sand, Gravel, and Quarry Resources

The volume of sand, gravel, and quarry stone required for workpad repairs, roadbed and surface materials, and flood damage control is estimated to be less than 100,000 yd^3/yr (TAPS Owners 2001a). If the Federal Grant for the ROW was renewed for 30 years and the TAPS continued operating, most of the required materials would be obtained from the 69 OMSs. However, development of new OMSs to help meet the materials requirements is possible, and the work limits of some existing sites would be expanded. The main impact of sand, gravel, and quarry stone mining would be resource extraction.

Impacts of Proposed Action on Material Use

Under the proposed action, impacts from the use of sand, gravel, and quarry stone would be expected to be similar to those observed historically.

Other environmental impacts associated with the extraction would be minor modification of local topography, loss of surface vegetation, creation of landscape scars, and a temporary increase of soil erosion and siltation near the OMSs. In some OMSs, destruction of permafrost would produce ponding. Historically, these impacts have been localized and small. Because the use of sand, gravel, or quarry stone for the proposed action would be similar that occurring historically during TAPS operation, the impacts would be expected to be similar as well.

4.3.5 Paleontology

The renewal of the Federal Grant is not anticipated to affect known paleontological resources adversely. All previously discovered Pleistocene fossils in the TAPS ROW were removed at the time of discovery, although smaller, pre-Pleistocene fossils may still be found in soils and rocks within the TAPS ROW and associated areas. New discoveries have been made close to the ROW. Eleven registered paleontological sites (from Alaska Heritage Resources Survey files) occur within a quarter mile of the TAPS ROW and associated materials sites.

New discoveries are always possible. APSC is required under Federal Grant Stipulation 1.9.2 to contact the JPO Authorized Officer and an archaeologist if any known or previously undiscovered paleontological resources are encountered during TAPS-related activities. Alaska’s Historic Preservation Act 41.35 also protects paleontological resources that may be encountered along the ROW on state-administered land.

Impacts of Proposed Action on Paleontological Resources

Renewal of the Federal Grant is not expected to have an adverse effect on any known paleontological resources. All Pleistocene fossils that were discovered in the ROW were removed at the time of discovery. APSC would be required to implement specific protective measures for any additional paleontological resources discovered during pipeline operations.

4.3.6 Surface Water Resources

The TAPS could cause impacts to surface water resources during normal operations for the proposed action. Surface waters along the ROW could also impact the pipeline. The impacts could be direct or indirect. Impacts from accidental releases are discussed in Section 4.4.4.3.

4.3.6.1 Impacts to Surface Water along the TAPS ROW

The continued presence of the pipeline and its continued maintenance for the next 30 years could affect surface water resources along the TAPS ROW. Specific direct impacting factors

Impacts of Proposed Action on Surface Water Resources

Direct impacts to surface water resources along the TAPS ROW could occur through continued water use to support operations. None of the activities of the proposed action would require use or disposal of more water than the amounts used or disposed of historically by TAPS operations. Historically, surface water use and disposal have represented a very small fraction of the total quantity of water available along the TAPS ROW and have been regulated under Alaska regulatory permits. Impacts from these historical uses and disposals have, thus, been small, local, and temporary. Because water use and disposal activities under the proposed action would be about the same as those that have previously taken place, impacts from the proposed action would be small, local, and temporary.

Indirect impacts to surface water resources could occur by discharge of water from operations to the land, with subsequent runoff to nearby surface water bodies. None of the activities of the proposed action would dispose of more water than the amounts that were disposed of historically. Impacts from the historical land discharges have been local and temporary and regulated by appropriate discharge permits. Because the quantity of water that would be discharged to the land for the proposed action would be similar to the quantities discharged historically, impacts to the surface water bodies would also be similar.

anticipated for the proposed action include the following:

- Dewatering 15 to 20 corrosion repair sites per year that could release an annual total of 500,000 gal of water per site to the environment;
- Replacing or repairing buried, refrigerated portions of the pipeline that would potentially require disposing of water encountered;
- Replacing or repairing buried valves at a rate of no more than five valves per year that would potentially require disposing of water encountered;
- Installing new impressed-current rectifiers for cathodic protection and repair, and replacing or improving 6 to 10 anode grid beds per year;
- Refurbishing pipeline coating for up to a total of 5 mi of pipeline that would potentially require excavation dewatering over a 30-year period;
- Draining secondary containment structures along the TAPS ROW;
- Discharging hydrostatic-test water;
- Maintaining workpad slopes;
- Removing sand, gravel and quarry rock from borrow sites for workpad repairs, road bedding and surface materials, and flood damage control and revetment projects at a rate of about 100,000 yd^3 per year;
- Repairing, replacing, and installing river training structures;
- Using surface water for drinking, cooking, and personal hygiene at manned facilities; equipment washing; dust abatement on roads and workpads; hydrostatic testing; MCCFs; and other special projects (see Section 3.7.2.3); and
- Discharging wastewater to land at PS 5 and MCCFs.

For those activities involving dewatering of excavations made to repair corrosion problems, the maximum release of water would be 250,000 gal per event (but not to exceed 500,000 gal per year total). This volume of water is independent of the three pipeline throughputs evaluated for the proposed action (0.3 million, 1.1 million, and 2.1 million bbl/d [see Section 4.2]). As discussed in Section 3.7.2.5, water discharge from dewatering operations has been regulated through various permits, beginning with a State of Alaska wastewater discharge permit in 1983. The current linewide permit requires notification, volume estimates, and descriptions of procedures used to minimize erosion and the discharge of pollutants (see Section 3.16.4). Between 1993 and 1999, 12 such releases were made to water; the total volume of water released was approximately 1 billion gal, with a maximum annual discharge of 800 million gal in 1996 in 25 separate activities (TAPS Owners 2001a), including dewatering excavation sites. In 1997, more than 600 secondary drainage structures along the ROW were drained. The total volume of water released was 15,678,000 gal. Most of this water came from early summer dewatering of the tank farm at PS 1, where the secondary containment volume is the greatest. Because these releases have had only local and temporary impacts on surface water resources along the TAPS ROW (see Section 3.7.2.5), continued operation of the pipeline would be expected to produce similar impacts.

Cathodic Protection

Cathodic protection is reduction of the corrosion rate by shifting the corrosion potential at the electrode (pipeline) toward a less oxidizing potential by applying an external electromotive force (DC power supply).

The continued discharge of hydrostatic-test water to the environment could also have adverse impacts on surface water resources. Those impacts are expected to be independent of the pipeline throughput. In 1991, 3.8 million gal of test water was released when more than 8 mi of the pipeline was reconstructed because of corrosion concerns in the Atigun River valley (see Section 3.7.2.5). This water was released under the linewide NPDES permit. If released at a constant rate, the discharge would have been be approximately 7 gal/min. (Flow in the nearby Atigun River has a mean annual value of about 29,000 gal/min [USGS 2002a].) The actual rates of release are not known, but are expected to have been somewhat higher than the 7 gal/min average cited above because of seasonal effects (e.g., hydrostatic testing may not occur during the winter), and gravity evacuation may be required. Because the impacts of this release have been small relative to typical stream flows, future impacts from such activities under the proposed action would be expected to be similar — local and temporary.

The activities discussed above could also affect surface water resources by modifying runoff from workpads during slope maintenance. As discussed in Section 3.7.2.5, storm-water runoff is regulated under the EPA Storm Water Multi-Sector General NPDES Permit. Compliance with this permit guarantees that storm-water runoff will have no significant adverse impact on the environment. Similarly, construction activities that disturb more than 5 acres, do not involve excavation dewatering, and have a potential to impact waters of the United States are regulated under the NPDES Permit for Storm Water Discharge from Construction Activities Associated with Industrial Activity. Specific notices of intent must be submitted to the EPA, and regulations must be followed for projects that meet the criteria for coverage under the permit. Historically, there is no evidence that storm-water runoff from workpads or other areas has produced any measurable harm to the environment. Because continued operation of the pipeline would produce impacts similar to those observed historically, the impacts would be expected to be similar.

During continued operations under the proposed action, approximately 100,000 yd^3 of sand, gravel, and quarry rock would be removed each year from borrow areas near the TAPS ROW. Most of these materials would probably be obtained from the 69 OMSs on public lands for which APSC has mining permits (TAPS Owners 2001a). Removal operations could cause erosion and siltation that could affect surface water resources. Historically, these impacts have been local and temporary. Because the removal rates under the proposed action would be similar to those of the past, their impacts on surface water resources would be expected to be similar.

Proposed action activities could also impact surface water resources through modification of water bodies during repair, replacement, or installation of new river training structures. Erosion and sedimentation in streams and rivers are discussed in Section 3.7.2.1. Although river training structures and their maintenance can impact the associated streams, these impacts are limited to the immediate vicinity of the structure and are temporary, particularly in braided river systems that have very fast and large natural dynamic changes (see Section 3.7). Because continued operations would produce similar impacts to those observed historically, the impacts would be expected to be similar.

Surface water resources along the TAPS ROW could also be affected by the continued use of surface water for drinking and cooking at manned facilities (including pump stations, MCCFs, and other TAPS facilities), equipment washing, dust abatement on roads and workpads, hydrostatic testing, and other special projects (see Section 3.7.2.3). Historically, water use along the ROW has supported a wide variety of pipeline throughputs, ranging from a high of about 2 million bbl/d (maximum capacity of 2.1 million bbl/d) to the current value of about 1.1 million bbl/d of oil (TAPS Owners 2001a). The largest single project for which a temporary water-use permit was issued occurred in 1997. That permit allowed the use of 7.4 million gal of water for tank cleaning and testing at PS 1. This water was withdrawn from East Lake and produced a small, local, and temporary effect. Similar temporary water-use permits have been issued on an as-needed basis. These activities have all produced small and local impacts along the ROW. Because continued operation of the pipeline under the proposed action would use quantities of water similar to or less than those used historically (less water would be required for a 0.3 million bbl/d throughput of oil because some pump stations would be shut down), impacts to surface water resources would be expected to be similar.

Finally, surface water resources along the TAPS ROW would be affected by discharging treated domestic wastewater at PS 5 and other MCCFs. As discussed in Section 3.7.2.5, spreading treated wastewater and other release water at MCCFs is regulated under the linewide NPDES permit and the Wastewater General Permit. These impacts have been local and small because of large potential dilution in receiving waters. The impacts are, however, not temporary because they have continued through time. Under the proposed action, discharging treated wastewater to land would continue at approximately the same level as observed historically or increase slightly if stack injection is not possible under low throughputs. Therefore, the associated impacts would be expected to be similar.

4.3.6.2 Surface Water Impacts on the TAPS Pipeline

Historically, surface water has directly affected the TAPS ROW, requiring continued surveillance, regular maintenance, and rapid mitigation response to acute events. As discussed in Section 3.7.2.1, rivers and streams crossed by the pipeline are subject to floods, erosion, debris flows, and sedimentation. In extreme cases, maintaining the integrity of the pipeline required very rapid response and immediate implementation of appropriate mitigation activities. For example, installation of river control structures was required to protect the pipeline from release flows on the Tazlina River in 1997, the August 1992 flood on the Sagavanirktok River, and the very high flows on the Dietrich/Middle Fork/Koyukuk river systems in 1994 (TAPS Owners 2001a). The TAPS crosses many rivers and streams and is located extensively in floodplain areas. The probability of floods along the TAPS ROW is high, as is the need for maintenance and surveillance. However, because of contingency planning, continued surveillance, and timely mitigation, long-term impacts to the pipeline and the environment for the proposed action would be similar to those that have previously occurred (see Section 3.7 for a discussion of these historic impacts).

Surface Water Impacts on the TAPS Pipeline under the Proposed Action

For the proposed action, the pipeline would remain subject to the impacts of flooding, debris flows, erosion, and sedimentation. Historically, rapid response and immediate implementation of appropriate mitigation activities have been used to prevent or minimize damage to the pipeline from these natural processes. Contingency planning, continued surveillance, and timely mitigation would continue to be used in the future, and impacts for the proposed action would be similar to those that have previously occurred.

In order to minimize impacts to the pipeline from flowing water, erosion, and sedimentation, the following remediation methods have been implemented (see Section 3.7.2.1):

- Adding spur dikes,
- Constructing revetments, and
- Armoring by adding riprap and gabion guidebanks.

For the proposed action alternative, the pipeline would remain subject to the impacts of flooding, debris flows, erosion, and sedimentation. The magnitude of these impacts would be independent of the throughput of oil in the pipeline. If the historical mitigation procedures and strategies continued to be followed, the long-term impacts of these processes on the pipeline would be expected to be similar to those seen historically.

4.3.7 Groundwater Resources

Direct and indirect impacts to groundwater resources along the TAPS ROW could occur during normal operations and during postulated accidents for the proposed action. The impacts of normal operations are discussed below. Direct and indirect impacts from accidental releases are discussed in Section 4.4.4.4.

The continued presence of the pipeline and its maintenance for the next 30 years would provide impacting factors on groundwater resources along the TAPS ROW. Both direct and indirect impacts would be anticipated. Specific direct impacting factors anticipated for the proposed action include use of groundwater for TAPS activities and melting of permafrost along buried sections of the pipeline. These factors could affect the quantity, location, and quality of groundwater resources along the ROW. Indirect impacting factors for the proposed action include the first five items listed as impacting factors in Section 4.3.6.1 plus the following additional activities:

- Operating machinery to remove sand, gravel, and quarry rock from borrow sites, and
- Disposing of sanitary wastewater in septic fields at PS 6 (Fly Camp), 7, 9, 10, and 12 and discharging sanitary waste to land at PS 5, MCCFs, and at the Valdez Marine Terminal.

Impacts of Proposed Action on Groundwater Resources

Under the proposed action, two processes could produce direct impacts to groundwater resources: (1) pumping water for drinking, cooking, personal hygiene, equipment washing, dust abatement, and hydrostatic testing and (2) moving warm oil through sections of the pipeline that are buried in permafrost. Because the anticipated use of groundwater would be about the same as that used historically for TAPS operations, impacts of pumping would be similar. Melting of permafrost along the ROW could change the number and size of thaw bulbs, depending on the throughput of the pipeline. However, the range of variation in the number and size of thaw bulbs is expected to remain within the historical range observed. Any changes in thaw bulbs would be local and small (less than about 60 ft in diameter).

Indirect impacts to groundwater resources could occur through infiltration of contaminated surface water. Historically, during TAPS operations, groundwater impacts from surface contamination has been local because of the presence of permafrost that limits deep percolation, the assimilation properties of the groundwater, and adherence to guidelines specified in the linewide NPDES permit. Because the activities associated with the proposed action would produce impacts similar to those observed historically, the magnitude of the impacts would also be similar. In addition, under current operations, septic fields have been used to dispose of sanitary wastewater at PS 7, 9, 10, and 12. Impacts to groundwater from these systems have been local and have not affected other groundwater users along the TAPS ROW. Continued operation of the TAPS would be expected to produce similar impacts at these septic fields.

These surface activities would have no impact on the quantity of groundwater, but they could indirectly affect its quality through infiltration of contaminants. Because there are no direct releases to groundwater along the TAPS ROW and none are planned for the future for these activities, there would be no direct groundwater impacts to water quality under the proposed action.

As discussed in Section 3.8, pipeline operations have required fresh water for drinking, cooking, and personal hygiene at manned facilities; equipment washing; dust abatement on roads and workpads; and hydrostatic testing. Potable water use at pump stations has averaged about 100 gal/d per person (TAPS Owners 2001a). At the pump stations and camps, most of this water has been obtained from 25 existing wells, 6 of which are currently active (Table 3.1-1). The reported capacities of all these wells are small, ranging from 20 to 75 gal/min (Table 3.1-1). For the proposed action, groundwater use along the TAPS ROW would continue at about the same rate as has occurred historically, and regular water-quality monitoring would continue to ensure that the water meets applicable State of Alaska regulations (18 AAC 80). Because the historical impacts of groundwater use have been negligible and local, impacts of the proposed action would be expected to be similar when compared with other users along the ROW (e.g., the city of Fairbanks).

During normal operations, warm oil flows in the pipeline through regions of permafrost, transferring heat to the ground. In some areas (e.g., at PS 3), the permafrost has melted and formed thaw bulbs of groundwater (see Section 3.8). Under the proposed action, oil would continue to flow through the pipeline and maintain the presence of thaw bulbs. However, the size and number of thaw bulbs present along the ROW would depend on the throughput volume of oil and its temperature. Higher flow rates favor an increase in the number and size of the thaw bulbs; lower flow rates lead to a reduction in the size and number of thaw bulbs. Similarly, an increase in the temperature of the oil can increase the size and number of thaw bulbs. For the proposed action, the temperature of the oil is expected to be about the same as past operations, although that temperature has decreased with time as colder crude streams have been transported through the pipeline. For analysis, three levels of the oil throughput have been assumed: 0.3 million, 1.1 million, and 2.1 million bbl/d. A throughput of 0.3 million bbl/d would decrease the size and number of thaw bulbs. A throughput of 2.1 million bbl/d would increase their size and number. The historical impact of thaw bulb formation on groundwater resources has been small and local. Thaw bulbs are generally very small (up to a diameter of 60 ft [see Section 3.8]), discontinuous, and generally not usable as a source of water. Because the proposed action would not measurably alter the number, size, or degree of connection of thaw bulbs along the ROW, the impacts from permafrost warming on groundwater resources would be similar.

Many surface activities associated with the proposed action would require digging, trenching, removing surface vegetation, grading, and other ground-disturbing activities. Excavations often require the use of heavy equipment for prolonged periods and frequently require dewatering of excavations to complete all of the required tasks. These surface activities can result in contamination of surface water with soluble contaminants that can indirectly contaminate underlying groundwater by infiltration. Historical impacts from such surface activities have been local because of the presence of permafrost that limits deep percolation of the water and assimilation properties of the local groundwater. In addition, all surface releases must be within the guidelines of the linewide NPDES permit, the Wastewater General Permit, and the NPDES Permit for Storm Water Discharge from Construction Activities Associated with Industrial Activity. Because the activities associated with the proposed action would produce impacts similar to those observed historically, indirect impacts to groundwater quality are expected to be similar.

In addition to the indirect impacts from infiltration of contaminated runoff water, groundwater quality can be impacted by sanitary water from the conventional septic systems used to treat wastes at PS 6 (Fly Camp), 7, 9, 10, and 12 and by landspreading of wastewater at

PS 5 and temporary MCCFs. As discussed in Section 3.8, the capacities of these septic fields are small (3,400, 1,000, 12,000, and 9,100 gal, respectively [Mikkelsen 1997]), and disposed water is in compliance with ADEC regulations. The septic fields at PS 7, 9, 10, and 12 would be nearing their typical useful life in the next 10 years and would be replaced, if necessary (TAPS Owners 2001a). Because the historical impacts of using the septic fields and of landspreading on groundwater resources have been local and have not affected any other groundwater users along the ROW, impacts of continued operation would be expected to be similar.

4.3.8 Physical Marine Environment

Potential direct and indirect impacts of the proposed action on physical marine resources are discussed in this section. The areas considered are Port Valdez, Prince William Sound, and other nearby locations that could be affected. Direct impacts are impacts that would be caused by the proposed action and occur at the same time and place. Indirect impacts would also be caused by the action, but they would occur later in time or would be located farther in distance from the action. Impacts are evaluated for 30 years of continued operation. See Section 4.4.4.5 for a discussion of potential accidental releases under the proposed action.

4.3.8.1 Discharges from the Valdez Marine Terminal

Materials discharged to the water during the continued operation of the Valdez Marine Terminal and its associated tanker operations for the next 30 years could impact physical marine resources. These discharges can be divided into the following categories: industrial wastewater, domestic sanitary wastewater, and storm water. Regulatory permits govern the type, quantity, and methods of treatment or best management practices applicable to each wastewater discharge, as discussed in Section 3.16.4.

Impacting factors include contaminants in the treated industrial wastewater and domestic sanitary sewage, and contaminants and sediments in overland storm-water runoff. Normal maintenance and construction activities under the proposed action could result in increased sediment loads in the Valdez Marine Terminal runoff during construction. These increases would end with the completion of the activity that could potentially cause them.

Discharges from the Valdez Marine Terminal

Materials discharged to the water during the continued operation of the Valdez Marine Terminal and its associated tanker operations for the next 30 years could impact physical marine resources.

Impacts from Valdez Marine Terminal releases resulting from normal operations under the proposed action would not be expected to be different from historical impacts and could decrease with decreasing throughput.

Under the proposed action, the Valdez Marine Terminal would continue to treat and release industrial wastewater, domestic sanitary wastewater, and storm water to Port Valdez. Section 4.3.12.5 provides details on the anticipated releases. Under the proposed action, effluent volumes released from the terminal to Port Valdez would be expected to remain largely unchanged, except for treated ballast water. That treated water would be expected to decrease in volume over time. Ballast and bilge waters currently account for as much as 93% of the influent to the BWTF (TAPS Owners 2001a). Reduced throughput of oil would reduce the number of tanker visits to the Valdez Marine Terminal, and segregation of ballast water in new tankers would reduce the average volume of wastewater treated on a per tanker basis (TAPS Owners 2001a).

The total BWTF effluent flow for the year 2000 was 3,785,050,000 gal or approximately 10.3 million gal/d (see Appendix C), with historical maximum monthly volumes of about 15 million gal/d. On the basis of data on existing tanker ballast water volumes, reduced future throughput, and the replacement of current tankers with tankers that have segregated ballast water, the estimated future discharges from the BWTF range from a high of 10 million gal/d to a low of 3.5 million gal/d (TAPS Owners 2001a), as shown on Figure 4.3-1. Reductions in volume would occur during the first 10 years of continued operation; after this period, volumes would stabilize.

Historically, pollutant loading of the effluent from Valdez Marine Terminal decreased over time as new treatment technologies were implemented at the BWTF. This trend should continue as a result of potential treatment changes and reduced volumes treated. Discharges are expected to continue to comply with all applicable regulations. Reduced volumes and reduced loadings would increase the residency time of the wastewater in the BWTF, resulting in slightly more degradation in the biological treatment tanks (TAPS Owners 2001a). These reduced volume and waste loadings may require adjustments to the operation of the BWTF. However, the maximum capacity and potential maximum flow rate of the BWTF are expected to remain the same (TAPS Owners 2001a).

No changes would be expected in the volumes or composition of domestic sanitary sewage or storm-water runoff as a result of the proposed action (TAPS Owners 2001a).

Normal maintenance and construction activities could result in increased sediment loads in the runoff from the Valdez Marine Terminal. These impacts could be minimized by following standard construction practices and stipulations of required construction permits. These impacts would cease with the completion of the construction activity.

Impacts from releases from normal operations at Valdez Marine Terminal under the proposed action would not be expected to be different from historical impacts, which were small and local, and could decrease with decreasing throughput.

4.3.8.2 Trace Elements

Under the proposed action, no increase in releases of trace elements to Port Valdez or Prince William Sound would be expected from normal operations. Changes due to decreased tanker traffic and decreased volumes released from the BWTF could potentially lower the amount of trace elements released. However, discharges would continue. Impacts from trace elements resulting from normal operations under the proposed action would not be expected to be significantly different from those resulting from historical operations (see Section 3.11.2).

4.3.8.3 Hydrocarbons

Under the proposed action, the only hydrocarbon discharges to the physical marine environment expected from normal operations are addressed in Section 4.3.8.1, with the exception of very small releases that could accompany the normal operation of the tanker fleet and the SERVS. No increase in these discharges from historical levels would be expected under the proposed action; in fact, the potential for impacts should decrease with the reduction in throughput and tanker traffic.

4.3.8.4 TAPS-Associated Marine Transportation

Factors associated with normal tanker operations that could affect physical marine resources include small hydrocarbon emissions addressed above and the physical transit of tankers through Prince William Sound, into Port Valdez, and docking at the Valdez Marine Terminal. The berths at the Valdez Marine Terminal are in deep water, and sediment studies in Port Valdez have not noted any significant impacts to the benthic sediments from normal tanker operations (Hood et al. 1973; Gosnik 1979; Colonell 1980; Feder and Shaw 2000; TAPS Owners 2001a). Transit of the tankers through Prince William Sound under normal operations also has not resulted in any observed impacts on physical marine resources.

It is estimated (Folga et al. 2002) that the number of tanker visits to the Valdez Marine Terminal will decrease from 496 in 2004 to 82 in 2034. Accordingly, any impacts from normal tanker operations under the proposed action would decrease over the course of the proposed action.

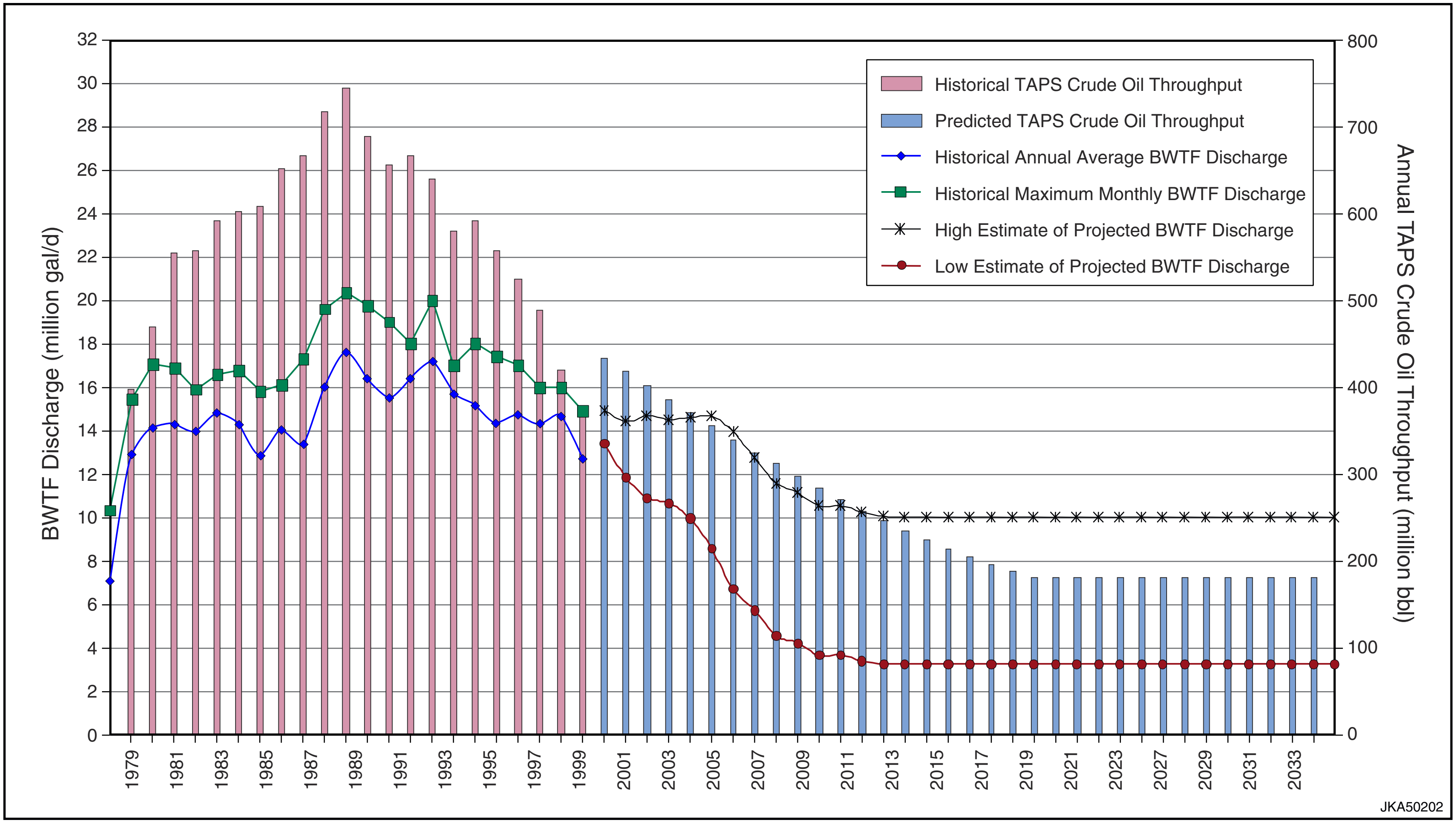

FIGURE 4.3-1 Historical and Projected Flows from the Ballast Water Treatment Facility Discharge and TAPS Throughput (Source: TAPS Owners 2001a, Figure 4.3-15)

4.3.9 Air Quality

Impacts of Proposed Action on Air Quality

The potential impacts on air quality and air-quality-related values (AQRVs) (visibility and acid deposition) from emissions associated with TAPS activities under the proposed action have been estimated. Maximum concentrations of criteria pollutants are estimated to be below applicable standards. Hazardous air pollutant emissions from TAPS are estimated to contribute little to the ambient concentrations in residential areas, except in the residential areas of Valdez, where the emissions from Valdez Marine Terminal are estimated to contribute up to about 10% of HAPs exposures to the residents. Carbon dioxide emissions from TAPS would add little to the global CO_2 concentration level. Water vapor emissions from TAPS and associated facilities and activities would not contribute noticeably to ice fog problems. Analyses for specific TAPS sources did not predict any adverse visibility impacts. The impacts of TAPS facility emissions on acidic deposition would be minor.

The potential impacts on air quality and air-quality-related values (AQRVs) in the vicinity of TAPS facilities that would result from emissions associated with TAPS operation and maintenance activities under the proposed action are discussed in this section. The discussion includes estimates of emissions (criteria pollutants, hazardous air pollutants [HAPs], and CO_2) and of impacts on ambient air quality, visibility and acid deposition, the primary AQRV of interest, and on global CO_2 concentration level. The discussions focus on emissions from pump stations and the Valdez Marine Terminal facilities. Potential impacts are evaluated for three levels of TAPS operation in terms of crude oil throughput — 0.3, 1.1, and 2.1 million bbl/d. Because of the large distances separating each of the TAPS facilities,[1] emissions from one facility would have little or no air quality and AQRV impact on areas in the vicinities of other facilities. Therefore, potential air quality and AQRV impacts are discussed for specific pump stations or the Valdez Marine Terminal, as appropriate.

Potential air quality and AQRV impacts due to emissions resulting from accidental release or spills of crude oil and petroleum products during the period of TAPS operation and maintenance under the proposed action are discussed in Section 4.4.4.6.

The potential system upgrades under the proposed action are described in Section 4.2.2.6.3. The system upgrades that would affect emissions from existing TAPS facilities and TAPS-related activities include (1) replacement of existing fuel-gas-fired turbine pumps with more efficient units at PS 1, 3, and 4 or with electric motor-driven units at PS 7, 9, and 12 and (2) removal of all pump-station-related infrastructure at currently ramped down PS 2, 6, 8, and 10. Because of the preliminary nature of these proposed upgrades, information necessary for detailed air quality impact assessment is not yet available. However, all of these system upgrades would result in reduced long-term emissions from these emission sources and, consequently, reduced air quality impacts. Although there would be air quality impacts due to emissions released from construction-related activities associated with the upgrades, they would be local and short-term and are estimated to be small.

4.3.9.1 Criteria Pollutants

Existing emission sources at 11 pump stations (PS 1 through 10 and PS 12) and at the Valdez Marine Terminal are listed in Tables 3.13-1 and 3.13-2, respectively, and potential emissions of criteria pollutants from these facilities are listed in Tables 3.13-3. Relative significance of the emissions from TAPS facilities in comparison with emissions from other major emission sources in the vicinity of each TAPS facility is shown in Table 3.13-4. A summary of available ambient air quality monitoring data in the vicinity of TAPS facilities, modeled air quality concentration increases due to emissions from TAPS facilities, and estimated

1 The minimum distance between two adjacent TAPS facilities is about 32 mi between PS 3 and PS 4.

total ambient air quality concentrations that include both the TAPS facility contributions and background concentrations is presented in Table 3.13-9. Trends in ambient concentrations of selected criteria pollutants in the Prudhoe Bay area during a 14-year period are described in Table 3.13-10.

Air quality impacts of potential emissions (maximum emission levels allowed under ADEC operating permits) of TAPS facilities have been estimated through air quality modeling performed under the protocols approved by ADEC for PS 2 (APSC 1990a), PS 7 (APSC 1990b, 1991), PS 8 through 10 and PS 12 (APSC 1991), a generic pump station (APSC 1997), and Valdez Marine Terminal (Fluor and TRC 1995). All of the estimated maximum ambient concentrations (including TAPS facility contributions and background concentrations) are below applicable ambient air quality standards (as shown in Table 3.13-8). The maximum ambient concentrations are estimated to occur within very short distances from emission sources. For example, maximum ambient concentrations modeled for criteria pollutant emissions from the generic pump station are estimated to occur within a distance of about 0.4 mi or less from the central location of emission sources at the pump station.

Because the emissions from these facilities are not allowed to exceed the potential maximum emission levels specified in the ADEC operating permits under all operating conditions (Table 3.13-3), the estimated maximum ambient concentrations presented in Table 3.13-9 reflect the potential air quality impacts of TAPS facilities for the maximum capacity throughput of 2.1 million bbl/d. For 1.1 million bbl/d throughput, the levels of TAPS facility equipment operation and other activities that result in emissions would be mostly lower than the levels under the conditions of 2.1 million bbl/d throughput, although some may remain the same. Therefore, potential air quality impacts of operating TAPS facilities under the conditions of 1.1 million bbl/d throughput would be lower than or at most equal to the potential impacts estimated for the conditions of 2.1 million bbl/d throughput. Under the conditions of 0.3 million bbl/d throughput, potential impacts could be even lower.

Fuel-combustion sources at PS 1 through PS 4 are currently burning fuel gas produced in the North Slope area, although they are designed to use both liquid and gas fuels. The hydrogen sulfide (H_2S) content of the fuel gas consumed at the North Slope facilities and PS 1 through PS 4 has steadily increased from less than 10 ppm in the early years of operation to 22 ppm in 2001. Even if the H_2S content of fuel gas from the North Slope area increases in the future substantially above the current levels (e.g., to 100 ppm), SO_2 emissions from burning such fuel gas would be only about one-eighteenth (5.6%) the SO_2 emissions from burning liquid fuel with a sulfur content of 0.3%, the level assumed for the calculation of SO_2 emissions from liquid fuel combustion in the air quality impact modeling performed for the generic pump station described above. Therefore, potential impacts on ambient SO_2 concentrations in the vicinity of PS 1 through PS 4 would be lower than those listed in Table 3.13-8 for the generic pump station as long as fuel gas is consumed, even if H_2S content increases substantially above the current levels.

The Fairbanks and North Pole areas are the only air quality nonattainment areas (with respect to CO) near the TAPS ROW. These CO nonattainment areas are located about 20 mi northwest of PS 8 and 33 mi south-southeast of PS 7. The estimated maximum increases in 1-hour and 8-hour average concentrations of CO from the generic pump station are estimated to be about 550 and 230 $\mu g/m^3$, respectively, corresponding to about 1 and 2% of applicable ambient air quality standards of 40,000 and 10,000 $\mu g/m^3$, respectively. Because these maximum CO concentration increases are estimated to occur within about 0.4 mi or less from the pump station, potential CO emissions from PS 8 or PS 7 would have little or no impact on the nonattainment area located more than

Nonattainment Area

A nonattainment area is any area designated by EPA as not being in compliance with a specific ambient air quality standard.

20 mi away from these pump stations. The ancillary TAPS maintenance and administrative facilities located within the Fairbanks nonattainment area would, under the proposed action, have continuing activities similar in scope and operation to current activities, which have little or no impact on the air quality in the nonattainment area. Therefore, no formal conformity analysis or determination is required.

As in the last 25 years of TAPS operation, continued operation of TAPS in the next 30 years would also entail certain construction activities associated with required repair and maintenance and system upgrades. Future levels of these construction activities are estimated on the basis of recent history. Over the past 5 years, excavations of main-line pipe to repair corrosion problems have averaged 14 digs per year. It is estimated this level of activity may continue or possibly increase to 20 digs per year over the next 30 years. However, it is also possible that the number of pipeline excavations may remain constant or possibly decline, depending on the performance of the new impressed-current cathodic-protection system installed along the pipeline (TAPS Owners 2001a). The principal sources of emissions associated with such construction activities would include (1) fugitive dust from land clearing and site preparation, excavation, wind erosion of exposed ground surfaces, and operation of a concrete batch plant (if needed); and (2) exhaust from and road dust raised by construction equipment; vehicles delivering materials for construction, repair, and system upgrades; and vehicles carrying construction workers. Even at the level of 20 digs per year, the sites of excavation would be scattered over the 800-mi length of TAPS ROW, and, therefore, emissions from one excavation site are not likely to have any measurable impacts on the air quality of the areas in the vicinity of other excavation sites.

The largest construction project performed since the beginning of TAPS operation was replacement of approximately 8.5 mi of TAPS main pipeline in the upper Atigun River floodplain between MP 157 and 166. Pipeline construction activities, beginning with trenching and ending with replacement of soil, lasted for about 4 months. Evaluation of potential air quality impacts conducted as a part of a comprehensive environmental impact evaluation of the project concluded that potential air quality impacts for the short-term project with all planned mitigation measures implemented would be minor, and no applicable ambient air quality standards would be violated (JMM 1990).

Construction projects anticipated during the next 30 years of TAPS operations could be larger or smaller than the Atigun Pass pipeline replacement project. Any sizable construction projects similar to the Atigun Pass project would have to be evaluated with respect to their potential environmental impacts, including air quality impacts, and mitigation measures would be required so that no significant air quality impacts would occur.

4.3.9.2 Hazardous Air Pollutants

Potential emissions of HAPs from the 11 pump stations and Valdez Marine Terminal are listed in Table 3.13-6. Common sources of HAPs at TAPS facilities include vapor releases from crude oil tanks, stack releases from combustion equipment, and equipment leaks. Crude oil tanks at PS 1 and Valdez Marine Terminal are storage tanks and those at the remainder of the pump stations are breakout tanks (Tables 3.13-1 and 3.13-2). Vapor releases from crude oil storage tanks at PS 1 are flared (burned off as they are vented), while those at Valdez Marine Terminal are collected and incinerated. Vapor releases from crude oil breakout tanks[2] at other pump stations are emitted directly into the atmosphere. In addition to these common sources, Valdez Marine Terminal has unique HAPs emission sources — the BWTF system and tankers being loaded with crude oil at berths that are not connected to the

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2 A breakout tank is defined as a tank used to (1) relieve surges in a hazardous liquid pipeline system or (2) receive and store hazardous liquid transported by a pipeline for reinjection and continued transportation by pipeline (49 CFR 195.2). In this definition, hazardous liquids include petroleum, petroleum products, or anhydrous ammonia.

vapor collection system. As can be seen in Table 3.13-6, potential HAPs emissions from individual pump stations are less than about 9% of those from Valdez Marine Terminal. Therefore, ambient HAPs impacts due to emissions from individual pump stations are estimated to be only small fractions of those due to the emissions from Valdez Marine Terminal.

Data on ambient concentrations of six HAPs collected at four monitoring sites in the Valdez area are listed in Table 3.13-11. The data were collected for a one-year period (November 1990 through October 1991) when the TAPS average crude oil throughput was about 1.8 million bbl/d and before the installation of the tanker vapor recovery system at Valdez Marine Terminal in March 1998.

It was estimated that recovery of VOCs by the tanker vapor recovery system and subsequent destruction of collected VOCs in incinerators or power boiler furnaces would result in elimination of about 27,600 tons per year of VOCs containing the above-mentioned HAPs (Fluor and TRC 1995), about eight times the current estimate of potential VOC emissions from Valdez Marine Terminal. Furthermore, the on-going process of replacing the existing single-hulled tankers being used to transport the oil to the West Coast with double-hulled tankers is projected to be completed by the year 2013 (GAO 1999). Use of double-hulled tankers makes it possible to segregate ballast water and would reduce the average volume of ballast water (on a per tanker basis) to be treated in the BWTF at Valdez Marine Terminal before discharge to Prince William Sound. This treatment process is a main source of HAPs emissions at Valdez Marine Terminal. Therefore, it is estimated that current ambient HAPs concentrations in the vicinity of Valdez Marine Terminal, even under the conditions of 2.1 million bbl/d throughput, would be substantially lower than those monitored during the 1990-1991 period. Ambient HAPs concentrations are expected to continue to decrease until 2013, when the tanker conversion process is expected to be complete. Under the conditions of 1.1 or 0.3 million bbl/d, the ambient HAPs concentrations in the vicinity of Valdez Marine Terminal would be even lower.

Potential health effects due to exposures to HAPs emitted from TAPS facilities under the proposed action are discussed in Section 4.3.13.2.2. Potential impacts of accidental oil spills on ambient HAPs concentrations are discussed in Section 4.4.4.7.

4.3.9.3 Other Pollutants

Emissions of ozone-depleting substances (ODSs), which also act as greenhouse gases, released from the TAPS in recent years are listed in Section 3.13.1.3. The small amounts of annual ODSs currently released from the TAPS would be further reduced gradually during the 30-year renewal period under the proposed action because the production of these substances was phased out in 2000, and they are being replaced as industry develops suitable substitutes. Thus, TAPS operations during the renewal period would contribute little to the depletion of stratospheric ozone.

Potential emissions of CO_2, a greenhouse gas, from the TAPS were estimated to be a very small fraction of global CO_2 emissions (Section 3.13.1.3). Carbon dioxide emissions from the TAPS during the 30-year renewal period under the proposed action would be smaller than the current level because less fossil fuel would be used after the potential TAPS system upgrades (Section 4.2.2.6.3) were implemented. Less fossil fuel would be used because the system upgrade would (1) replace fuel-gas-fired turbine pumps with more-fuel-efficient units at PS 1, 3, and 4 or with electric motor-driven units at PS 7, 9, and 12 and (2) remove all pump-station-related infrastructure, including fuel-burning equipment, at currently ramped-down PS 2, 6, 8, and 10. Therefore, TAPS CO_2 emissions during the renewal period would contribute little to the global CO_2 concentration level.

4.3.9.4 Visibility

Information on heavy fogs restricting visibility at the six National Weather Service stations along the TAPS ROW and on visibility impairment due to ice fog in the Fairbanks/North Pole area is presented in Section 3.12.4, and information on visual range at the Denali

National Park, a PSD Class I area where visibility is an important value, is presented in Section 3.13.2.3. The following information discusses potential impacts of continued TAPS operation on these environmental factors.

4.3.9.4.1 Impacts on Ice-Fog-Prone Areas. During the winter, at ambient temperatures of –20°F or colder, water vapor emitted from equipment and vehicle operations at TAPS facilities has a potential to contribute to periodic ice fog episodes that cause serious visibility problems in areas prone to ice fog.

Among all TAPS facilities, PS 1 may have the highest potential for impacts on ice fog episodes. However, its contribution of water vapor to the North Slope area is minor by itself, as well as in comparison with emissions from most other major facilities in the area. (The contribution of water vapor emissions from PS 1 can be estimated from the emission rates of combustion-related pollutants from PS 1 and those from the area's major facilities, as provided in Table 3.13-4.)

Pump Station 8, which currently is in rampdown mode operation, also has some potential to contribute to ice fog problems in the Fairbanks/North Pole area when winds are from the southeast. PS 8 is located about 20 mi southeast of the Fairbanks/North Pole area. However, prevailing winds in the Fairbanks/North Pole area are from the north to northeast; winds from the southeast quadrant are the least frequent (Map 3.12-3). In addition, the water vapor emitted from PS 8 would have dissipated to a negligible level by dispersion while being transported over a distance of 20 mi to the Fairbanks/North Pole area. Therefore, potential impacts of water vapor emissions from PS 8 to the ice fog problem at the Fairbanks/North Pole area are estimated to be negligible.

Pump Station 7 is located too far from the Fairbanks/North Pole area (33 mi north-northwest) to have any noticeable impacts on the ice fog problem in that area. All other stations are sufficiently distant from ice-fog-prone areas that they would not contribute noticeably to periodic ice fog episodes.

The above assessments of potential impacts of TAPS facility operations are relevant to the conditions of 2.1 million bbl/d throughput. Under the conditions of 1.1 million bbl/d throughput, such potential impacts would be even smaller, because fuel consumption, and consequently water vapor emissions, would be smaller in general at all TAPS facilities, in particular at PS 8, which would be in rampdown mode operation. Under the conditions of 0.3 million bbl/d throughput, potential impacts could be even lower still.

4.3.9.4.2 Impacts on Visibility-Sensitive Areas. Visibility impact analyses have been performed for potential impacts of (1) the emissions from PS 2 and PS 7 on visibility at Denali National Park, the PSD Class I area nearest to these pump stations (about 378 mi south of PS 2 and about 95 mi south-southwest of PS 7) (APSC 1990a,b), and (2) the emissions from the tanker vapor recovery project at Valdez Marine Terminal on visibility at Tuxedni National Wilderness Preserve, the PSD Class I area nearest to Valdez Marine Terminal (about 200 mi to the west), Wrangell-St. Elias National Park and Preserve, a sensitive Class II area nearest to Valdez Marine Terminal (about 55 mi to the east), and a second Class II area location frequented by recreational vehicle users approximately 3 mi east of the main emission sources of Valdez Marine Terminal (Fluor and TRC 1995). These analyses predicted that the emissions from these TAPS sources would not cause any adverse visibility impacts at the specified Class I and sensitive Class II areas.

4.3.9.5 Acid Deposition

Information presented in Section 3.13.2.4 on acid deposition at the two NADP acid deposition monitoring sites in Alaska (Poker Creek and Denali National Park and Preserve) indicates that acid deposition rates in Alaska are very low and have shown a trend of decreasing sulfate and no significant change in nitrate over the last 20 years.

Potential emissions of SO_2 and NO_x, the primary precursors of acidic species, from TAPS facilities are only small fractions of Alaska's total emissions (Table 3.13-4). Therefore, it is estimated that the impact of TAPS facility emissions on acidic deposition at the sensitive receptors near TAPS facilities would be minor.

4.3.10 Noise

Section 3.14 describes the existing noise sources at TAPS facilities, levels of noise generated by these sources, and ambient noise levels in adjacent areas. Although there are no noise measurement data for the areas inside facility boundary lines and in the immediate vicinity of TAPS facilities, no adverse impacts beyond facility boundary lines due to noise from existing stationary TAPS facility sources are known. Some disturbances to wildlife caused by noise from air traffic, particularly helicopters, during pipeline surveillance overflights have been reported (TAPS Owners 2001a). Additional information on such disturbances to wildlife is provided in Section 4.3.17.2.

Construction activities associated with required repair and maintenance and with future system upgrades for the TAPS under the proposed action would require use of heavy construction equipment and vehicles. They generate noise levels from about 80 to 100 dBA at 50 ft from the source, but these levels would decrease to about 70 dBA or less within 200 to 1,600 ft from the source area, which is the EPA guideline level (in L_{eq}) for protection against hearing loss over a 40-year period.

The noise impacts from TAPS construction and operational activities would not be affected very much by the TAPS crude oil throughput level; therefore, no adverse impacts would be expected during the 30-year renewal period of TAPS facility operation regardless of the level of crude oil throughput.

Noise Impacts of Proposed Action

Noise emitted from TAPS facility operations and maintenance activities under the proposed action is estimated to be barely distinguishable from background noise levels at the towns and residences closest to the site boundaries of each TAPS facility. Potential impacts of noise due to construction activities associated with repair and maintenance and future TAPS system upgrades required under the proposed action would be temporary and decrease to the EPA guideline level for hearing protection or less within 200 to 1,600 ft. Noise from air traffic, particularly helicopters, during pipeline surveillance overflights under the proposed action is expected to cause some disturbances to wildlife in the immediate vicinity of flight paths.

4.3.11 Transportation

Transportation of personnel, materials, and supplies would continue at about the current levels with renewal of the TAPS ROW for 30 more years. Currently, pipeline throughput is approximately 1 million bbl/d. Should throughput drop as low as 0.3 million bbl/d or rise again to near the maximum throughput of 2.1 million bbl/d, maintenance, surveillance, and repair operations on the pipeline itself would continue at near the same level of effort. Lower throughput might result in additional pump stations being put in standby, and higher throughput might result in existing standby pump stations being brought back online. However, neither of these is thought likely at this time. The current transportation infrastructure, as discussed in Section 3.1.2.1, was in place to handle operational requirements at peak throughput levels (2.1 million bbl/d) and, therefore, is adequate to support continued TAPS operations at higher levels of throughput than is currently experienced.

Impacts of Proposed Action on Transportation

The current Alaskan transportation network that supports TAPS operations is an upgraded version of the infrastructure that was in place to handle maximum capacity throughput levels of 2.1 million bbl/d. Thus, the current transportation infrastructure is adequate to support pipeline activities at any anticipated throughput level.

4.3.11.1 Aviation

Aviation plays an important role in TAPS operations. Workers travel to and from PS 1, 3, 4, 5, and 12 by air for one- or two-week shifts. Routine surveillance and mapping operations are conducted from aircraft. Some parts and supplies are shipped by air. Aviation also plays a similar role in North Slope oil field operations. Such operations would be expected to continue if the Federal Grant is renewed.

4.3.11.2 Marine

Some materials and supplies for TAPS operations are received by barge from the Lower 48 States. One example is the drag reducing agent used in the pipeline. Inland waterways are not used in direct support of TAPS operations but are used to supply and maintain emergency oil spill response equipment. In addition, tankers are used to transport the TAPS oil from the Valdez Marine Terminal to refineries and other customers. In 1999, an average of 37 tankers were filled per month at the Valdez Marine Terminal when the pipeline throughput averaged 1.1 million bbl/d (APSC 2001i). This level of activity could increase or decrease with changes in oil throughput if the ROW is renewed.

4.3.11.3 Rail

Railroad transport is used for shipment of some materials and supplies. As an example, the drag reducing agent shipped by barge to Alaska is transported by rail to Fairbanks. On average, about one railcar of drag reducing agent is shipped every two months (Kramer 2001). No major change in this level of activity is anticipated.

Some crude oil from TAPS is sent to refineries in the Fairbanks area. The finished petroleum products are used locally and shipped throughout Alaska. Shipment by rail of refined products from Fairbanks to Anchorage helped petroleum shipments account for nearly one-third of the Alaska Railroad Corporation's revenue in 1999 (ARRC 2000).

4.3.11.4 Road

TAPS operations rely heavily on Alaska's existing roadways. Routine surveillance, maintenance, and repair of the pipeline occur continuously along the pipeline. APSC personnel logged over 11 million mi on service vehicles, excluding construction equipment, in 2001 in the performance of these functions (Norton 2001a).

The bulk of materials and supplies for the pump stations and the Valdez Marine Terminal are delivered via truck shipments. Turbine fuel is shipped approximately once a day (14,000 gal) from the refinery in Valdez to PS 12 in a tractor-trailer tanker and associated pup trailer. However, some arctic grade fuel is received by PS 12 from the refinery in North Pole during the winter months — 93,000 gal in 2001 through October 31 (Kramer 2001). Pump Stations 7 and 9 use more fuel than PS 12 and receive their turbine fuel via truck from the refinery in North Pole. For 2001, as of October 31, consumption of turbine fuel at PS 7 and 9 averaged 21,000 and 35,000 gal/d, respectively (Kramer 2001). The other operating pump stations (PS 1, 3, and 4 [PS 5 is a relief station only]) run off the natural gas fuel line from the North Slope fields.

The Dalton Highway primarily supports TAPS and North Slope operations. The average annual daily traffic on this highway in 1998, 1999, and 2000 was 261 vehicles, 213 vehicles, and 233 vehicles per day, respectively (ADTPF 2001). The level of road traffic for such activities could vary slightly in response to pipeline throughput levels under the proposed action.

The 11 million mi per year traveled by APSC vehicles is a very small percentage, approximately 0.24%, of the miles driven annually in Alaska. In addition, many of these miles are accumulated on TAPS private access roads and along the pipeline workpad. Therefore, TAPS operations have a minor contribution overall to wear and tear on Alaska's highways. Statistics are not available for comparison among industries in the state.

4.3.12 Hazardous Materials and Waste Management

4.3.12.1 Hazardous Materials Management

4.3.12.1.1 Materials Usage. Hazardous material usage in routine TAPS operations is described in Section 3.16.1 and Appendix C. With continuation of TAPS operations, no significant changes would be anticipated with respect to either the types or the amounts of hazardous materials used or the current logistical arrangements for storage or distribution of hazardous materials throughout the TAPS facilities. A detailed description of hazardous materials used in connection with the TAPS is provided in Appendix C.

Administrative controls established within the APSC HAZCORE system would continue to play a pivotal role in controlling hazardous materials usage. Program elements such as review and approval of new hazardous materials being proposed for use, shelf-life monitoring, and material consolidation and redistribution, as well as complementary waste management programs such as recycling and reuse of spent or excess materials, can be expected to maintain the level of hazardous material usage at or near its present condition. More aggressive management practices in these programmatic areas can even be expected to result in an overall decrease in the amounts and types of hazardous materials used. Continued commercial development of nonhazardous or less hazardous alternatives to commonly used solvents and protective coatings can also be expected to result in a decrease in hazardous materials usage as such alternatives are incorporated into APSC work practices.

Most of the hazardous materials used by APSC are readily available and can be expected to remain so into the foreseeable future. One notable exception, however, is Halon 1301™ (bromotrifluoromethane), a chlorofluorocarbon that is used extensively in fire suppression systems at pump stations and at the Valdez Marine Terminal. Halon 1301, a Class I ozone-depleting chemical (ODC), is no longer being produced. Consequently, APSC must rely on its existing stocks as well as its purchase of additional Halon from secondary markets to maintain its fire suppression systems. APSC has modified the fire suppression systems to eliminate or greatly reduce the probability of accidental discharges of Halon.

As availability of Halon decreases, APSC may need to undertake a wholesale redesign of its fire suppression systems in future years and replace Halon with a different fire suppressant that is currently available. It can be reasonably anticipated, however, that there will continue to be a secondary market for any Halon removed from redesigned systems, such that no significant amount of waste Halon is anticipated in association with this transition.

Hazardous Materials Usage and Management under the Proposed Action

Hazardous material usage and management under the proposed action would be similar to current circumstances. The majority of hazardous materials used would continue to be refined petroleum products that serve as fuels for TAPS equipment and vehicles, including aircraft. Waste generation and management under the proposed action would be fundamentally the same as current activities. Hazardous waste would be delivered to out-of-state facilities for treatment and/or disposal. Solid wastes would be managed in APSC-operated or municipal landfills; however, some would be incinerated at pump stations prior to landfill disposal. Industrial wastewaters generated along the ROW (e.g., excavation dewatering) would be managed according to the current linewide NPDES permit. Industrial wastewaters at the Valdez Marine Terminal would continue to be treated in the BWTF and discharged to the Port of Valdez under the authority of the current Valdez Marine Terminal NPDES permit. Domestic and sanitary wastewaters generated at pump stations and at the Valdez Marine Terminal would continue to be managed by stack injection, septic systems, activated biological treatment package plants, or through treatment agreements with nearby municipalities. Minimal amounts of special wastes (e.g., PCBs, asbestos, medical waste, etc.) are expected to be generated and would continue to be managed in accordance with existing procedures and regulations.

It is assumed that any alternative material selected by APSC would conform to the Significant New Alternative Policy published by the EPA.[3] However, numerous circumstantial factors need to be considered before completely acceptable substitutes can be selected for each APSC installation that currently relies on Halon. Such factors include the engineering logistics and limitations of modifying or replacing existing systems to accommodate any new fire suppressant, overall effectiveness of the agent in each application being modified, worker safety, and cost.

Ozone-Depleting Chemicals

Chemicals designated by the EPA as Class I ODCs have the greatest potential to deplete ozone present in the earth's stratosphere. Class I ODCs display ozone-depleting potentials (ODPs), ranging from a high of 10 to a low of 0.02 (a dimensionless value). Halon 1301 has an ODP of 10 (see 40 CFR Part 82, Subpart A, Appendix A). In accordance with the Montreal Protocol, the Clean Air Act Amendments of 1990, and federal regulations, production of Class I ODCs ceased on January 1, 2002. However, the continued use of Halon is still authorized (see Clean Air Act Amendments § 604 and 40 CFR Part 82).

4.3.12.1.2 Impacts of Hazardous Materials Usage. With respect to hazardous materials usage, both direct and indirect impacts can be identified. Direct impacts result from those activities that involve the use of hazardous materials in direct support of pipeline operations (e.g., the use of a heat transfer fluid in a turbine pump or the use of Halon in fire suppression systems). Both APSC employees and contractors conduct such activities.

Indirect impacts result from the use of hazardous materials in essential or ancillary activities (e.g., use of glycol-based antifreeze in both on- and off-road vehicles or aviation fuel for helicopters used in aerial inspections). Contractors conduct many such activities. However, because all hazardous materials usage associated with such activities is centrally controlled, the available operating record as described in Section 3.16.1 and Appendix C indicates the collective impacts of all hazardous material usage in both direct and indirect activities by both APSC employees and operation and maintenance (O&M) contractors.

Some additional contractor activities that involve hazardous material usage are also known to be occurring. Such activities are outside of APSC administrative controls and would result in additional indirect impacts. For example, commercial entities provide transportation and distribution of supplies and fuels. Hazardous materials used to maintain those commercial vehicles and vessels, as well as their fuel consumption, qualify as indirect impacts.

Numerous other services are provided by contractors or commercial businesses on periodic or as-needed schedules. Because such services invariably involve specialized knowledge and equipment or are needed only infrequently, such support services would likely continue to be provided by external resources. These services include such wide ranging activities as servicing of office machines and major infrastructure systems (e.g., building HVAC systems), conducting ecosystem studies, installing and servicing special technologies (e.g., communication and control systems), and conducting special engineering studies and services (e.g., removal and remediation projects involving asbestos-containing building components). Some specialized equipment fabrication, repair, and replacement services also are provided.

The amounts of hazardous materials used by private contractors engaged in such activities are expected to be relatively small, and no effort has been made to quantify the materials used or subsequent impacts. (However, air quality impacts from fuel consumption related to

3 In 40 CFR Part 82, Subpart G, the EPA has identified substitutes for ODCs that will present less hazards to human health and the environment than the ozone-depleting compound(s) they replace. The EPA has already identified eight commercially available substitutes for Halon in a total flooding agent fire suppression application, such as those existing in TAPS facilities (40 CFR Part 82, Subpart G, Appendix A).

contractor activities are addressed in the air emission impact evaluation [Section 4.3.9].) Hazardous material usage by external resources in support of continued TAPS operations is not expected to undergo substantial change.

4.3.12.2 Waste Management

The operating record described in Chapter 3 with respect to waste generation and management is expected to be generally representative of waste impacts from continued TAPS operations into the foreseeable future (Section 3.16.2). However, anticipated changes in management philosophy and oil throughputs may cause subtle but identifiable changes in the generation and subsequent management of wastes.

The major factors that may influence the nature and amounts of future wastes and the manner in which they are managed are discussed below. It is also probable that regulations governing waste management would evolve to the extent that existing management strategies would no longer be appropriate, adequate, or cost effective. However, it is assumed that APSC would adjust its waste management activities to maintain compliance with evolving regulatory requirements and that there would be no environmental impacts from such changes beyond those anticipated by the modified regulations and standards.

4.3.12.2.1 Waste Impacts Resulting from Changes to Management Strategies and Oversight Postures. The JPO and APSC are currently engaged in discussions regarding the adoption of an RCM approach to asset maintenance. Under such a scenario, each critical piece of pipeline equipment and the pipeline itself would be evaluated for the role it plays in system operation. In an RCM approach, both environmental impacts and safety factors would be considered in determining the consequences of equipment failure and assigning priority to certain maintenance tasks. The impacts of operational disruption would also have a role in setting priorities. Notwithstanding responses to accidental releases and major equipment repairs or replacements, routine and preventative maintenance activities are currently the major sources of waste. Changes to maintenance priorities may, therefore, impact future waste generation rates.

Because strategic decisions regarding an RCM approach are still evolving, the impacts of such a maintenance strategy can only be qualitatively identified at this time. It is possible that certain pieces of equipment would have a higher priority placed on their maintenance than is now the case because of the calculated consequence of their failure. In such a case, “consequence” may include disruption to TAPS operations (i.e., the continuous delivery of oil to Valdez Marine Terminal and beyond) as well as impacts to the environment as a result of loss of TAPS system integrity (i.e., an accidental release) or impacts to the safety of workers or the public. This higher priority may in some instances dictate that maintenance actions occur on a more frequent basis than is currently the case. However, the maintenance action itself is not likely to change.

Conversely, some maintenance intervals may be increased with no anticipated loss in performance reliability or increase in failure probability. Thus, with respect to waste generation, the character of maintenance-related waste is not likely to change with the adoption of an RCM-based maintenance strategy, although the overall volumes of individual maintenance-related waste streams may vary as RCM protocols are applied to individual TAPS elements or systems. Such volumetric changes are expected to be relatively minor, however, and are not likely to unduly impact the capacities of the existing waste management systems.

4.3.12.2.2 Impacts Resulting from Changes to TAPS Operational Conditions. In addition to changes to management philosophies that would impact maintenance postures, changes in operating conditions might also have significant impacts on the character and volume of waste generated. The most dramatic changes would result from changes in the status of major facilities, such as the ramping down of currently active pump stations or the restarting of currently inactive facilities (such as pump stations now on standby or “mothballed” topping plants). While changes to waste generation and management can be anticipated from such events, there are no published schedules for the reactivation of any currently dormant facility. However, rampdowns of some facilities can be reasonably anticipated (see Section 4.2.2.6.3 for a discussion of planned upgrades and modifications). Projected reductions in crude oil throughput may allow for the rampdown of additional pump stations. Discussions in the following sections, therefore, include an analysis of the impacts to waste management from any such changes to facility status. The categories of wastes analyzed are the same as those used to describe TAPS waste profiles in Section 3.16.

4.3.12.2.3 Direct versus Indirect Impacts from Waste Generation and Management. It is possible to differentiate wastes directly related to TAPS operations from those with a more indirect relationship. As was the case for hazardous material usage, it is possible to distinguish individual waste streams as representing either direct or indirect impacts, depending on the nature of the activities from which the waste originates. However, waste management is centrally controlled wherever possible, including the commingling of wastes equally eligible for the same management scheme, regardless of the sources of the wastes. Consequently, distinguishing between waste stream origins and determining whether each waste stream should be considered a direct or indirect impact adds little benefit to an overall understanding of the collective environmental impacts from TAPS wastes.

4.3.12.3 Hazardous Wastes

Routine and preventative maintenance activities will continue to result in generation of hazardous waste along the pipeline and at the Valdez Marine Terminal. Preventative maintenance waste generation is cyclical and therefore may be impacted by the adoption of RCM strategies, although the chemical composition of the wastes is not expected to dramatically change. Generation of maintenance-related wastes may also increase as critical equipment nears the end of its useful life and undergoes major refurbishment or replacement.

Section 3.16.2 and Appendix C provide descriptions of the hazardous wastes representative of past routine TAPS operations. Table C-2 provides types and quantities of hazardous waste generated from January 1998 through December 1999. Notwithstanding the influence of RCM strategies, these data are considered to also be representative of the nature and amounts of hazardous waste that can reasonably be anticipated into the foreseeable future from continued pipeline and Valdez Marine Terminal operations. This conclusion is valid only if there are no major reconfigurations of the TAPS (e.g., rampdowns or new or reactivated facilities) or substantial changes to the quality of the crude oil (i.e., its chemical composition, because that affects the chemical constituency of maintenance-related wastes) being delivered through the pipeline. Further, the hazardous waste management procedures described in Section 3.16 are also expected to undergo very little change.

The rates of hazardous waste generation have been nominally low during periods of routine TAPS operations, thereby allowing most locations at which hazardous waste generation occurs to maintain eligibility for “Conditionally Exempt Small Quantity Generator” status. This situation is expected to continue to be the case during routine operations.

Conditionally Exempt Small Quantity Waste Generators

Under federal hazardous waste regulations, various categories of waste generators are defined. A conditionally exempt small quantity generator is one who generates less than 100 kg (220 lb) per month (at each noncontiguous facility operated). Conditionally exempt small quantity generators enjoy exemption from many of the requirements imposed on large quantity generators. These exemptions are outlined in 40 CFR 261.5.

Tank bottoms, sludge, and sediment continuously accumulate in various equipment and locations within the TAPS over time. Such “materials in process” are allowed to remain within the system until their presence affects system performance; then the equipment is cleaned and such materials in process are removed and declared waste. Replacement of aging equipment may also result in the generation of some material in process.

Material in process wastes have exhibited hazardous waste characteristics in the past. Therefore, cleanout of crude oil storage tanks, facility sumps, and equipment and some equipment replacement activities would likely also exhibit hazardous waste characteristics. Changes to the crude oil stream characteristics and temperature, as well as changes to throughput, may affect the rates at which sediments accumulate in equipment, and thus the volumes of in-process wastes produced. Such wholesale cleanout activities are considered to be routine maintenance (i.e., occurring cyclically). However, in the past, the intervals between some wholesale cleanout operations have been as long as 20 years.

Waste is also generated during some repair activities. These wastes can be generated along the ROW as a result of repairs that must, by necessity, be made in situ, but would occur under controlled conditions at pump stations and maintenance facilities whenever possible. (Under current practices, contractors immediately move wastes that are generated at ROW locations to a storage facility at the nearest pump station or maintenance facility until final disposition.) Repair-related wastes might include spent solvents, sludge, and debris (including scale and rust in some instances) removed from the failed piece of equipment during its repair.

Wastes would also result from surface preparation activities for purposes of corrosion control. However, spent sandblast media and debris from the removal of original coatings have not exhibited hazardous waste characteristics in the past and have been managed as industrial solid waste. However, excess materials and wastes associated with surface preparation and the application of the new paint or coating may exhibit hazardous waste characteristics.

The character of corrosion-control-related waste is most strongly influenced by the nature of the original coatings being removed and the substitute coatings being applied. With few exceptions, the paints and coatings originally used in the TAPS have no hazardous components, and their eventual removal would not result in the generation of hazardous waste. Likewise, applications of substitute coatings that are nonhazardous once they are fully cured are also not expected to result in hazardous waste generation. However, piping at the Valdez Marine Terminal used to deliver ballast water to the BWTF is known to have a lead-based paint coating underneath a rosin liner on the interior of the piping. Much of the liner and paint coating have been removed in recent years as a result of maintenance activities on the piping. If future maintenance activities require removal of the liner, it would be managed as a hazardous waste.

For the purpose of this discussion, repair-related waste does not include contaminated environmental media resulting from a release of crude oil, refined petroleum product, or hazardous material. Such “spill debris” are discussed separately below in Section 4.3.12.6. Also, any repair action that can impact system integrity would also involve performance of a hydrostatic test of the affected equipment before service is resumed. Wastewaters from such tests are discussed in Section 4.3.12.5.

Finally, lower crude oil throughputs in future years might allow for the rampdown of additional pump stations. While the long-term result of such rampdowns would be the elimination of hazardous waste from those locations, in the short-term, hazardous waste generation may increase from the cleanout of retired equipment. Such increases would be attributed to the removal of material in process (e.g., accumulated sludge, residue, tank bottoms, and condensate) that would necessarily be part of placing individual pieces of equipment into stable standby modes. Such sludge and residue may exhibit hazardous waste characteristics. The use of petroleum fuels or organic solvents in the purging of crude oil from pumps, transfer lines, surge tanks, and storage tanks; the subsequent cleaning of such equipment; and the removal of various filters might also contribute to hazardous waste related directly to rampdown actions. However, judicious choices of purging solvents might allow those organic rinsing agents to be reintroduced into the crude oil stream.

Some heat transfer fluids and coolants currently in service may also become hazardous waste if they are removed as part of a rampdown action. However, recycling might also be possible for some coolants, especially if their essential cooling properties had not yet been depleted. Such “spikes” in hazardous waste generation associated with facility rampdowns are expected to last only a matter of weeks. APSC may have to modify the physical features and administrative controls of their waste storage facilities at these locations to comply with requirements for longer-term hazardous waste storage areas or arrange for special waste pickups immediately after the rampdown-related wastes are generated.

4.3.12.4 Solid Wastes

Nonhazardous solid waste from pipeline and Valdez Marine Terminal operations falls into one of three categories: industrial solid waste, office waste, and domestic solid waste. Industrial solid waste can be identified as being either a direct or indirect impact from TAPS operations, depending on the specific activity that generated the waste. Office wastes and domestic solid wastes are considered to be indirect impacts from TAPS operations. Only marginal changes to the characteristics of these three categories of solid waste are anticipated under the proposed action. However, some volumetric changes can be anticipated. Specifically, domestic solid waste from the O&M of personnel living quarters has the potential to undergo substantial volume reduction. The volume of domestic solid waste is directly and primarily a function of the complement of personnel working and living at each TAPS facility.[4]

With steady or decreasing oil throughputs over time, less energy would be required to deliver the oil to the Valdez Marine Terminal. Consequently, additional pump stations might be put into standby mode in future years, resulting in eventual reductions in the workforce and proportional reductions in solid waste volumes at affected locations over the long term. Over the shorter term, however, volumes of domestic solid waste might increase, reflecting the increased number of workers at the facility to perform rampdown actions. Once rampdowns were completed, these volumes would decrease dramatically, reflecting the presence of only a minimal caretaker workforce (including security personnel). Industrial solid wastes would also be affected by rampdowns, with volumes increasing initially because of wastes generated directly from rampdown actions, then reducing eventually to near zero at such facilities once rampdown actions are completed. However, as noted in Section 4.3.12.3, the majority of waste generated from rampdown actions might, in fact, display hazardous waste characteristics.

Three primary options are currently employed for solid waste management: (1) incineration of domestic and nonhazardous industrial solid wastes at PS 1, 2, 3, 4, 5, 7, 10, and 12 and at the Valdez Marine Terminal and disposal of the resulting ash in APSC or public landfills; (2) direct burial of solid waste in APSC landfills and landfills operated by various municipalities or boroughs; and, (3) recycling or energy recovery. All three options are expected to remain generally available.[5] However, some changes to current solid waste management options can be anticipated.

Amounts of solid wastes typically recycled throughout the TAPS are listed in Table C-4. However, with the exception of scrap metal, recycling markets are not reliable or economically available for all portions of TAPS where recyclable wastes are generated (Seward 2001f). ADEC officials confirm that logistical factors, especially transportation, often impede aggressive solid waste recycling in some parts of Alaska. Nevertheless, although ADEC regulations do not mandate a certain level of recycling, applicants for solid waste disposal

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4 Currently, personnel from PS 1 are housed in BP’s Prudhoe Bay housing facility. Pipeline maintenance crews and emergency response personnel are quartered at various pump stations proximate to their respective geographic areas of responsibilities. It is assumed that both of these housing circumstances would continue into the period covered by a Federal Grant renewal. However, there may be some redeployment of personnel if planned pump station upgrades are pursued. (See Section 4.2.2.6.3.)

5 Although they are not operated, incinerators at PS 2, 6, 7, and 10 still exist.

permits (i.e., landfills) are required to demonstrate that they have considered recycling as an option to disposal of the solid wastes they receive and have made a commitment to implement recycling whenever market conditions are appropriate (Stockard 2001a).

Transportation costs may, however, be rate-limiting factors to efficient pursuit of some recycling options. Were any of the current recycling options to disappear or become no longer economically viable, all materials would be diverted to appropriate waste disposal facilities with only nominal impacts. Finally, regardless of whether recycling remains possible, it may still be appropriate for APSC to maintain its solid waste segregation programs for wastes going to its incinerators, to guarantee the continued nonhazardous character of the resulting ash.

APSC incinerators have provided for substantial volume reductions to waste requiring disposal. As has been the case for previously ramped-down pump stations, incinerators at additional PS that are ramped down would likely be shut down, despite the fact that operation of the incinerators is largely independent of operation of the remainder of the pump station. At the same time, however, the incinerators have been used to treat only locally generated solid wastes.[6] Because the volumes of solid wastes at closed pump stations dramatically decrease, the loss of the incinerator has only marginal impact, and any remaining waste volumes from such facilities would be transported to the closest operational facility.

Landfilling of solid waste or incineration of solid wastes at PS 1, 3, and 4 and at the Valdez Marine Terminal followed by landfilling of ash would continue to be the main options for solid waste management into the foreseeable future (assuming no further pump station closures). Table C-3 provides data on the amounts of solid waste or ash delivered to various landfills in calendar year (CY) 2000. Historically, APSC has not been a major contributor to solid wastes going to municipal landfills; thus, any changes to TAPS solid waste generation rates are not likely to cause capacity problems at the landfills to which these wastes are being sent. Table 4.3-2 shows the amounts of APSC solid wastes delivered to each publicly owned landfill relative to the total amounts of solid wastes received at each site. Disposal of APSC ash either in its own or in publicly owned landfills would remain a viable option provided APSC maintains controls for segregation of wastes going to its incinerators to ensure that the nonhazardous resulting ash remains nonhazardous.

All of the municipal landfills currently being used are likely to meet their design limits, and each landfill will see its current operating permit expire before the expiration of the proposed 30-year Federal Grant renewal (see Table 4.3-2). With the exception of the Oxbow Landfill, these disposal facilities provide the primary opportunity for disposal of solid wastes for their respective communities. Consequently, it is reasonable to assume that the municipalities or boroughs will take prudent and timely actions to extend their permits or establish new, permitted solid waste disposal facilities before design or permit limits are reached.

The Oxbow landfill exists exclusively for the use of the TAPS and the oil exploration and production companies currently on the North Slope. Although no Alaska Native communities on the North Slope use the Oxbow Landfill, it is nevertheless incumbent on the North Slope Borough authorities to maintain their permit to preserve this revenue source and to continue to provide disposal opportunities for North Slope oil companies and the TAPS. Currently, APSC delivers only incinerator ash and inert solid waste from PS 1 to the Oxbow Landfill. Historically, the amounts have not been excessive. No evidence suggests that the Oxbow Landfill will discontinue service in the foreseeable future. However, if that were to happen, APSC would have the option of redirecting those wastes to its own landfills (within the limits of their operating permits) or to the nearest municipal landfill.

The permits for all three APSC-operated landfills will expire in July 2006 (Seward

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6 There are two exceptions: (1) the PS 7 incinerator burns oily waste from APSC operations in Fairbanks, and (2) the PS 5 incinerator also burns solid domestic and nonhazardous industrial solid wastes from PS 6.

TABLE 4.3-2 Annual Volumes of APSC Waste and Total Volumes of All Wastes Received at Publicly Owned Landfills[a]

Disposal Site	Permit Expiration	APSC Waste Received (tons /yd^3)[b]	Total Waste Received (tons/yd^3)[c,d]	Percentage of APSC Waste to Total Received (%)
Oxbow Landfill[e]	04/30/02	883.6 / 2,209	48,000 / 120,000	1.8
Anchorage Regional Landfill	08/22/06	352 / 880[f]	348,806 / 872,015	0.1
South Cushman Landfill (Fairbanks North Star Borough)	08/01/06	643.2 / 1,608[g]	91,095 / 227,738	0.7
Delta Landfill	04/30/03	NA[h]	1,500 / 3,750	NA
Glennallen Landfill (Copper Basin Sanitation)	12/31/01[i]	780 / 1,950[j]	3,480 / 8,700	22.4
Valdez City Landfill	08/21/06	580 / 1,450	4,100 / 10,250	14.1
Valdez construction debris landfill	03/31/01[k]	16 / 40	850 / 2,125	1.9
Palmer Landfill (Mat-Su Central)	11/20/05	0 / 0[l]	46,533 / 116,333 221 / 553[m]	0

a Data are for CY 2000 unless otherwise noted.

b Data provided to APSC by landfill operators (Seward 2001c-f; 2002).

c Data provided by ADEC in tons (Stockard 2001a) for planning and design purposes. ADEC considers 1 ton of uncompacted solid waste to compose 2.5 yd^3 (Stockard 2001c).

d Except for Anchorage Regional Landfill and Palmer Landfill, all values are estimates.

e Customers of the Oxbow landfill include APSC and all North Slope oil exploration/production companies, only.

f The reporting period is November 12, 2000, through November 12, 2001. Some portion of solid waste from the Bragaw facility is compacted on-site before delivery to the landfill.

g Totals represent wastes from Doyon industrial facility, Nordale maintenance yard, and Van Horn maintenance yard.

h NA = data not available.

i A permit application has been received by ADEC before the permit's expiration date and is currently in process. ADEC anticipates that a new permit will be issued in the summer of 2002. In the interim, the landfill has been authorized to continue operations in a manner consistent with the just-expired permit (Stockard 2002).

j Figures represent wastes from PS 11 and 12, as well as wastes from main-line refrigeration projects occurring over the reporting period.

k A permit renewal application is currently being prepared (as of November 21, 2001) (Stockard 2001b).

l No APSC waste was delivered to the Palmer Landfill in CY 2000 (Seward 2002).

m Amount of asbestos waste received from all sources. Asbestos waste totals are not included in volumes of all wastes received.

2001a,b). APSC will need to extend current permits or identify suitable new locations and pursue the necessary permits. Some difficulty may be encountered in finding a location with suitable soil conditions in an area proximate to the northernmost of the APSC landfills. It is assumed that any permit extension or permits for new locations would have limitations similar to the current permits. Therefore, APSC would be able to use any new landfills only for the disposal of nonhazardous incinerator ash or inert, nonhazardous, and nonputrescible solid waste. It is assumed that APSC would continue to use its solid waste incinerators.

With the exception of the North Slope Borough where local ordinance guarantees a revenue source by requiring all wastes generated within a prescribed service area to be disposed of in the Oxbow Landfill, there are no jurisdictional limits on solid waste disposal in Alaska (Mach 2001). Consequently, APSC would have the option, if necessary, of delivering its solid wastes to landfills located anywhere in the state if the landfills currently in use become unavailable. Notwithstanding substantial increases in transportation costs, such modified solid waste management strategies would not create additional environmental impacts over the current arrangements, assuming all of the landfills being utilized are in compliance with their respective operating permit conditions.

Under routine operations, the complement of APSC employees responsible for pipeline and pump station maintenance can be expected to remain constant or decrease slightly as more remote control technologies are introduced into the TAPS. These individuals normally reside at various pump stations or adjoining work camps, and their impact on solid waste generation is already accounted for in the above discussions. However, in the event that it becomes necessary to undertake a major pipeline repair or reroute, it can be expected that more personnel would be required to reside near the work site. Such major repair or reroute actions would undoubtedly increase the populations of workers at the nearest pump stations and camps to their respective maximum capacities, and might even result in the temporary construction of additional work camps.

The MCCF at PS 3 is an example of an existing work camp that would be used for additional worker residences. Additional solid wastes from such facilities can be expected to be nonhazardous domestic garbage and would likely be managed by the existing management schemes. However, additional provisions might be required for solid waste collection from temporary camps or from existing camps or pump stations where populations have greatly increased.

New disposal options might be necessary if the increased volumes of solid waste exceed the capacities of existing facilities (including the APSC incinerators and landfills). However, given the relatively short duration of any such worker population increases, it is not likely that additional solid waste incineration facilities would be added. Also unlikely is the establishment of an additional APSC landfill. Existing permits suggest that APSC landfills would be available to support disposal of increased volumes of solid wastes, but, ideally, that waste should first be incinerated to accommodate the limited capacities of the landfills and the permit limitations to daily volumes of wastes received. Alternative arrangements might involve transport of solid wastes to existing municipal and borough landfills. Only nominal impacts would occur at each of the landfills involved.

In addition to major reroute or repair actions, similar impacts to resident populations at some facilities might result from response to and remediation of major accidental releases of crude oil or refined product. The principal wastes from such events are contaminated environmental media (primarily soils) and miscellaneous response-related debris, all collectively referred to as remediation waste. Management of remediation waste is discussed in Section 4.3.12.6. In addition, however, major spill response actions would also affect the number of workers at living quarters near the spill site, or might even require the establishment of short-term work camps at or near the spill location. Increased numbers of workers would, in turn, increase the volumes of domestic wastes generated. Because responses to spills would be of relatively short duration (at least that portion of the response that would require substantial increases in personnel), it is anticipated that existing solid waste management options can be used to handle the short-term increases in domestic solid wastes.

4.3.12.5 Wastewater

Wastewater anticipated from continued operations and maintenance of the pipeline and the Valdez Marine Terminal would be in the following categories: industrial wastewater, domestic sanitary wastewater, and storm water. As discussed in Section 3.16.4 and Appendix C, regulatory permits govern the type, quantity, and method of treatment or best management practices applicable to each wastewater discharge.

The Valdez Marine Terminal, specifically the BWTF, is expected to continue to be the single largest source of industrial wastewater. Table C-5 shows the currently permitted influent sources to the BWTF and their respective estimated average volumes. Wastewater at the Valdez Marine Terminal can be expected to remain largely unchanged except for ballast waters. Ballast water and bilge water from tankers berthed at the Valdez Marine Terminal account for up to 93% of the flow into the BWTF (TAPS Owners 2001a). Treatment of ballast water from tankers, as well as anticipated changes to those activities because of tanker reconfiguration, are identified as cumulative impacts because such wastewaters originate from outside the TAPS system. Impacts are therefore discussed in Section 4.7.

Industrial wastewater generated in connection with O&M along the pipeline results primarily from excavation dewatering, hydrostatic testing, and secondary containment drainage. Under the proposed action, these linewide industrial wastewater discharges are expected to remain near current levels (see Table C-7).

Excavation dewatering results from corrosion control activities on sections of buried pipeline, as well as from special projects (e.g., vaulting of check valves, repairs, or replacement). Dewatering can be expected to occur anywhere along the ROW where the pipeline is buried. Corrosion control activities are considered to be preventive rather than routine maintenance and, as such, would occur only on an “as-needed” or “as-indicated” basis by routine inspections or monitoring.

Because neither preestablished schedules nor predesignated locations exist for these activities, it is impossible to predict the volumes of excavation water that would be generated in future years. Factors affecting volumes of excavation water to be managed include the location, the time of year in which the excavation takes place, precipitation events during excavation, height of the groundwater table relative to excavation depth, and topographical factors that affect surface water run-in. It is assumed that all available steps would be taken to minimize excavation water, not only to avoid the management and disposal costs, but also to prevent such water from impacting the maintenance or repair activity itself. However, when excavations are required for an emergency repair operation, such considerations may be preempted.

Historical discharges under the linewide NPDES permit are shown in Table C-7. It is assumed that these discharges are representative of discharges in future years of operation. As discussed above, under RCM, certain pieces of equipment might be assigned a higher priority, resulting in an increase in the frequency of maintenance activities. If these higher-priority elements are located underground, the volume of excavation dewatering discharges might increase somewhat in the future.

Hydrostatic testing is required whenever maintenance, repair, or replacement actions result in wholesale or partial disassembly of those portions of the TAPS in which crude oil is present. Because hydrostatic testing is normally required on the reassembled system, most test waters are generated at the project site. Historical discharges of hydrostatic testing wastewater under the linewide NPDES permit are shown in Table C-7. It is assumed that these discharges are representative of discharges in future years of operation. However, RCM-based protocols might dictate more frequent maintenance schedules, with a subsequent increase in the volume of hydrostatic test waters generated. In addition, a drop in the quality of the crude oil being recovered from aging fields could be expected to cause an increase in the volumes of wastes (sediments and sludge) accumulating in the system. This increase in waste volumes could result in increased frequencies of cleanout or maintenance activities, which would often be followed by hydrostatic testing and, consequently, an increase hydrostatic wastewater discharges.

The volumes of domestic sanitary wastewaters generated along the pipeline depend on the workforce population. A drop in crude oil throughput may allow for the rampdown of additional pump stations, with concomitant reductions of personnel at those locations. Technological enhancements may also allow for the remote operation of some pump stations, which would result in a reduction of the workforce at those locations to minimal caretaker and security forces. All such reductions in personnel would result in proportional reductions in sanitary wastewater volumes. However, major pipeline repairs or reroutes or seasonal maintenance schedules might result in temporary increases in the workforce housed at nearby pump stations or work camps (including new work camps erected exclusively to support specific major actions). These increases might cause sanitary wastewater volumes to exceed the peak capacities of the existing treatment systems at those facilities.

Although it is reasonable to assume that existing housing quarters would be used in preference to the establishment of new or short-term work camps, when such new living quarters are deemed essential, necessary provisions would also need to be established for sanitary wastewater management. Self-contained package plants for sewage capture and treatment are the most cost-effective options for such short-term needs. However, seasonal conditions may make use of such plants inappropriate, and it may be necessary to simply capture the sewage and transport it to the nearest permanently established treatment facility. Special treatment agreements between APSC and the nearest municipality may also make municipal sewage treatment plants available for such short-term treatment. Agreements of this sort have already been used to effectively deal with short-term operational problems of the sewage treatment systems at some pump stations.

Sanitary wastewater is currently treated through stack injection systems at PS 1, 3, and 4. This treatment methodology takes advantage of the waste heat in main-line oil pump turbine exhausts to destroy pathogens and vaporize filtered sanitary wastewater. However, variability in the oil throughput projected through 2010 and the resulting variability in the operating parameters of the main-line pumps have created reliability problems (Kinney and Ramos 2001). Further, a conceptual study conducted in August 2001 (Kaercher 2001) identifies the lack of a completely dedicated air line for delivery of wastewater to the exhaust stack at the appropriate pressures to ensure atomization (and thus proper destruction of contaminants) and the lack of a dual nozzle configuration in the PS 3 system as contributing factors to decreased system reliability. These variability factors have resulted in periods of operation when turbine exhaust gas temperatures and compressed air pressures in the wastewater delivery system have not met minimum requirements specified in the turbine air permits, thus requiring the temporary suspension of sanitary wastewater injection/treatment.

No serious problems are expected with the reliability or adequacy of the PS 1 stack injection system as long as operating personnel continue to reside at BP’s Prudhoe Bay housing facility rather than at the facility (thus resulting in low volumes of sanitary wastewater in need of treatment). However, interruptions to stack injection at PS 3 and 4 have resulted in exceedances of the on-site storage and surge capacities of wastewater handling systems. When stack injection is unavailable at PS 3, wastewater can be delivered to the package mechanical treatment system that serves the colocated MCCF. At PS 4, untreated sewage can be diverted to an outdoor holding tank to bridge those periods of stack injection unavailability. When on-site wastewater disposal is not available, sewage must be hauled to the North Slope Borough wastewater treatment plant in Prudhoe Bay (Kaercher 2001).

Reliability studies determined that the stack injection system at PS 3 failed to reach or maintain operating conditions commensurate with adequate wastewater treatment for 17.5% of the time in CY 2000 (Kinney and Ramos 2001). On the basis of anticipated decline in oil throughput, the studies projected that the stack injection system could be stabilized through 2007, but it would lose its practical viability after that time. Reliability calculations at PS 4 showed its stack injection system to be unavailable for wastewater treatment 7.5% of the time in CY 2000. System viability at PS 4 was projected to last through 2008. System upgrades and changes to operating parameters could potentially extend the lives of the existing systems.

The conceptual study of wastewater management system upgrades at PS 3 and 4 identified various options for domestic wastewater treatment, including (1) installation of a new treatment system at PS 3; (2) improvements to the stack injection system at PS 3 (e.g., installing a dual nozzle configuration); (3) connecting PS 3 facilities to the MCCF package mechanical wastewater treatment system, which would require coincident upgrades to the MCCF system; (4) system upgrades to the stack injection system at PS 4, with increased diversion tank capacity; and (5) a new wastewater treatment system at PS 4 (Kaercher 2001). To date, none of the recommendations of this conceptual study have been selected.

The accuracy of the pipeline throughput projections that serve as the basis for the reliability assessments performed on PS 3 and 4 will ultimately dictate the exact time at which use of the stack injection systems will cease to be viable options for sanitary wastewater disposal. System reconfiguration actions also will affect the point in time when stack injection systems will no longer be sufficient. Regardless of the accuracy of the throughput projections, and irrespective of when exactly system reconfiguration occurs, it is reasonable to assume that stack injection systems at PS 3 and 4 would be replaced with alternative wastewater management systems sometime before expiration of the proposed 30-year Federal Grant renewal. The need to replace the existing system at PS 1 is less certain, but also a possibility.

Domestic wastewater from PS 7, 8, 9, 10, and 12, and the Fly Camp at PS 6 are handled by on-site septic systems (TAPS Owners 2001a). These wastewater treatment systems are the limiting factor at each of the pump stations when considering future staffing capacities (Mikkelsen 1997). The life of the septic systems at these pump stations is not unlimited. In fact, the system at PS 7 is in marginal soils, and it may be difficult to secure the necessary permits for any expansion of this leach field in the future (Mikkelsen 1997). Therefore, at sometime before expiration of the renewed Federal Grant, the septic systems at PS 7, 8, 9, 10, and 12, and the Fly Camp at PS 6 might have to be expanded, relocated, or replaced with alternative wastewater treatment systems. Changes to workforce configurations at pump stations will also influence the useful life of the septic systems (see Section 4.2.2.6.3).

The EPA Multi-Sector General Permit for Industrial Activities controls discharges of storm water from 12 industrial areas along the ROW and at the Valdez Marine Terminal. This permit contains requirements for best management practices to control the quality of storm-water runoff. It is assumed that future discharges would be similar in character and volume to historic discharges (see Section 3.16.4 and Appendix C). It is also assumed that the system currently in place to divert storm water from the industrialized areas of the Valdez Marine Terminal to the BWTF for treatment would remain functional, regardless of changes that might occur to the other influents to the BWTF.

4.3.12.6 Special Wastes

Special wastes associated with TAPS operations and their current management schemes were identified in Section 3.16.5. Special wastes are generated at relatively small volumes or on very sporadic schedules. Nevertheless, some constituents of these wastes have a relatively high potential for human health and/or environmental impacts if improperly managed. No major changes to these management options are anticipated. Anticipated impacts on special wastes are discussed below.

PCB Wastes: PCBs are present in only a few pieces of electrical equipment and light fixture ballasts. Current disposal options are not likely to change in the foreseeable future. No significant amounts of PCB-containing waste are anticipated in future years. Also, it is not anticipated that pieces of PCB-containing equipment would be taken out of service before the end of their useful lives. Light fixtures are currently being replaced.

Asbestos Waste: Very little asbestos-containing material (ACM) is present in the TAPS. No changes in the rates of asbestos waste generation are anticipated. Asbestos waste would be generated when equipment with ACM is repaired or replaced. Such actions would continue to be performed by APSC personnel. Small amounts of ACM waste generated would be sent to out-of-state permitted disposal facilities. Asbestos waste would be generated when infrastructure remodeling involves disturbance of ACM building components. Licensed contractors would perform such removal or remediation actions. Asbestos waste from removal or remedial actions would be disposed of in the Palmer Landfill.

Pesticide Waste: Very limited pesticide usage now occurs along the TAPS. Circumstances of pesticide usage are not expected to change in the foreseeable future.

Drag Reducing Agent: Amounts and management procedures for drag reducing agent are not expected to change (see Appendix C, Section C.6.4).

Spent Glycols: All spent glycols that are currently generated are recycled through a private contractor. Recycling is expected to continue. Adoption of RCM-based maintenance postures might affect the maintenance intervals for some equipment and, therefore, also change the volume of waste glycols produced over time.

Tanker Garbage: No changes to the management procedures for tanker garbage are expected. Volumes of tanker garbage would decrease with lower crude oil throughputs because of less frequent tanker berthings at the Valdez Marine Terminal.

Medical Waste: Very small amounts of medical wastes are produced. Volumes are not expected to change. The current management procedures would continue. However, if pump station or Valdez Marine Terminal incinerators stop operating, medical wastes from those locations are likely to be diverted to the closest municipal landfill that can receive such wastes. Landfill acceptance criteria may require sterilization before disposal.

Spent Sandblast Media: No changes to the character of spent sand blast media that result from corrosion control activities are anticipated (see Section 4.3.12.3). RCM-based maintenance strategies could affect the volumes of spent media generated, although not substantially. Disposal options would continue unchanged.

Asphalt: APSC would continue to use the ADEC-approved options for disposal of asphalt. Major access road rebuilding projects may allow for the temporary installation of an asphalt “hot mix” plant near the work site. This might create recycling options for the asphalt removed from the affected sections of road.

Radioactive Wastes: Replacement schedules for smoke detectors and self-illuminated signs are likely to continue. No changes in waste volumes or management procedures are anticipated. However, if components containing radioactive materials were replaced with ones having no such materials, radioactive waste volumes would decrease to zero once replacements were completed.

NORM Waste: Eligibility criteria for oil received at PS 1 are critical to preventing NORM wastes generated coincidentally to North Slope oil production from impacting the pipeline or the Valdez Marine Terminal. Provided these criteria remain the same, NORM wastes are not expected to result from continued TAPS operation.

Spill Debris and Remediation Waste: Management of remediation waste and spill debris would continue to be controlled by ADEC-approved site-specific remediation plans. Thermal treatment of contaminated soils is expected to continue to be the main treatment option. No additional long-term soil stockpile locations other than those identified in Appendix C are expected to be necessary.

Proposed rules by ADEC would impact cleanup levels and response planning.[7]

4.3.13 Human Health and Safety

Impacts of Proposed Action on Human Health and Safety

Operations, maintenance, and construction workers at any facility are subject to risks of fatalities and injuries from physical hazards. Over the 30-year renewal period, the estimated annual number of fatalities for TAPS workers is less than one, while the total number of fatalities over the renewal period is approximately six. The estimated annual numbers of recordable injuries (125-153) and lost time injuries (76-92) represent upper bound ranges of the physical hazard risks of injuries to TAPS workers over 30 years. Recent JPO oversight has addressed employee safety concerns and compliance issues related to fire safety and electrical systems.

Potential risks to the general public from chemical exposures resulting from normal operations of the pipeline were also evaluated. Effluent from the BWTF has not been shown to present an elevated carcinogenic risk through the consumption of fish or shellfish. Human health risks from inhalation of TAPS-associated emissions would be below EPA levels of concern. While some persistent, bioaccumulative, and toxic (PBT) chemicals have been detected at elevated concentrations in Alaskan mammal and fish species, normal operation of TAPS is not associated with significant quantities of these chemicals.

The potential environmental consequences on human health and safety from continued operation of the TAPS under the proposed action alternative are evaluated in this section. Two types of impacts from normal operations are addressed — the industrial (physical hazard) risk to workers (occupational) and the potential risk from chemical exposures to the general public from normal operations. Impacts to human health and safety as a result of potential accidental releases are discussed in Section 4.4.4.7.

4.3.13.1 Occupational

4.3.13.1.1 Physical Hazards. Operations, maintenance, and construction workers at any facility are subject to risks of injuries and fatalities from physical hazards. While such occupational hazards can be minimized when workers adhere to safety standards and use appropriate protective equipment, fatalities and injuries from on-the-job accidents can still occur. Rates of accidents have been tabulated for all types of work, and risks can be calculated on the basis of historical industrywide statistics. Where possible, these statistics have been used to estimate the extent of worker physical hazard risk for continued TAPS operation under the proposed action.

The U.S. Bureau of Labor Statistics (BLS) and the National Safety Council (NSC) maintain statistics on the annual number of injuries and fatalities by industry type (NSC 2000, 2001). The expected annual number of worker fatalities and injuries for specific industry types have been calculated on the basis of BLS and NSC rate data and on the number of annual FTE workers required for operations and maintenance activities along the pipeline. It is assumed that there would be 1,828 operations, contract, and special projects workers at the beginning of the renewal period, decreasing to 1,716 employees in 2010, and remaining at that level until 2034 (TAPS Owners 2001a). (The anticipated decline in operating employment is attributable to the closing of pump stations as a result of reduced throughput.) It is assumed that, in general, the types of activities required of these employees would be similar to those for workers in the transportation and public utilities industrial

7 Changes are proposed to Chapter 75 of the ADEC rules to update and modify the regulations and references to guidance documents, to correct errors, to clarify the intent and purpose of the regulations, to update soil cleanup levels, to modify off-site and portable treatment facilities requirements, to add a time frame for appeals, to modify various definitions, to modify and adjust civil penalties, to modify sampling and analysis requirements, and to refine the regulations to be consistent with 18 AAC 78. The public comment period ended on February 11, 2002 (ADEC 2002).

sector (pipelines are not broken out separately by the BLS), so fatality and injury rates for that sector were used to estimate annual risks to TAPS workers. Specifically, the following incidence rates are used: 11.5 fatalities per 100,000 full-time workers, 7.3 recordable injuries per 100 full-time workers (defined as total OSHA-recordable cases), and 4.4 lost time injuries per 100 full-time workers (defined as total lost workday cases). Annual fatality and injury risks were calculated as the product of the appropriate incidence rate and the number of FTE employees.

On this basis, the annual fatality and injury rates for continued operation of TAPS are shown in Table 4.3-3. No distinctions are made among categories of workers (e.g., supervisors, laborers) because the available fatality and injury statistics by industry are not sufficiently refined to support analysis of worker rates in separate categories.

The estimated annual number of fatalities for TAPS workers is less than 1 (specifically, between 0.20 and 0.21 per year). The total number of fatalities expected over the 30-year renewal period is approximately six, which is comparable to APSC's historical safety performance data showing nine lives lost to date in operations-related incidents (APSC 2001i) (see Table 3.17-1).

TABLE 4.3-3 Annual Occupational Hazard Rates Associated with Continued Operation of TAPS (proposed action)

	Impacts to Workers[a]			
Time Period	FTEs[b]	Fatalities[c]	Recordable Injuries[d]	Lost Workday Injuries[d]
2004-2009	1,828	0.21	133 (21)	80 (5)
2010-2034	1,716	0.20	125 (20)	76 (5)

[a] All employees and contractors involved in pipeline operations are included in the physical hazard risk calculations.

[b] The number of FTEs is based on assumptions presented in the Environmental Report (TAPS Owners 2001a) and used in the economics sections of this EIS.

[c] Fatality incidence rates used in the calculations are the latest (2000) transportation and public utilities industrywide statistics from the BLS (NSC 2001). Fatality incidence rates for the industry classification of "pipelines, except natural gas," based on reports of NSC member companies, are not provided in the NSC (2000) report.

[d] Injury incidence rates used in the calculations are the latest (1999) transportation and public utilities industrywide statistics from the BLS (NSC 2001). For comparison, the number of injuries in parentheses are estimated using the latest (1999) incidence rate for the industry classification of "pipelines, except natural gas" (NSC 2000). While these data would appear to be more applicable to the TAPS, they are based on reports of NSC member companies only, so they may not be representative of the pipeline industry.

The estimated annual numbers of injuries is between 125 and 133 per year for total recordable cases and 76 to 80 for total lost workday cases. These results are based on transportation and public utilities industrywide statistics from the BLS (NSC 2001). For comparison, the number of injuries was also estimated using the incidence rate for the industry classification of "pipelines, except natural gas" (NSC 2000). The estimated annual numbers of injuries based on this subset of self-reported data from NSC member companies is 20 to 21 recordable injuries and 5 lost-time injuries. (For comparison, the actual numbers of recordable and lost-time injuries for both APSC employees and contractors over the period 1995 to 2000 fall in between the BLS- and NSC-based estimates, averaging 68 and 17 per year, respectively (see Table 3.17-1); note, however, that APSC's past occupational injuries may be underreported, as explained in Section 3.17.1.) Thus, the BLS-based estimated annual numbers of recordable injuries (125 to 133) and lost-time injuries (76 to 80) would be expected to represent upper bounds on the physical hazard risks of injuries to operations workers over the 30-year renewal period.

The calculation of risks of fatality and injury from industrial accidents was based solely on historical industrywide statistics and, therefore, it was assumed that any activity would result in some estimated risk of fatality and injury. The use of best management practices for occupational health and safety compliance should reduce future fatality and injury incidence rates.

4.3.13.1.2 Employee Safety Concerns. A 1996–1997 review of the APSC safety program by the JPO (1998c) found that APSC was generally in compliance with state fire, health, and safety standards. That study also found that employee concerns relative to safety were decreasing and that when violations of procedures occurred, action was taken to avoid recurrence. As a follow-up to JPO's review of the APSC safety program, a JPO survey to evaluate the Alyeska Employee Concerns Program (JPO 2000a) showed continuing issues regarding management response to worker concerns. Allegations of harassment, intimidation, and retaliation against workers raising concerns were numerous. There were also strong indications of a lack of employee satisfaction with steps taken to resolve concerns. In a more recent review of identified health and safety hazards (including employee concerns), the JPO concluded that while there were "a vast number of items that were abated in a timely manner, "There is an unsatisfactory trend where health and safety hazards have not been abated in a timely manner or interim safety controls have not been implemented to minimize the hazard" (Elleven 2002a). As a result, APSC has agreed to a number of improvements identified in a compliance MOA, including a review of its corrective action process and identification of additional improvements that will increase the efficiency and effectiveness of the current process (JPO 2002c) (see also Section 4.1.1.5).

4.3.13.1.3 Fire Safety Issues. Fire protection at the Valdez Marine Terminal is described in the text box on the next page. The adequacy of fire safety systems at the Valdez Marine Terminal has been an issue in recent years. In 1999, the reliability of the Valdez Marine Terminal fire safety systems became an issue because of poor maintenance and cost-saving measures taken. Portions of the foam delivery system piping for suppression of a tank fire were found to be clogged by sludge (JPO 2001a). JPO issued three orders to APSC concerning the testing of 18 crude oil storage tank subsurface fire foam systems at the Valdez Marine Terminal (JPO 2001a). APSC committed to conducting annual preventive maintenance tasks to ensure that the fire suppression system remains functional (JPO 2001a). In July 2000, JPO also received and accepted a satisfactory contingency and evaluation plan for a fire at the Valdez Marine Terminal (JPO 2001a).

A Regional Citizens' Advisory Council review in June 2001 (Slye and Semenza 2001) found significant progress in addressing fire safety system deficiencies. Foam delivery system upgrades were underway, equipment purchases had been initiated, and outstanding maintenance tasks had nearly been completed. At the same time, the review warned of potential for decreased attention to maintenance and found inadequate systems for wharf protection. A joint Valdez Marine Terminal and Valdez Fire Department training session was held in October

Fire Safety at the Valdez Marine Terminal

The Valdez Marine Terminal has a number of fire-protection systems. Fire-detection systems are used at the Valdez Marine Terminal to give early notification of smoke, flame, or heat. Various devices detect anomalies and alert people through alarms. When a fire has been detected, fire-suppression systems are activated to extinguish the fire before it becomes unmanageable.

These systems use ionization or photoelectric detectors for smoke, ultraviolet for flame, and thermal detectors for heat. Except for certain local fire-alarm systems that are separate from the Valdez Marine Terminal systems, an activated fire-detection system sounds an alarm at the Operations Center and activates the alarm system. The fire-detection systems may also provide ventilation-unit automatic control, initiate equipment and process shutdown, and activate the fixed automatic fire-suppression systems.

Combustible-gas-detection systems are installed in buildings or areas where potentially explosive atmospheres can develop in the presence of flammable vapors or gases. All large-volume process areas/zones are protected by gas-detection voting logic. The gas-detection systems automatically start emergency ventilation units, control the equipment and process shutdown, and activate the fixed automatic systems.

Halon or carbon dioxide is automatically discharged when a fire condition is sensed and alarms sound. The chemicals are dispersed only in the area potentially exposed to the fire. Carbon dioxide total-flooding suppression systems are installed in the switchgear room, the lifeline generator room, and selected power-distribution centers. Halon is available only in the analytical laboratory.

The Valdez Marine Terminal fire-fighting systems consist of onshore and offshore firewater systems, a foam system for tanks, a separate foam system for the East and West Metering Buildings, a Halon extinguishing system, carbon dioxide at some locations, and other auxiliary water systems involving fire trucks and other fire-fighting equipment.

The onshore firewater system supplies seawater from Port Valdez to hydrants near critical buildings, tanks, and equipment. Water form the firewater system also supplies two fixed foam systems protecting tanks in the East and West Tank Farms, and a separate Metering-Building foam system. Three pumping systems serve the three primary Valdez Marine Terminal areas: lower terminal, upper terminal east, and upper terminal west. Jocky pumps maintain pressure in the main firewater lines. Booster pumps supply water to the East and West Tank Farms.

The firewater system is a closed-loop system. Any point on the main firewater lines can be supplied from two directions. Electric heat tracing is installed on sections of firewater line installed above the frost line (8 ft below grade). Cathodic protection protects the buried pipe from external corrosion.

Each of the four tanker berths has a separate fire-control system. A firewater supply pump is located in the pump building on the offshore structure on each berth. The pump supplies firewater to the foam system on the berth.

Each berth's system is tied into the onshore fire system by a redundant firewater line running along the berth causeway. The redundance firewater supply provides an alternate source of water to the berths. If the berth firewater pump fails, water may be supplied to the berth from the onshore firewater system. These systems can be supplemented with fire trucks and other portable equipment and by fire-protection equipment on tugboats.

The fire protection systems are under continuous upgrade, and the fire-alarm panels and detection devices in Valdez Marine Terminal buildings were recently improved. Firewater piping was relined in 2000 for corrosion protection, and a fire-hydrant replacement program is in place, which will change out 10 units every year until all are complete. All components of the firewater system have built-in redundancies so that fire protection is virtually guaranteed.

APSC performs periodic maintenance and follows operating procedures to inspect and test the fire- and gas-detection and -suppression systems regularly. Procedures are being upgraded to improve consistency and documentation and to fill any identified gaps. The State Fire Marshal Office is a member of the JPO and oversees fire protection measures.

2001. At that time, remediation of most of the previously identified deficiencies was found to have been completed or scheduled (Loss Control Associates and Semenza 2001). The JPO had also verified that the work satisfied all order requirements and closed the orders in February 2001 (JPO 2001a).

4.3.13.1.4 Electrical Systems Issues. In 1997, numerous violations of the National Electrical Code were found in the installation of the vapor control system for marine tanker loading, which APSC subsequently corrected and JPO verified (JPO 1998a). An assessment conducted by JPO in 1998 consisted of 11 surveillances and resulted in 5 findings and 6 notices of violation (JPO 2000c, 2001a). Follow-up surveillances were conducted in 1999 to verify that the corrections taken in 1998 continued to be effective (JPO 2001a). Results of these surveillances indicated that APSC's electrical code compliance has improved (JPO 2001a).

4.3.13.2 Public

This analysis primarily addresses the potential risk to the general public from chemical exposures resulting from normal operation of the pipeline. The potential for exposure to PBT chemicals is addressed.

4.3.13.2.1 Ballast Water Treatment Facility Effluent. Ballast water from tankers is treated in the Ballast Water Treatment Facility (BWTF) and discharged under an NPDES permit into the waters of Port Valdez. Treated water is discharged through a series of ports in a 63-m-long diffuser positioned at a depth of 62 to 82 m. Low concentrations of polycyclic aromatic hydrocarbons (PAHs) are present in untreated ballast water but have rarely been found above detection limits in the treated effluent. The soluble BTEX pollutants are the pollutants found in the highest concentrations in the BWTF effluent (APSC 1995).

During routine operation of the BWTF, the biological treatment component operates efficiently, and the effluent is well within permit limits. Fluctuating conditions in the biological treatment, caused by interruptions in ballast water flow, are problematic, however, and require special management (JPO 2000b). Efficiency of the biological processing requires a nearly constant supply of oily, relatively warm input water. Disruptions to the flow occur when severe winter storms temporarily shut down tanker loading operations. Such interruptions may increase in the future as oil throughput decreases or ballast water volume is reduced for other reasons (JPO 2000b).

An evaluation of human health risk associated with the BWTF discharge found that the only likely exposure pathway for humans is through consumption of fish or shellfish from affected waters. The propensity of metal and volatile organic constituents of the effluent to bioaccumulate was considered in the risk assessment. Human subsistence consumption levels of 180 g/d of fish and 20 g/d of shellfish were assumed. On this basis, the evaluation concluded that human carcinogenic risk from consumption of fish and shellfish does not exceed 1×10^{-5} (1 in 100,000), and that it does not exceed thresholds for mutagenic or teratogenic risks (APSC 1995). This risk is within the 10^{-6} to 10^{-4} range used by the EPA as an indicator of increased cancer risks generally not requiring mitigating actions (EPA 1990). (See Section 4.4.4.7 for further analysis and discussion of the food chain pathway under an accidental spill scenario.)

Recent operational problems at the BWTF have affected fire risks. See the text box on the following page for a discussion of this issue.

4.3.13.2.2 Hazardous Air Pollutants in Ambient Air and Potential Health Hazards. The potential human health impacts from inhalation of HAPs in ambient air under existing conditions were discussed in Section 3.17.2.4. For assessment of potential impacts from TAPS-associated emissions, risk calculations were conducted on the basis of ambient HAPs levels for the Valdez area reported in the Valdez Air Health Study (Goldstein et al. 1992), but scaled to represent the varying throughput levels assumed for the duration of the 30-year TAPS renewal period. Again, inhalation risks for the Valdez area are

Recent BWTF Operational Problems

Recently, APSC has been experiencing an increased amount of paraffin material entering the gravity separation tanks (the "90s tanks") at the BWTF. This paraffin material accumulates with other petroleum fractions as a layer of waxy solids at the top of the wastewaters being stored in the 90s tanks. The original design basis for the 90s tanks anticipated that a petroleum layer would build up to an average thickness of 1 ft. However, the increased amount of paraffin solids has led to operational problems with the mechanical skimmers installed to periodically remove the accumulated petroleum layer. Consequently, the thickness of the petroleum layer has exceeded the design basis. However, the condition in the 90s tanks has not affected biological treatment activities at the BWTF, and the effluent discharges to Prince William Sound have remained below the allowable levels in the BWTF's NPDES permit.

APSC has been attempting to deal with this problem by using high-pressure water streams from the Valdez Marine Terminal firewater system to break up the paraffin, allowing the skimmers system to remove the petroleum fraction. Although this technique allows the skimmers to again function properly, there is some risk that this practice would create the potential for a static discharge in the tank headspace (i.e., introducing a potential ignition source into a potentially explosive environment). Because of this risk, APSC stopped this practice in May 2002 and started to explore other options to break up the paraffin so that petroleum fractions could be removed on a schedule that would maintain the design basis.

Although stopping the practice has eliminated the fire risk from static discharge, the increased amounts of petroleum accumulating in the tanks represent a different fire risk. The Alaska State Fire Marshal's Office, a participating agency of JPO, concluded in May 2002 that if a fire were to occur in a 90s tank that held petroleum fractions in amounts beyond the design basis, it might extend the time necessary to contain and extinguish a fire with the currently available fire-fighting equipment. The extended time taken to control the fire might, in turn, compromise the structural integrity of the tank, causing it to fail, thus greatly expanding the dimensions of the fire emergency.

In October 2002 the Fire Marshal and the JPO directed APSC to find a different method to reduce the amount of the petroleum fraction accumulating in the 90s tanks. Through a collaborative effort involving APSC, the State Fire Marshal, and numerous JPO-agency representatives, a consensus has been reached on an appropriate course of action toward a resolution. Representatives from the Prince William Sound Regional Citizens' Advisory Council (PWS RCAC) have since reviewed and concurred in the appropriateness of the selected response strategy. APSC has begun designing engineering modifications to the BWTF that will provide for the "fluidization" of waxy solids in a fire-safe manner so that they can be removed from the 90s tanks with the other petroleum fractions. It is anticipated that modifications will be in place by early 2003.

Importantly, although the primary and immediate concern was the increased fire risk, the selected corrective actions have been evaluated from all perspectives. Safety engineers from APSC and JPO considered the impacts to worker safety and identified the necessary procedural and engineering controls (e.g., personal protective equipment [PPE] and appropriate specifications for electrical equipment) that are required as part of the modifications. Representatives from EPA and ADEC, the two agencies having the most direct authority over the discharge of treated wastewaters to Prince William Sound have both concluded that, once installed, the modifications will not impact the BWTF's biological treatment capability and that effluent discharges under the new configuration will not exceed the contaminant limits established in the existing NPDES permit. They have further concluded that the modifications can be undertaken without the need for permit modification.

The modifications described above are considered to be a short-term solution. Efforts are continuing among the parties to identify more fundamental, long-term solutions. (Hughes 2002).

assumed to be a bounding case for all exposures along the pipeline, because HAP emissions from the Valdez Marine Terminal greatly exceed those from the pump stations (Table 3.13-6) and because the pump stations are located as far or farther from residential locations as is the Valdez Marine Terminal.

Specifically, this assessment evaluates the potential health risks from exposures for the period 2004 through 2033 (30 years of exposure). For the residential area risk, a "baseline" risk was added to account for exposures that have occurred since the start of pipeline operations through 2003 (27 years). The hypothetical worst-case assessment used ambient levels at the Valdez Marine Terminal fenceline (although no people currently reside at that location), and the assessment for residential exposures used ambient levels measured in Valdez residential areas. No baseline risk was added for the worst-case assessment, because residential exposures at the fenceline have not occurred to date.

The three residential monitoring locations and the fenceline location are shown in Map 4.3-2. The three assumed operational throughput values (i.e., 0.3, 1.1, and 2.1 million bbl/d) were used to scale assumed ambient concentrations from the levels observed at the time of the Valdez Air Health Study (when throughput was 1.8 million bbl/d). A summary of the assessment results is given in Table 4.3-4. On the basis of a tracer study, the Valdez Air Health Study estimated that Valdez Marine Terminal emissions only contributed up to about 10% of the residential area HAP levels; the other 90% was likely from use of home heating fuels and household solvents. Therefore, only 10% of the measured residential area ambient HAP concentrations were scaled with assumed change in throughput; the 90% attributable to other sources was assumed to remain constant throughout the assessment period.

No noncancer adverse health impacts to members of the general public would be expected from inhalation of TAPS-associated emissions during the renewal period. Also, at Valdez residential locations and for all assumed throughputs, the increased lifetime cancer risk would be essentially the same, and within risk levels generally not requiring mitigating actions (EPA 1990). The levels and risks are essentially the same because the predominant source of ambient VOC levels in the residential area was found not to be the Valdez Marine Terminal.

For the Valdez Marine Terminal fenceline location, ambient levels and potential cancer risks were less than the EPA's level of concern of 1×10^{-4} for all assumed throughputs (see Table 4.3-4). In addition, for the worst-case fenceline assessment, it is unlikely that a member of the general public would be exposed to benzene at the fenceline concentration for prolonged periods; currently no one resides that close to the Valdez Marine Terminal. The vapor collection system installed in 1998 on two of the four tanker berths at the Valdez Marine Terminal decreased VOC emissions by a factor of more than 10 (see Section 4.3.9). Therefore, current Valdez Marine Terminal-attributable fenceline benzene concentrations (and associated cancer risks) would be expected to be much lower than those measured in the Valdez Air Health Study because of the reduced emission levels. However, the Valdez Air Health Study risk estimates are of interest for the purpose of bounding the potential risks from TAPS emissions.

4.3.13.2.3 Potential for Exposure to PBT Chemicals. As discussed in Section 3.17, some PBT chemicals have been detected at elevated concentrations in Alaskan fish and marine and terrestrial mammal species. The PBT substances of greatest concern are PCBs, mercury, radionuclides, and PAHs.

PCBs are present in some electrical equipment at TAPS facilities. Some equipment with PCBs has been removed and disposed of according to existing regulations for PCB-containing equipment, but some PCB material is still present in transformers at the Valdez Marine Terminal and in fluorescent light fixture ballasts (see Section C.6.1). Production of PCBs has been banned since the late 1970s. Exposure to PCBs at TAPS facilities is very unlikely, because PCB-containing equipment is inventoried and properly disposed of as it is phased out of use.

Mercury-containing substances are also not generally in use or storage for TAPS operations, although some equipment such as electrical switches, batteries, and thermostats may contain

TABLE 4.3-4 Potential Human Health Risks Associated with Inhalation of Hazardous Air Pollutants in Valdez Area Ambient Air[a]

Parameter	Risk, by Pipeline Throughput Level (10^6 bbl/d)		
	0.3	1.1	2.1
Cancer Risks[b]			
Residential area exposure[c]	3.0×10^{-5} (3.0×10^{-6})	3.1×10^{-5} (3.1×10^{-6})	3.2×10^{-5} (3.2×10^{-6})
Hypothetical worst-case exposure (fenceline)	1.2×10^{-5}	4.1×10^{-5}	8.6×10^{-5}
Hazard Index[d] *(noncancer hazards)*			
Residential area exposure[c]	0.05 (0.005)	0.05 (0.005)	0.05 (0.005)
Hypothetical worst-case exposure (fenceline)	0.07	0.22	0.46

a Risks were estimated for a 70-kg adult exposed daily. Pollutants included in the risk assessment were benzene (the only carcinogen), ethyl benzene, n-hexane, toluene, and xylene. Pollutant concentrations are 1991 data from Goldstein et al. (1992); values were scaled to the various assumed pipeline throughput levels.

b Risks between 10^{-6} and 10^{-4} are generally considered below the level of concern.

c Exposures in residential area of Valdez, based on 1991 ambient VOC concentrations (see Table 3.17-4). For residential cancer risks, a baseline risk of 1.5×10^{-5} from 27 years of exposure (1977–2003) was added to the risk from exposure during the proposed action period of 30 years (2004–2033). Values in parentheses represent the approximate risk and hazard index contribution (i.e., less than 10%) from the Valdez Marine Terminal (based on 1991 ambient VOC concentrations before installation of a vapor-collection system in 1998). Since installation, the Valdez Marine Terminal VOC emissions have decreased by a factor of more than 10, thereby further decreasing the terminal's contribution to ambient VOC levels.

d A hazard index of <1 means adverse health impacts are unlikely.

small amounts of mercury (EPA 2001a). Radionuclides are not associated with TAPS operation. PAHs are components of crude oil and refined oil products, as well as tobacco smoke and incomplete combustion emissions. Normal operation of the TAPS is not associated with significant PAH releases; however, a spill with or without associated fire could release large quantities of PAHs to the environment (see Section 4.4.4.7).

4.3.14 Biological Resources Overview

Direct and indirect effects of the proposed action on biological resources are discussed in this section. The region of influence for direct effects encompasses the footprint and vicinity of the 800-mi-long TAPS ROW and associated facilities, including the Valdez Marine Terminal, pump stations, material sites (quarries), disposal areas, previously contaminated sites, support facilities (e.g., airports, access roads, and work camps), and the gas fuel line that supplies gas to PS 1 to 4. The region of influence for indirect impacts includes areas that would be affected secondarily by activities within the project footprint. Examples include areas adjacent to pump stations affected by noise, the Dalton Highway (used to transport materials and people to various locations along the pipeline), and areas affected by runoff from the TAPS workpad or other surfaces. Such areas could include upland, wetlands, or surface water bodies.

Factors associated with the proposed action that could affect biological resources include facility existence, normal operations, monitoring, maintenance, and accidental releases (spills). These factors are described in Section 4.2, and mitigation measures to reduce their impacts are described in Section 4.1. These factors could affect biological resources by altering habitat characteristics and the species supported by those habitats. Impacts of spills are discussed in Section 4.4.

Facility existence (the physical presence of the TAPS and associated facilities without operation or maintenance) affects biological resources because vegetation, fish, and wildlife are displaced; existing habitats are fragmented; ROW habitats are maintained in an altered condition; the movements of fish and wildlife are at times obstructed; and human access is provided to otherwise inaccessible areas. Impacts of facility existence originate from the original TAPS construction, but the proposed action would extend those impacts into the future. Biological impacts of facility existence would for the most part be limited to the ROW and vicinity and are described in Sections 3.18 through 3.22.

Normal operations of the TAPS include oil pumping, transportation of materials and supplies, waste management activities, maintenance, monitoring, and security operations. Impacts of normal operations are expected to be similar to those that have occurred over the history of TAPS operation and would be limited primarily to the ROW and areas of associated facilities. They include habitat modification; impacts to water temperature in areas where the pipeline is buried in and adjacent to streams; changes in permafrost patterns and the occurrence of thermokarst resulting from the pumping of warm oil through the pipeline; noise and disturbance resulting from human activities especially at the pump stations, Valdez Marine Terminal, and Dalton Highway; effluent discharge from the Valdez Marine Terminal and other facilities; and effects on air quality from emissions at pump stations, the Valdez Marine Terminal, and transport vehicles along the Dalton Highway.

Maintenance includes those activities needed to ensure that the TAPS performs normally. Maintenance activities that would occur during the renewal period include vegetation management, repair of below-ground main-line pipe, maintenance of slopes and the workpad, potential pipe replacement projects, valve maintenance, maintenance of cathodic protection, maintenance and repair of river crossing and training structures, maintenance and repair of the fuel gas line, and quarry operations at material sites. Maintenance activities could result in impacts to areas within and outside of the ROW. While these impacts would be similar to those resulting from facility existence, they could involve additional areas that are not currently disturbed.

The biological resources assessment focuses on the effects of environmental changes resulting from the proposed action on terrestrial and wetland vegetation; fish; birds and mammals; and threatened, endangered, and protected species. Impact significance was determined on the basis of the areal extent of the change, including the project footprint and affected adjacent areas; characteristics of the area affected; the magnitude of the change (deviation from the baseline) anticipated; the season when the impact would occur; the duration of impacts; the sensitivity of biological resources to change; and the rarity and importance of the resource.

4.3.15 Terrestrial Vegetation and Wetlands

Terrestrial vegetation and wetland communities and their component species may be affected by factors associated with the presence of TAPS facilities, normal operations, monitoring, and maintenance under the proposed action. Impacts from potential accidental releases under the proposed action are discussed in Section 4.4.4.9.

4.3.15.1 Impacts of Facility Presence

Construction of the TAPS, including the ROW, pump stations, Valdez Marine Terminal, material sites, disposal sites, and the Dalton

Highway, resulted in the disturbance of terrestrial and wetland communities (see Section 3.18). This loss and alteration of vegetation communities would persist throughout the renewal period under the proposed action.

Impacts of Proposed Action on Vegetation and Wetlands

Impacts of the proposed action on terrestrial vegetation and wetlands would be similar to impacts of current pipeline operations. For the most part, differences between vegetation types in the ROW and those in surrounding areas would continue. In addition, localized disturbances to vegetation (with subsequent restoration) in the immediate vicinities of pipeline maintenance and repair activities and in association with extraction of sand, gravel, and quarry stone for pipeline-associated needs would generally be expected to continue at rates similar to current rates.

In most areas along the ROW, post-construction revegetation activities have resulted in the establishment of a vegetation community composed of planted species, some of which are nonnative, with varying degrees of invasion by native species (McKendrick 2002). Over the time period considered in this analysis, vegetative cover would be expected to continue to increase, through growth and reproduction, on most portions of the ROW that currently lack complete cover.

Some upland tundra locations, such as occur near Atigun Pass, may continue to lack sufficient fine soil particles to support vegetation. Some native species present within adjacent communities would continue to invade the ROW, resulting in an increase in the distribution and abundance of native species over the renewal period. However, the differences in substrate characteristics between the ROW and adjacent undisturbed areas (including moisture levels, organic surface layer, and gravel content), and the vegetation management program may preclude the establishment of mature communities typical of undisturbed areas in the vicinity of the ROW over the course of the renewal period (McKendrick 2002). Instead, earlier successional communities, similar in species composition to disturbance sites (e.g., riparian zones, avalanche chutes) will persist.

Sedimentation impacts may occur at any point along the ROW; however, the occurrence of such events would likely be very infrequent during the renewal period. Erosion of the ROW due to unanticipated stream flows can result in degradation of wetland and terrestrial plant communities downgradient of the ROW. Construction materials eroded from the ROW may cover existing vegetation where redirected stream flows occur, or sediment may be dispersed downstream of ROW river crossings, affecting streamside wetlands or floodplain communities. Herbaceous or low-growing woody species that become covered by sediment may be injured or killed. Vegetation effects in areas affected by sediment may result from reduced photosynthesis or leaf surface gas exchange. Physical effects include reduced oxygen availability in the root zone or changes in soil chemistry or moisture levels. Total vegetative cover may be reduced because species less tolerant of sedimentation may be eliminated, resulting in a shift in community structure toward more sediment-tolerant species. Although removal of sediments and other surface water contaminants is a function of wetlands, excessive sediment input can reduce or eliminate this functional capacity. High sediment inputs can fill wetlands, converting wetland plant communities to upland communities as soil surface elevation increases and soil moisture levels decrease from alteration of drainage patterns. Some areas of sediment accretion in unvegetated river channels may become colonized by pioneering plant species.

Surface water drainages that traverse the ROW through culverts or low water crossings may occasionally become blocked by the accumulation of ice, debris following high flows, or by beaver activity (APSC 2001j). Although maintenance activities have reduced the occurrence and duration of such blockage, temporary blockages may continue to occur on occasion (TAPS Owners 2001a) and may promote the development of wetland communities as upland vegetation or exposed soils are replaced with hydrophytic vegetation. Terrestrial communities, however, may be lost and replaced by unvegetated ponds where surface water is too deep for the establishment of wetland communities. Existing wetland communities along blocked drainages may, however, be altered or eliminated by the increase in depth or duration of surface water. Ice-rich permafrost in upland soils may be affected by inundation of the soil surface (TAPS Owners 2001a). Upper portions of the permafrost may become thawed, leading to thermokarst, or collapse of the soil structure. Continued expansion of the area of thermokarst as adjacent permafrost thaws may lead to changes in the composition of vegetation communities, both terrestrial and wetland, in the affected area.

The existence of the ROW has resulted in increased vehicle use near the ROW and associated impacts to vegetation. Effects of vehicle use can include injury or destruction of vegetation, increased erosion in areas of damaged vegetation or on disturbed soils, and changes in soil characteristics, such as moisture levels or compaction. These changes can alter plant community structure or even eliminate vegetation. Exposure of the soil surface in areas of shallow permafrost, especially if associated with the creation of shallow depressions, may result in the development of thermokarst. Adjacent vegetation communities may be lost as thermokarst expands and the area becomes inundated. However, the pattern and level of use over the renewal period would likely be similar to past levels. Most past use has occurred during winter snow cover when potential effects are minimized.

Terrestrial and wetland plant communities and surface waters downgradient from the workpad, existing material sites, disposal sites, or other disturbed areas may receive sediments from storm-water flows over exposed soil or gravel surfaces. Although current maintenance practices have reduced the occurrence of sedimentation (TAPS Owners 2001a), sedimentation impacts to wetland communities are still possible and could reduce the functional capacity of those wetlands for storm-water retention. Impacts of storm-water runoff from the workpad or other areas to surface water are expected to be local and temporary (see Section 4.3.6). Impacts from storm-water runoff generally would not be expected to result in a measurable change in terrestrial vegetation and wetland communities.

4.3.15.2 Impacts of Normal Operations, Monitoring, and Maintenance

Normal operations of the TAPS and monitoring activities throughout the renewal period, for the three throughput rates (0.3 million, 1.1 million, and 2.1 million bbl/d) evaluated under the proposed action, are expected to continue at levels similar to those of the past. Those activities would include vehicular traffic along the ROW, routine activities associated with the workpad, and pump station operations, including landspreading of treated wastewater, water use, and use of septic fields. Continued occasional disturbance to terrestrial vegetation and wetland areas along the ROW would maintain these communities in present conditions (such as the continued reduction of vegetation in vehicle tracks along portions of the workpad) (McKendrick 2002). In addition, impacts to surface water and groundwater (which could indirectly affect terrestrial and wetland vegetation) as a result of normal operations would be local and temporary (see Sections 4.3.6 and 4.3.7).

Airborne dust generated by traffic along the Dalton Highway results in a “dust shadow.” Deposition of fugitive dust on leaf surfaces can result in adverse impacts to vegetation by reducing photosynthesis and leaf surface gas exchange. Some moss and lichen species are especially sensitive to road dust (Everett 1980).

Dust Shadow

A “dust shadow” results from the settling of airborne dust along an unpaved highway. The accumulation of settling dust is most noticeable near the highway and decreases dramatically with distance. The area beyond 1,000 ft from the Dalton Highway is unaffected by this “dust shadow.” Ongoing improvements to the Dalton Highway road surface have resulted in a reduction in airborne dust along road segments treated.

Fugitive dust can also alter soil characteristics and affect water quality. Extensive deposition can reduce growth or survival of vegetation and alter the species composition of affected communities.

Storm-water flows from areas of heavy dust deposition on uplands can deposit sediment into adjacent wetlands and waterways with results similar to the impacts of erosion. The areas along the Dalton Highway potentially affected are currently in a disturbed condition from past deposition (TAPS Owners 2001a). These vegetation communities would remain disturbed and would not likely improve from their present condition. Therefore, additional impacts to terrestrial and wetland vegetation communities, both within and outside of the ROW, from normal operations and monitoring would not result in measurable changes in these communities.

Operation of the pump stations and Valdez Marine Terminal would continue to generate air pollutants. However, the levels of emissions of these pollutants would not be expected to result in detrimental effects on vegetation. Although no direct studies of air emission effects on vegetation near these facilities have been conducted, predictive evaluations have indicated that no detrimental effects to vegetation would occur from turbine rim cooling at PS 2 and 7, and significant impacts to vegetation from Valdez Marine Terminal tanker vapor recovery emissions would be highly unlikely (TAPS Owners 2001a). Minor increases in nutrient availability to plants may occur due to emissions and may result in higher productivity of some plant species near the pump stations and Valdez Marine Terminal.

Routine maintenance activities associated with continued operation of the TAPS would likely include a variety of ground-disturbing activities (APSC 2001j; TAPS Owners 2001a). These activities would include excavation or grading of areas within the ROW, primarily on the workpad. These excavations would remove existing vegetation within the work area and might result in the unavoidable filling of wetlands in the ROW with fill material or temporary draining of wetland areas. However, most activities would affect previously disturbed and replanted areas of the ROW. These actions might result in the erosion of soil or gravel, with subsequent sedimentation of surface waters, including wetlands, downgradient of the work site. Because of current erosion control procedures, impacts to surface water as a result of most of these activities are expected to be local and temporary (Section 4.3.6). Any sedimentation impacts to downstream wetlands, however, could reduce their functional capacity. Potential future upgrades to the pipeline or pump stations may also include similar types of ground-disturbing activities with resulting impacts to vegetation.

Following regrading, the disturbed areas would be restored by methods currently used in revegetation efforts. Revegetation procedures are evaluated and approved for each project by the Authorized Officer (AO) and the State Pipeline Coordinator (SPC). The methods used for revegetation would be modified according to site-specific conditions. Disturbed areas would be restored as soon as practical. Restoration must meet performance requirements, which include "remove all contaminated material; to the extent possible, return a disturbed site to its original or normal physical condition and natural biological productivity and diversity with reestablishment of native plant and animal species; prevent erosion; conform to the adjoining land forms and approximate the original land contours; maintain pipeline system integrity; remove improvements as required by the appropriate authority; and provide for public safety" (Brossia and Kerrigan 2001). Disturbed areas would be allowed to be revegetated primarily with native species found in adjacent natural areas. Diverse communities of local native species would be expected to develop on the restored areas. When maintenance work was not done during winter, soil compaction from the use of heavy equipment might alter soil moisture characteristics as well as soil structure and might initially hinder the reestablishment of native species.

Some areas, such as those that may be more susceptible to erosion or are difficult to revegetate, would be seeded with native perennial grasses (such as native varieties of red fescue and Bering hairgrass) and nonpersistent annual ryegrass, and mulched if necessary. A comparatively short period may be required for vegetation to become established on lightly seeded areas and for native communities to become well established (McKendrick 1999; APSC 1998d). Because native seed would be used for revegetation, the introduction of nonnative species would be limited (although nonnatives may become introduced in mulch).

Routine maintenance would include repairs of corroded sections of buried pipeline, which may entail 15 to 20 excavations per year (an increase from the present level of approximately 14 per year), resulting in a total disturbed area of 3.4 to 4.6 acres per year. Corrosion repairs would affect vegetation communities within the ROW that had been previously disturbed by TAPS construction and revegetated. Many maintenance excavations (those requiring extensive dewatering) would occur during winter, thus minimizing impacts to vegetation outside the excavation areas (TAPS Owners 2001a). Existing vegetation within the ROW would be removed during excavation, and revegetation would be undertaken after final grading. Corrosion repairs might be required in any segment of the pipeline and occasionally could take place in areas of high groundwater levels, such as near wetlands. Dewatering of the excavation and discharge of water is not expected to result in measurable impacts to groundwater (Section 4.3.7) and would only result in local and temporary impacts to surface water (Section 4.3.6). Replacement of belowground refrigeration units would have similar impacts to vegetation (no measurable impacts to groundwater and surface water) and might disturb up to 25 acres of vegetation within the ROW over the entire renewal period, requiring revegetation efforts. Repairs of pipeline cathodic protection might also require excavation within the workpad and subsequent revegetation. Maintenance of belowground valves may result in the disturbance of 0.3 acre per year within the ROW.

Maintenance of the workpad and slopes within the ROW may require regrading and revegetation of areas previously disturbed by TAPS construction. Also, highly sloped areas adjacent to the ROW may require grading or stabilization. Vegetation communities that are currently undisturbed may be removed by slope stabilization efforts. Replanting would establish vegetative cover on the affected area; however, extended periods may be required for native communities to become reestablished on alpine slopes (McKendrick 2002). Soil compaction from the use of heavy equipment may hinder the reestablishment of native species where work is not performed during winter.

Workpad maintenance also includes the clearing of drainage structures where accumulated debris has resulted in the impoundment of surface water. As the impoundments subsequently drain, the artificial wetland communities that developed may revert to the former terrestrial community type through colonization of species from adjacent undisturbed areas. Areas of exposed soil may create an opportunity for the invasion of nonnative weedy species. However, no invasion of undisturbed areas immediately outside the TAPS Row was observed in a 1999 survey (McKendrick 2002).

Routine maintenance of the ROW also would include activities related to the revegetation program and the vegetation management program, which includes the control, or brushing, of woody species. Trees and tall shrubs are periodically cut back near the pipeline to maintain access and reduce woody root growth near buried pipe sections. The JPO brushing policy addresses the values of vegetation protection and the need for maintenance access to TAPS structures (Brossia and Britt 2001). Brushing is conducted within the ROW, including the drivelane to 6 ft beyond the pipe centerline and within 10 ft around each vertical support member. Brushing is also conducted within 10 ft of culvert inlets and outlets. A 20- to 50-ft buffer zone, within which no vegetation is cut or disturbed (with minor exceptions) without approval of the AO and SPC, is maintained around all water bodies. Outside the buffer zone, vegetation disturbance is minimized to that necessary for maintenance activities.

Vegetation control would maintain plant communities in some portions of the ROW in early successional stages of community development (McKendrick 2002). Also, the substrate characteristics within the ROW may not allow the development of mature natural communities identical to those of nearby undisturbed areas (see Sections 3.18 and

4.3.1.5.1). Native shrubs would continue to increase in segments of the TAPS ROW within the lowland tundra and upland tundra zones through reproduction and invasion from nearby undisturbed plant communities. Vegetation management in the boreal forest and coastal forest zones would continue to suppress the growth of forest tree species (such as black spruce, white spruce, or Sitka spruce). The vegetation management program maintains shrub and herbaceous plant communities through forested segments of the ROW.

Pipeline replacements and subsequent impacts to vegetation are not expected during the renewal period because of current monitoring and early repair procedures. Four replacements have occurred since pipeline completion, including 9.3 mi of new construction. Two of these replacements have required new ROW, with subsequent disturbance of vegetation communities. The replacement of pipeline sections would likely result in disturbance to the ROWs and would potentially disturb existing terrestrial and wetland vegetation. Pipeline replacement within the ROW involves the removal of existing vegetation that has become reestablished since the original construction activities, and might result in impacts to wetland areas, especially where the ROW does not presently contain a gravel pad. Rerouting pipeline segments would destroy vegetation in currently undisturbed areas and might result in the filling or drainage of undisturbed wetland areas.

ROW maintenance might also include the placement of riprap or other materials where flooding has induced erosion of the ROW (and may have exposed the pipeline) or adjacent streambanks, such as occurred along the Sagavanirktok River in 1992 (TAPS Owners 2001a). The effects of such maintenance activities are primarily restricted to the ROW, which may be unvegetated in portions located within stream channels. Repairs within the ROW may require disturbance to terrestrial or wetland vegetation. However, such disturbances primarily affect previously disturbed areas that were replanted following pipeline construction. These areas would again be revegetated following completion of repairs.

Remedial measures may require placement of armoring materials, such as riprap, in stream channels or along stream banks to prevent future threats to the pipeline. Preventive maintenance may also include the construction of guidebanks or revetments (armoring placed along a bank to stop erosion, such as along the Middle Fork Koyukuk River in 1994 and 1998 and Tazlina River in 1999), new spurs along stream channels (Middle Fork Koyukuk River in 1995), or stream channel stabilization (Marion Creek, Minnie Creek, and Oskar's Eddy in 2000). Revetment and guidebank construction generally includes grading of the streambank and extensive placement of riprap along the bank and in the adjacent streambed (TAPS Owners 2001a). Riparian vegetation along the bank and upland vegetation along the crest of the bank may be removed during grading. Wetland communities in the streambed may be eliminated. Because severe erosion of the streambank typically necessitates revetment construction, vegetated wetlands are typically absent from the construction site except at the upstream or downstream ends.

Construction of spurs often includes the extensive placement of material in streambeds and may entail the removal of terrestrial and wetland plant communities during excavation and material placement. Extensive stream channel migration toward the pipeline caused by erosion at a sharp bend may require that the channel be moved back to a prior location. The moving of a stream channel as a preventive measure involves the initial destruction of any plant communities present because of construction activities, including grading and placement of riprap. Extensive wetland communities may be present in shallow, low-velocity areas on the inside bend. However, regrading of the floodplain may provide the opportunity for establishment of both wetland and terrestrial communities through revegetation efforts.

Construction activities along stream and river margins would also generate airborne dust and sedimentation. Dust emissions over the course of a single project would be local and temporary (Section 4.3.9). Impacts to surface water from sediment inputs to the stream or river are expected to be local and temporary (Section 4.3.6).

Maintenance and repair of the buried fuel gas line may also result in impacts to natural terrestrial and wetland vegetation. Several hundred feet of the line require regrading and backfilling each year. Although repairs are generally conducted during winter when indirect impacts are minimized, vegetation would be removed within the repaired area. The affected vegetation communities would be predominantly those communities established since gas line construction. A gravel workpad is absent from the gas line corridor, and natural terrestrial and wetland vegetation communities may be affected by burial under graded material, soil compaction, or disturbance by heavy equipment and other vehicles.

The development of new material sites would likely occur because of an anticipated need for 100,000 yd^3/yr of materials over the renewal period. Any removal of gravel and other construction materials from material sites would likely result in additional impacts to terrestrial vegetation and wetland areas at existing sites. The vegetation communities affected by material site development or expansion would be heretofore undisturbed communities located outside the ROW. Vegetation, possibly including wetland communities, would be removed as the sites were expanded. Sedimentation resulting from such operations might affect wetlands downstream of material sites and wetlands adjacent to material sites located along stream channels. Adjacent vegetation communities might be eliminated or affected by changes in drainage patterns at or near the sites, which might result in either a decrease or increase in the frequency or duration of substrate saturation.

4.3.16 Fish

Because of the proximity of the TAPS ROW to aquatic habitats along much of its length, various impacting factors can result in environmental changes that could affect fish. Specifically, barriers to fish movement, changes in water surface flow patterns, deposition of sediment in surface water bodies, changes in water quality or temperature regimes, contamination of water, loss of riparian vegetation, and changes in human access to water bodies are the environmental changes most likely to affect fish. This section describes the impacts from these environmental changes, broadly grouped into impacts that result from (1) alteration or loss of fish habitat, (2) obstructions to fish passage, and (3) increased human access. Potential impacts to fish associated with spills or releases of oil are addressed in Section 4.4.4.10.

Impacts of Proposed Action on Fish

The proposed action could have the potential to produce impacts to fish habitat, but continued operations are not expected to substantially affect fish populations during the renewal period.

4.3.16.1 Impacts of Alteration and Loss of Habitat

Alteration and loss of habitat can result from bank hardening, draining water bodies, changing or temporarily diverting river or stream channels, excavating streambed materials (e.g., gravel), removing riparian vegetation, or causing changes in water quality parameters (e.g., turbidity, sediment deposition, temperature, and chemical constituents) that affect the ability of fish to utilize specific locations. Changes in habitat can result in a variety of impacts to fish, including direct mortality and changes in population size, population structure, reproduction, and growth rate. For this reason, ADF&G permits are required under Alaska Statutes, Title 16, for activities in or near fish streams that could affect anadromous fish and their freshwater habitat or the free and efficient migrations of resident fish. Alteration or loss of essential fish habitat is of particular concern in waters and substrate necessary for spawning, feeding, or growth to maturity. Projects with a potential to affect marine habitats or anadromous fish streams are given special consideration. Under the authority of TAPS Stipulation 2.5.3.1, the BLM has designated all fish streams crossed or closely associated with the pipeline ROW as zones of restricted activities. Approval to work in streams normally requires notification of appropriate environmental specialists in conjunction with submittal of an ADF&G Title 16 permit application (APSC 1998a). The final decision on whether a permit is required for a specific activity rests with the ADF&G.

Overwintering has been identified as an especially sensitive period for fish inhabiting arctic and subarctic freshwater environments (Power 1997; Reynolds 1997; Moulton and George 2000). Because overwintering areas are scarce in many river systems along the TAPS, fish movement can be restricted, and fish tend to be concentrated in specific areas during winter months. As a consequence, mortality to a large portion of a fish population can result when flow is altered in an overwintering area or water quality is degraded by introducing sediment, altering turbidity, temperatures, or contaminant levels. Such effects to overwintering areas were identified as concerns during Sagavanirktok River flood repairs and corrosion digs in 1993 and 1994, Dietrich River spur dike construction and Phelan Creek corrosion digs in 1993 (SPCO 1993, 1995), and construction of the Dietrich River revetment in 1999. To reduce the potential for adverse effects on overwintering fish, the ADF&G requires a Title 16 permit for water withdrawals in overwintering areas. Permits issued by the ADF&G typically require activities in known overwintering areas to be conducted during open-water periods or with engineering controls in place. Erosion control measures commonly used for maintenance and repair operations are identified by the APSC (1998b, 2001j).

Turbidity and sedimentation from erosion are part of the natural cycle of physical processes in water bodies, and most fish populations are adapted to short-term changes in these parameters. However, if sediment loads are unusually high, last for extended periods of time, or occur at unusual times of the year, adverse impacts can occur. Increased sediment can decrease fish feeding efficiency, reduce levels of invertebrate prey species, and decrease fish spawning success. Deposition of fine sediment on to spawning gravels can adversely affect the survival of incubating fish eggs, alevin, and fry. Activities that increase turbidity and sedimentation during the overwintering period for fish are of particular concern because fish are often restricted to specific areas and are already stressed by cold temperatures and low availability of food.

DenBeste and McCart (1984) reported that erosion of the workpads associated with TAPS structures could lead to sedimentation in some water bodies. It is anticipated that under most conditions, the impacts of sedimentation related to normal erosion would be relatively minor, as it would be most likely to occur during wet periods of the year when turbidity in streams is naturally higher. Potential impacts may be somewhat higher in some stream systems (e.g., Hess Creek) because they remain relatively clear even during rainfall events. In addition, there has been progressive restoration of stream banks and erosion control over the years since the TAPS was constructed.

Sedimentation during pipeline construction and maintenance activities was recognized early as potentially affecting fish habitat (USFWS 1970). Under the proposed action, activities such as culvert replacements, modification of stream crossings, and excavations and replacement of pipeline components located near water bodies would be most likely to result in sedimentation. Increased turbidity resulted from instream gravel mining during pipeline construction (Woodward-Clyde Consultants 1980) and, although less extensive than in the past, gravel mining would continue to occur under the proposed action. With current operations, ADF&G issues permits that specify restrictions, control measures, and monitoring and mitigation actions for TAPS-related construction or excavation projects. When feasible, activities are avoided during winter months in areas where overwintering fish may be affected. Typical monitoring required by ADEC and EPA includes baseline measurements upstream of the project, in the mixing zone immediately downstream of the project, and downstream of the mixing zone. Effective use of the ADF&G permit review processes would minimize the adverse effects of normal operations and maintenance along the TAPS ROW (SPCO 1993, 1995).

Airborne dust resulting from vehicle traffic along unpaved portions of the Dalton Highway is another potential source of sediment introduction into streams. This dust can get into streams either directly by falling into the water from the air or indirectly in runoff from erosion of dust that settled on areas adjacent to streams. Because the highway crossings of streams are only very short segments and the dust typically falls out within 300 ft of the roadway, the amount of sediment introduced into individual streams is expected to be very small and would be unlikely to affect fish populations.

In some cases, habitat alteration may provide some benefit to aquatic systems. For example, at MP 47, a spur dike caused a scour pool that added overwintering habitat in the Sagavanirktok River (Martin et al. 1993). Pits created by gravel mining in inactive floodplains of the North Slope have been shown to provide overwintering habitat for fish in some cases (Woodward-Clyde Consultants 1980; Hemming 1995). Hemming (1995) also reported that spawning success by Arctic grayling was indicated for two gravel extraction sites associated with the Kuparuk River. Additional overwintering habitat has also been created by ponding of water near the Atigun River at approximately MP 160. However, most fish using the Atigun River move downstream and overwinter in Galbraith Lake. Channels connecting the ponded area to the main river have been modified to allow overwintering fish (primarily Arctic grayling) better access to the river when flows increase in the spring.

Fish may also be affected by deposition of airborne pollutants onto surface waters. Modeling studies carried out for TAPS PS 2 and 7 for the addition of turbine rim cooling in 1990 included an evaluation of impacts of gaseous emissions on nearby wildlife (APSC 1990c). Air quality effects on anadromous fish in the Sagavanirktok and Chatanika Rivers were evaluated. The Sagavanirktok is about 0.1 mi east of PS 2, while the Tatalina River (a tributary to the Chatanika) is approximately 1.5 mi north of PS 7. The predicted levels of nitrogen oxides and sulfur dioxide for both river systems were below EPA screening levels, and significant impacts to fish were not anticipated.

There is a potential for discharges from the BWTF and the sanitary water treatment plant at Valdez Marine Terminal to affect fish in Prince William Sound. However, as reported in Section 3.11.1, discharges from both of these sources are in compliance with permitted levels (see also Section 4.3.8). The resulting pollutant concentrations in Prince William Sound are unlikely to have significant impacts on fish. Measured concentrations of PAHs in water and concentrations estimated on the basis of bioaccumulation in mussel tissues indicated that the concentrations of PAHs in Port Valdez waters are in the low parts-per-trillion (ppt) range (Salazar et al. 2002). This is well below the levels (approximately 1 ppb) that have been associated with adverse effects in herring and salmon embryos in the laboratory (Carls et al. 1999; Heintz et al. 1999). In addition, Salazar et al. (2002) did not detect reductions in overall growth of caged mussels that could be attributed to PAH burdens. In addition, concentrations of hydrocarbons in sediments near the ballast water diffuser in 1999 were found not to exceed sediment quality guidelines (Feder and Shaw 2000). Concentrations of PAHs in sediment and water due to BWTF operations are not expected to change substantially as a result of the proposed action.

A potential also exists that nonindigenous organisms could be introduced into Prince William Sound with discharges from the BWTF. Under the proposed action, the BWTF would continue to receive ballast water from tankers utilizing nonsegregated ballast water (i.e., the ballast water is carried in oil-holding compartments) in order to removed the oil residues contained within the ballast water. As discussed in Section 4.3.8.1, the amount of water treated in the BWTF should decrease during the renewal period as double-hulled tankers with segregated ballast water become more prevalent, but treatment of nonsegregated ballast water would continue until all tankers are double-hulled. A study by Ruiz and Hines (1997) found that nonsegregated ballast water contained very few viable organisms, possibly because of the toxicity of the hydrocarbons in the water. It is considered unlikely that nonindigenous organisms would be introduced into Port Valdez as a result of releasing the water treated in the BWTF. The potential for introduction of nonindigenous organisms into Prince William Sound via the exchange of untreated (i.e., not treated in the BWTF) segregated ballast water from oil tankers is addressed as part of the cumulative impacts presented in Section 4.7.7.2.1.

Essential fish habitat (EFH) consultation with NMFS was completed (Kurland 2002), including preparation of an EFH assessment (BLM 2002b). The EFH assessment indicated that alteration or loss of habitat under the proposed action may result in short-term adverse effects to essential habitat for salmon and Gulf of Alaska groundfish. However, the effects are expected to be adequately minimized and mitigated by conservation measures associated with the proposed action such that there would be no significant adverse effects to EFH.

4.3.16.2 Impacts of Obstruction of Fish Passage

Obstructions to fish movement are most likely to occur when culverts or low-water crossings are not properly sized or maintained (Gustafson 1977; Rockwell 1978; Elliott 1982). Movement can be obstructed at either high or low flow. Elliott (1982) investigated stream crossings and channel modifications in the Atigun River in 1980 and described a number of fish-passage problems associated with culvert placement and design. DenBeste and McCart (1984) concluded that most of the passage problems at pipeline crossings were from pipeline construction, with substantially fewer problems during pipeline operation. Vehicular traffic during periods of low water can cause rutting and accumulation of cobbles that interfere with fish passage. Low-water crossings and culvert crossings were recognized as a potential source of fish passage problems early in construction of TAPS (Gustafson 1977) and continued to be an issue (SPCO 1993, 1995). A recent review of compliance with the requirements of state laws (Title 16), regulations, and Federal Grant Stipulation 2.5 (Fish and Wildlife) revealed that approximately 23 site-specific fish passage deficiencies were recorded in the JPO Compliance Monitoring Database over the 5-year period from 1997 to 2001. The JPO's final report concluded that corrective actions by APSC had resolved these 23 previously recorded fish passage deficiencies (Gnath 2001).

Under the proposed action, activities that could obstruct movements would continue to be reviewed under the ADF&G Title 16 and Fish Habitat Permit processes. APSC also conducts a surveillance program along the pipeline, and identification of potential obstructions to fish movement is one aspect of that program. Current operations include training, coordination between APSC personnel and biologists from BLM and ADF&G, annual inspection of fish crossings to identify potential obstructions, and follow-up procedures to ensure that obstructions are removed and improvements are made in a timely fashion. Effective use of these surveillance reviews has minimized, and should continue to minimize, obstructions to fish movement along the ROW (SPCO 1993, 1995).

Fish Movement

The proposed action could result in temporary impediments to fish movement in some streams, but long-term effects on fish populations are not anticipated.

Obstruction of fish movement or entrapment also can occur during water withdrawal or when project activities such as in-stream gravel mining causes surface flows to spread, go below the surface, or become isolated (Woodward-Clyde Consultants 1980; Elliott 1982). Such a loss of surface flow occurred in the Atigun River, where flow dropped into the buried pipeline trench (Elliott 1982). Entrapment occurs, either naturally or due to human alterations, where decreasing flow strands fish in isolated pools. These pools can then dry out, become too warm to support fish, or freeze during winter (Woodward-Clyde Consultants 1980; Elliott 1982; DenBeste and McCart 1984). These problems were recognized either during the construction phase or early in operation and have been addressed with subsequent permitting and monitoring. Under Alaska Statute 16.05.870, permits from ADF&G are required for all activities below the ordinary high water line in anadromous fish waters. Excavation activities below the ordinary high water line in nonanadromous fish streams must be evaluated by ADF&G to determine if a Title 16 permit is required, pursuant to AS 16.05.840 (APSC 1998a). Because of the review and permitting process, obstruction of movement and entrapment are not expected to persist over multiple seasons and should not result in significant impacts to fish populations in streams or rivers along the ROW.

Another potential cause of entrapment is the attraction of fish to water heated by the pipeline. In some areas, the buried pipeline heats subsurface water, the water emerges at a higher temperature than the receiving water, and fish are attracted to the warmer water as they search for overwintering areas (DenBeste and McCart 1984). Mortality occurs when water subsequently freezes or becomes anoxic. Water temperature problems resulting from the buried pipeline have been identified in the Atigun, North Fork Chandalar, Dietrich, and Middle Fork Koyukuk Rivers. DenBeste and McCart (1984) concluded that small numbers of fish were being lost in those streams where instream pipeline burial caused such temperature problems. Lower throughputs of oil in the future would result in reduced thermal effects because oil temperatures in the pipeline would be lower. Under the proposed action, these impacts to fish are expected to be minor because thermal effects occur in limited areas and because only small numbers of fish are likely to be affected.

An EFH assessment (BLM 2002b) indicated that obstruction of fish passage under the proposed action may result in short-term adverse effects on essential habitat for salmon. However, the effects are expected to be adequately minimized and mitigated by conservation measures associated with the proposed action such that there will be no significant adverse effects to EFH.

4.3.16.3 Impacts of Increased Human Access

The increased access to remote areas provided by the ROW and access roads could potentially lead to increased harvest of fish in some locations. Prior to construction of TAPS, concern was expressed that such access might lead to excessive fish harvest (USFWS 1970). Overharvest can occur when access is provided to desirable resources and fishing regulations and enforcement do not adequately control harvest. BLM and USACE (1988) reported that in areas accessible to anglers, individual fish of the species preferred for harvest were smaller and less numerous than before construction of the TAPS Haul Road (now Dalton Highway). Because stream productivity is lower in northern areas than in southern areas, fish populations on the North Slope are likely to be more susceptible to impacts from excessive harvest than those in other regions of the state. Although such impacts may be important to stocks of fish in the immediate vicinity of access areas, they are not expected to be significant relative to nonanadromous fish populations as a whole in water bodies crossed by or adjacent to the TAPS ROW. Although a large increase in fishing effort and catch of Arctic char, Arctic grayling, and lake trout was expected when the entire length of the Dalton Highway was opened to the public in 1994, estimates from the annual Statewide Harvest Surveys do not indicate that this had happened on the North Slope (Burr 2001). In streams where anadromous fish migrate past access points, there is a potential for overharvesting to adversely impact anadromous fish populations. Maintenance of fish of desired sizes and at desired population levels has been largely accomplished by regulations established by the Board of Fish and enforced by the ADF&G. Consequently, the impacts of increased access to fish populations are expected to be minor. No adverse effects to EFH for salmon, scallops, or Gulf of Alaska groundfish from increased human access are expected under the proposed action (BLM 2002b; Kurland 2002).

4.3.17 Birds and Terrestrial Mammals

An overview of potential environmental changes associated with the proposed action that could affect wildlife is presented in Section 4.3.14. Undesirable consequences of any right-of-way corridor, such as that for the pipeline, can include adverse effects on hydrology and geomorphic features, habitat fragmentation, increased predation, road kills, invasion by nonnative species, increased spreading of diseases, degraded water quality and chemical contamination, degraded aquatic habitat, destructive human actions (e.g., poaching, fires, dumping), loss of soil productivity, and declines in biodiversity (Gucinski et al. 2001). Those changes most likely to affect wildlife include (1) habitat loss, alteration, or enhancement; (2) disturbance and/or displacement; (3) mortality; and (4) obstruction to movement. These impacts can result in changes in habitat use, changes in behavior, collisions with structures or vehicles, changes in predator populations, and chronic or acute toxicity from hydrocarbons and other compounds related to oil spills (see Section 4.4.4.11).

Impacts of Proposed Action on Birds and Terrestrial Mammals

Potential impacts to birds and terrestrial mammals associated with routine operation, maintenance, and monitoring of the TAPS include habitat loss, alteration, or enhancement; disturbance and/or displacement; mortality; and obstruction to movement. These impacts would essentially be a continuation of those currently associated with the TAPS. Impacts would be localized (e.g., usually to the immediate area of activity, although temporary avoidance responses may extend to 0.6 mi). Only individual animals would be impacted; no adverse impacts to populations of a species would be expected.

4.3.17.1 Habitat Loss, Alteration, or Enhancement

The direct and indirect effects from the existence and normal operation of the TAPS would include the habitat losses and modifications from maintenance activities; changes in habitat use caused by dust, impoundments, water quality impacts, or other habitat modifications; behavioral disturbance from noise and human activities; attraction or aversion to project facilities; wildlife injuries and mortality; and species-specific reductions or increases in productivity (Ritchie and Anderson 1997). Effects on wildlife from habitat loss or modification, discharges, and disturbance are expected to be minor at the population level and may not be detectable above natural population fluctuations (ADNR 2000b; MMS 1998).

Generally, wildlife impacts associated with facility existence would occur from monitoring and maintenance over the next 30 years. Construction of the TAPS and monitoring and maintenance over the past 30 years have resulted in the current affected environment for birds and terrestrial mammals, as described in Sections 3.20 and 3.21. Impacts to wildlife have occurred primarily from the elimination and modification of habitats within the ROW, access roads, pump stations, Valdez Marine Terminal, and associated facilities (e.g., camps, airfields, and material sites). Habitat modification has resulted in both beneficial and adverse impacts to certain species. Wildlife species that would continue to be adversely affected by the existence of the TAPS are those that are most dependent on forests within the interior. Species preferring edge, shrub, willows, old-field or grassland habitats will continue to benefit from the existence of the TAPS. Some species may experience both beneficial and adverse impacts. For example, although the impoundments created by roads and workpads have provided nesting habitat for the Pacific loon, roads may prevent movement of loon families between wetlands, limiting their access to adequate food supplies (Kertell 2000).

With certain exceptions, areas lacking vegetation (e.g., workpad, access roads, active portions of quarries, river spurs, and river training structures) provide minimal habitat. Gravel roads and pads within the North Slope have reduced grazing habitat for caribou, but have provided insect-relief habitat (MMS 1998). Ground squirrels occupy previously unavailable areas and den in gravel fill within the oil fields (Shideler and Hechtel 2000). While gravel placement has resulted in habitat loss for most shorebirds, a few species, such as the semipalmated plover, that frequent natural gravel habitats, make use of the gravel pads and roads. Other shorebirds may roost or display from the elevated gravel surfaces (Troy 2000). Foxes have been known to use culverts and other construction materials for denning sites (ADNR 1999). Beavers dam culverts and occupy other areas where flowing water is diverted around TAPS infrastructure.

Periodic brush cutting of the ROW, which occurs primarily in forested areas, maintains those sections of the ROW in an early stage of plant community succession. Such vegetation management could benefit small mammals that use early successional habitats (e.g., hares) and their predators (e.g., lynx). Temporary increases in growth of willows following brush cutting benefits moose and other species that use willows (Wilson 2002). However, habitat maintenance can have localized adverse effects on species such as red squirrels, red-backed voles, and marten that prefer late-successional or forested habitats.

A corridor such as the TAPS ROW provides a specialized early succession habitat for certain species and travel lanes that enhance species' movements; however, it also presents barriers to movement for other species. The edges provided by rights-of-way (especially in forested areas) can be areas of relatively high biological productivity. Medium-sized predators concentrate within edges because of the increased availability of prey there (Williams 1995). Furthermore, the TAPS ROW can increase the browse available to ungulates (hooved animals such as moose and caribou) (Lunseth 1987).

Dust fallout is a common occurrence along the Dalton Highway (see Section 4.3.15.2). In areas of heavy dusting, vegetation can be eliminated within 70 ft of the road (TAPS Owners 2001a). Thermokarst has also been noted within 80 ft of a road (Troy 2000). In areas farther from the road or adjacent to less traveled dirt roads, the effects of dust fallout are early snowmelt and vegetation greening in spring, making such areas attractive to many herbivorous animals and, consequently, their predators (see TAPS Owners 2001a). Dust effects occur within less than 1.0 mi, with most effects concentrated within 300 ft of the roadway (MMS 1996), except in the areas where dust deposition may blanket the vegetation. Waterfowl can benefit from both early open water and the early season food-plant growth in dust deposition areas (Section 4.3.15) (MMS 1998; Brown 2002). Often, roadside ditches provide the only open water areas during spring and, as such, attract birds (Anderson 2002). Heat from the buried portions of the pipeline can also provide similar benefits to waterfowl and other wildlife.

Most maintenance activities can occur on or along the workpad, so only minimal changes to wildlife habitat are expected under the proposed action. Nevertheless, some temporary losses of habitats along the TAPS would occur from ground-impacting activities (primarily trenching). Excavation, gravel placement, and other earthwork would normally alter small areas, primarily affecting small mammals such as shrews, voles, lemmings, and squirrels inhabiting those sites. Given the relatively small area that would be covered by newly placed gravel, the direct effects on wildlife populations of gravel placement are expected to be minimal.

4.3.17.2 Disturbance and Displacement

With normal operations of the TAPS, animals would continue to be disturbed by aircraft, trucks, snow machines, off-road vehicles, foot traffic, excavation equipment, and facility machinery. The response of wildlife to this disturbance is highly variable and depends on species; physiological or reproductive condition; distance; and type, intensity, and duration of disturbance (MMS 1995). In some areas, disturbance may affect selection of den sites by species such as bear and fox or displace animals from their dens. Wildlife can respond to disturbance in various ways, including attraction, habituation, and avoidance (Knight and Cole 1991).

Use of the TAPS ROW by snowmachines and ATVs may disturb and cause temporary displacement of some individuals. This activity has the potential to disturb denning animals on the ROW and in locations where these vehicles leave the ROW to access other areas. The entire ROW is used extensively for snow machine and ATV access in recreational activities, mining, trapping, and subsistence hunting (Schmidt 1999; Trudgen 1999).

Habituation to the TAPS and oil field facilities has been documented for a number of species. Moose acclimate to certain levels of disturbance over time, and the overall effects of normal operations are not expected to adversely affect moose populations (ADNR 2000b). Sopuck and Vernam (1986b) found that the distribution and local movements of moose were not significantly affected by the TAPS near Big Delta. Repeated exposure to human activities over a large area of summer range has lead to some acclimation by caribou of the Central Arctic herd (Cronin et al. 1994). Nevertheless, for the 2-week period during calving, some cows with calves will avoid an area up to 0.6 mi around roads and facilities (Cameron et al. 1992). Additionally, the Prudhoe Bay oil field is a very wet area that is not an ideal area for calving. Therefore, there is no evidence that the area was ever used by a large number of caribou during calving (Cronin et al. 1998b). The Nelchina caribou herd (see Map 3.21-2) continues to migrate along traditional routes despite the presence of the TAPS (Carruthers and Jakimchuk 1987). There is no evidence that populations of Dall sheep, musk ox, bison, or moose have been displaced as a result of the operation and maintenance of the TAPS (DuBois and Rogers 1999; Reynolds 1998; Eide et al. 1986; Jakimchuk et al. 1984), but such impacts may not be detectable above natural population fluctuations (ADNR 2000a; MMS 1998).

Bears, wolves, foxes, and squirrels are readily habituated and even attracted to human activities, primarily when a food source is accidentally or deliberately made available (Milke 1977; Follmann et al. 1980). Human food wastes and other attractants in developed areas can increase the populations of foxes, gulls, ravens, and brown bears, which in turn prey on waterfowl and other birds (Johnson 2000a,b; Ritchie and King 2000; Sedinger and Stickney 2000; Shideler and Hechtel 2000). It has been suggested that efforts to minimize impacts of predators may have greater benefits to wildlife populations in oil fields than would efforts to minimize habitat loss (Troy 2000).

Regular or periodic disturbance at TAPS facilities could cause adjacent habitats to be less attractive to wildlife and result in a long-term reduction of wildlife use in areas exposed to a repeated variety of visual disturbances and noise. A study of the effects of increased noise at the Central Compressor Plant in the Prudhoe Bay oil field found that spectacled eiders and pre-nesting Canada geese avoided habitats near noise sources. However, most species, including nesting Canada geese and brood-rearing brant, often habituate to these noises (Anderson et al. 1992). Although it has been demonstrated that some brown bears avoid areas within about 300 ft of roads (McLellan and Shackleton 1988), this response has not been reported in the TAPS and Prudhoe Bay areas.

Displaced animals could have lower reproductive success if they would be displaced to areas already occupied by others of their species (Riffell et al. 1996). However, it has not been demonstrated that animals within the North Slope are at their carrying capacity (Troy and Carpenter 1990). Thus, considering other population limiting factors, displacement does not seem likely to become a limiting factor (Brown 2002). If birds are disturbed sufficiently during the nesting season to cause displacement, then nest or brood abandonment might occur and the eggs and young of displaced birds would be more susceptible to cold or predators. However, no population-level effects to any wildlife species related to oil field developments, including the TAPS, have been demonstrated.

Caribou can be disturbed by snow machines and other moving vehicles (Tyler 1991; Horejsi 1981). Individual caribou generally hesitate before crossing under an elevated pipeline and may postpone crossing a pipeline and road for several minutes or hours during periods of heavy road traffic. Nevertheless, successful road crossings do occur (MMS 1998). Disturbance of individual caribou could cause (1) energetic stress resulting from displacement and (2) increased exposure to predators. In general, caribou can habituate to structures, noise, or odors. However, this generality does not apply to female caribou with newborn calves within 0.6 mi of roads or facilities, as previously mentioned. Also, all caribou habituate slowly or not at all to people on foot or to large moving objects (Murphy and Lawhead 2000). Regardless of potential impacts to individual caribou, the Central Arctic caribou herd has grown since its documented concurrence with oil field development (e.g., from about 5,000 in 1978 to more than 27,000 in 2000) (TAPS Owners 2001a; Lenart 2000). Traditional knowledge viewpoints on the potential effects of the TAPS (and oil field development) on caribou movements are presented in Section 3.24 and are also addressed in Section 4.3.20.

Disturbance also can result from regular helicopter surveillance and other flights along the TAPS ROW. The effects of aircraft on wildlife vary among species, populations, environmental variables, and habitat types (TAPS Owners 2001a). For example, Watson (1993) reported that disturbance to bald eagles was greater in response to helicopters than to fixed-wing aircraft at similar distances. The response of brown bears to helicopters and fixed-wing aircraft depends on the degree of habituation, availability of cover, and aircraft flight characteristics (Harting 1987). Animals that live near airports or other continuous sources of aircraft disturbance appear to become habituated (TAPS Owners 2001a). On the other hand, when brant are molting (losing feathers) they can be disturbed by helicopter takeoffs and landings at distances up to 1.7 mi (MMS 1996). If aircraft overflights are infrequent and of short duration, long-term displacement or abandonment of nesting, molting, or foraging areas is unlikely (MMS 1998). Generally, routine overflights by surveillance aircraft would only temporarily disturb animals along or near the ROW. Such disturbances would constitute a minor impact to animals residing in those areas, provided that deliberate harassment did not occur. Flight distance restrictions apply near zones of restricted access (ZRAs) to protect peregrine falcons and other nesting raptors (e.g., Franklin Bluffs Peregrine Falcon ZRA and Sagwon Bluffs Peregrine Falcon ZRA [APSC 1993]).

The effects on caribou from disturbance by helicopter and light fixed-wing aircraft have been studied extensively (see TAPS Owners 2001a). Responses of caribou to aircraft disturbance depend on season, activity before overflights, and habituation (Valkenburg and Davis 1984). Low-flying aircraft, fast-moving ground vehicles, and construction activities can disturb caribou. Responses can vary from no reaction to panic behavior. Cow and calf groups appear to be most sensitive (MMS 1998). Panic behavior can occur when aircraft fly within 1,000 ft (Calef et al. 1976). This response occurred when the aircraft circled and repeatedly flew over caribou groups. Disturbance from a single pass of an aircraft is expected to be brief, lasting a few minutes to one hour. These short-term disturbances should not affect caribou herd distribution or abundance (MMS 1998).

Most studies reported a fixed-wing tolerance threshold of 200 ft, below which panic and escape responses in individual caribou were apparent. Above 500 ft, reactions were rarely observed (see McKechnie and Gladwin 1993). As with most other terrestrial mammals, responses elicited in caribou by helicopter disturbances are greater than those from light fixed-wing planes. The tolerance threshold for helicopters was estimated to be 1,000 ft in altitude (Miller and Gunn 1979).

Reynolds (1998) cautioned that because musk ox are present on the Arctic Coastal Plain year-round and are limited by winter weather and food availability, they are vulnerable to human activities and should be avoided before, during, and after calving (April to mid-June). Energetic costs associated with forced movements of musk ox in winter from disturbance could be as significant as disturbance impacts during the calving season (ADNR 1999).

Brush cutting along the TAPS ROW would cause short-term disturbance of wildlife in the immediate vicinity of such activities. Animals that inhabit shrubs in the ROW would be displaced to adjacent undisturbed habitats. The relatively low frequency of this activity (once every few years, depending on the rate of vegetation growth) would reduce the severity of the impact. Avoidance of brush cutting in the early summer nesting period would further reduce these impacts to birds.

4.3.17.3 Mortality

The presence of TAPS facilities (e.g., pump stations, elevated portions of the pipeline, and the Valdez Marine Terminal) creates a physical hazard for some wildlife. For example, birds can collide with buildings during flight, and mammals may collide with fences. However, collisions of birds and mammals with TAPS facilities are infrequent (TAPS Owners 2001a).

The killing of nuisance bears and wolves has not been identified as a significant limiting factor for populations of these mammals in the vicinity of the ROW. With improved garbage management by APSC, enforcement of the animal feeding policy, public awareness programs, personnel training, and implementation of bear and nuisance wildlife plans, the incidence of killing nuisance animals as a part of TAPS operation is not expected to increase and might actually decrease over the

30-year renewal period. However, as the number of people continues to increase in all areas of the state, concerns for human safety will continue to be the main factor in nonhunting mortality of bears and wolves. In particular, with more frequent recreational use of remote areas accessible from the Dalton Highway (BLM 1998), mortality of brown bears may increase.

Legal and illegal take by hunters and trappers who use the ROW, Dalton Highway, and access roads will constitute one of the impacts associated with continued operation of the TAPS system on gamebirds (e.g., waterfowl and ptarmigan) and furbearers (BLM 1998; TAPS Owners 2001a). These losses of game species could adversely affect predators, such as raptors, by decreasing the prey base (BLM 1998). However, hunting management regulations are designed to prevent serious impacts on populations. Hunter access will be available with or without ROW renewal. There is no evidence demonstrating whether increased access associated with the TAPS ROW has had an effect on wildlife populations (see also Sections 4.3.20 and 4.3.24.1) (TAPS Owners 2001a).

Vehicle use associated with normal operations (e.g., during transport of goods, monitoring, or commutes of workers to maintenance sites) could also affect wildlife. Collision with vehicles can be a source of mortality, especially in wildlife concentration areas or travel corridors. Increased traffic volumes result from increased human population and improved access. As the Dalton Highway increases in recreational value and its use is advertised and encouraged (BLM 1998), traffic volumes may increase. Concentrations of wildlife occur near the highway during spring snowmelt, and the numbers of roadkills increase during that period (Brown 1999; Shoulders 1999). Public use of access roads is very restricted, so roadkills on these roads would be extremely low. From a wildlife population perspective, roadkills do not result in a significant impact.

4.3.17.4 Obstruction to Movement

Continued operation of the TAPS would maintain a cleared ROW that may hinder or prevent movements of some small mammals. In particular, species preferring heavy cover in forested areas may be adversely affected (Oxley et al. 1974; Forman and Alexander 1998). Caribou, moose, Dall sheep, and bison encounter the pipeline and associated roads during seasonal migrations. The pipeline and associated facilities have become established components of the annual home range for nonmigratory populations. The degree to which roads serve as barriers to the movements of terrestrial mammals depends on traffic volume and speed, roadside vegetation, traditional movement patterns, and environmental factors motivating animal movement (e.g., insect harassment, predator avoidance) (Curatolo and Murphy 1986; Cronin et al. 1994).

In general, the ROW and the Dalton Highway are not barriers to movements of terrestrial mammals. However, there is evidence of deflected or delayed movements of individual moose and caribou. These occurrences are not regular, and no data indicate adverse effects at the population level (TAPS Owners 2001a). Caribou cows with new calves are wary of potential predators and may distance themselves from roads with traffic. Studies in the Milne Point oil field indicated that on the basis of a homogenous distribution, statistically fewer than expected numbers of calves were located closer than 0.06 mi from a road with traffic (Cameron et al. 1992). However, there were some calves within 0.6 mi, and all of the pregnant cows had to cross roads and pipelines to get into the study area (TAPS Owners 2001a).

4.3.18 Threatened, Endangered, and Protected Species

Six species that are federally listed as threatened, endangered, or depleted occur in the vicinity of the TAPS and may be affected by the proposed action. However, no designated critical habitat occurs in the vicinity of the TAPS. The spectacled eider and Steller's eider occur in the northernmost portions of the ROW. Both eiders are federally listed under the ESA as threatened and are considered species of special concern by the state. The fin whale, humpback whale, and Steller sea lion occur in Prince William Sound at the southern terminus of the TAPS and are listed under the ESA as endangered and under the MMPA as depleted. The humpback whale is state-listed as endangered, and the Steller sea lion is considered a species of special concern by the state. The beluga whale may occasionally occur in Prince William Sound in the winter; these animals are from the Cook Inlet stock, which is listed under the MMPA as depleted.

Impacts of Proposed Action on Threatened, Endangered, and Protected Species

Impacts to listed and protected species that may result from the proposed action would be within the range of those experienced over the past 25 years of TAPS operations. Impacts may result from ground disturbing activities, operational noise, human disturbance, and release of effluents from the Valdez Marine Terminal into Prince William Sound. Impacts are not expected to produce population-level effects that are distinguishable from natural variation in numbers.

Although the proposed action may result in some impacts to all of these species (see Table 4.3-5), the impacts are not expected to produce population-level effects that are distinguishable from natural variation in numbers. None of the listed and protected species that occur within the Beaufort Sea would be affected by the proposed action because TAPS operation does not directly or indirectly affect the waters of the Beaufort Sea. A biological evaluation, prepared by the BLM pursuant to Section 7 of the ESA, concluded that the proposed action was not likely to adversely affect any listed species or critical habitat (BLM 2002a). Both the USFWS and NMFS concurred with this conclusion (Balsiger 2002; Bennett 2002).

Several other listed or protected species occur in the vicinity of TAPS and also may be affected by the proposed action. Potential impacts to these species also are summarized in Table 4.3-5. The Eskimo curlew, federally and state-listed as endangered, formerly nested in habitat crossed by the ROW, but it has not been observed in the wild for decades and may be extinct. Two formerly listed species — American peregrine falcon and Arctic peregrine falcon — nest along the ROW. Four species of songbirds — olive-sided flycatcher, gray-cheeked thrush, Townsend's warbler, and blackpoll warbler — are considered species of special concern by the state and could occur along the ROW. Eight species of marine mammals occur in Prince William Sound and are protected but not considered depleted under the MMPA. These species include the gray whale, minke whale, killer whale, Pacific white-sided dolphin, harbor porpoise, Dall's porpoise, harbor seal, and sea otter. No other species occurring in the vicinity of the TAPS are candidates or proposed for federal or state listing.

4.3.18.1 Impacts to Spectacled and Steller's Eiders

Both the spectacled eider and Steller's eider breed along the coast of the Beaufort Sea and in adjacent wetlands and ponds of the Arctic Coastal Plain. The portion of the TAPS ROW that crosses through habitat of these species is between MP 0 and 40. The number of spectacled eiders in the vicinity of the TAPS is relatively low compared with the numbers of other portions of the species' summer range, and although Steller's eider habitat exists in the project area, none have been observed there (see Section 3.22.1). Overall, the potential for interaction between these species and TAPS infrastructure and operations is relatively low because of the distribution and density of populations in the project area. The relatively low density of eiders in the TAPS vicinity has not been attributed to human disturbance or developments, and these species exist in relatively high densities in other portions of North Slope oil fields where levels of development and activity are comparable or even higher (Anderson et al. 1992; TERA 1995, 1996; Warnock and Troy 1992).

TABLE 4.3-5 Potential Impacts of the Proposed Action on Threatened, Endangered, and Protected Species

Species	Status[a]	Time of Year	Locations	Potential Impacts
Spectacled eider	ESA-T AK-SC	May - Sept.	Wetlands and ponds of Arctic Coastal Plain (MP 0–40)	Potential disturbance in immediate vicinity of ROW resulting from noise and human activity associated with monitoring and maintenance activities and PS 1 operations. Ground-disturbing activities could affect nesting habitat if water or sediment is discharged into nesting habitat.
Steller's eider	ESA-T AK-SC	May - Sept. along ROW; winter in Prince William Sound	Wetlands and ponds of Arctic Coastal Plain (MP 0–40); Prince William Sound	Same as previous along ROW. In Prince William Sound, routine operations result in effluent discharge, but these discharges are expected to decrease over the renewal period; no impacts to the species are anticipated.
Eskimo curlew	ESA-E AK-E	NA[b]	NA	No impacts anticipated because species probably extinct. Previously nested in arctic tundra of Alaska and Canada.
American peregrine falcon	ESA-DM AK-SC	April - Sept.	Near rivers and lakes south of Brooks Range (MP 240–800)	Potential disturbance in immediate vicinity of ROW resulting from noise and human activity associated with monitoring and maintenance activities and pump station operations.
Arctic peregrine falcon	ESA-DM AK-SC	April - Oct.	Near Sagavanirktok River (MP 0–110)	Same as previous.
Olive-sided flycatcher	AK-SC	April - Oct.	Coniferous forest south of Brooks Range (MP 240–800)	Same as previous.
Gray-cheeked thrush	AK-SC	May - Oct.	Coniferous and mixed forest south of Brooks Range (MP 240–800)	Same as previous.
Townsend's warbler	AK-SC	April - Oct.	Coniferous forest in Yukon River valley (MP 330–380) and southern Alaska (MP 540–800)	Same as previous.
Blackpoll warbler	AK-SC	April - Oct.	Coniferous and mixed forest south of Brooks Range (MP 240–800)	Same as previous.

TABLE 4.3-5 (Cont.)

Species	Status[a]	Time of Year	Locations	Potential Impacts
Gray whale	ESA-D MMPA-P	Late spring and early fall	Prince William Sound	Routine operations at the Valdez Marine Terminal result in effluent discharges to Prince William Sound; these discharges, however, are expected to decrease over the renewal period. No impacts to the species are anticipated.
Fin whale	ESA-E MMPA-D	April – June	Prince William Sound	Same as previous.
Beluga whale	MMPA-D	Winter	Prince William Sound	Same as previous.
Minke whale	MMPA-P	Summer	Prince William Sound	Same as previous.
Humpback whale	ESA-E MMPA-D AK-E	Summer	Prince William Sound	Same as previous.
Killer whale	MMPA-P	All year	Prince William Sound	Same as previous.
Pacific white-sided dolphin	MMPA-P	All year	Prince William Sound	Same as previous.
Harbor porpoise	MMPA-P	All year	Prince William Sound	Same as previous.
Dall's porpoise	MMPA-P	All year	Prince William Sound	Same as previous.
Steller sea lion	ESA-E MMPA-D AK-SC	All year	Prince William Sound	Same as previous.
Harbor seal	MMPA-P	All year	Prince William Sound	Same as previous.
Sea otter	MMPA-P	All year	Prince William Sound	Same as previous.

[a] Notation: ESA = listed under the Endangered Species Act with the following qualifiers: E = endangered, T = threatened, D = delisted, DM = delisted but being monitored; AK-SC = Alaska species of special concern; MMPA = listed under the Marine Mammal Protection Act, with the following qualifiers: D = depleted, P = protected.

[b] NA = not applicable.

The proposed action may affect individuals of either eider species in several ways. Human activity associated with normal operations, monitoring, and maintenance would occur regularly throughout the 30-year renewal period along the ROW and in the vicinity of PS 1. This activity and the noise generated by equipment have the potential to disturb eiders, especially during nesting. In addition, any ground-disturbing activities needed to repair the pipeline, workpad, or associated facilities could affect habitat if water or sediment was discharged into nesting habitat. As discussed below, there is no indication that the proposed action would affect populations of either the spectacled or Steller's eider.

Human activities would occur along the TAPS on a daily basis under the proposed action as a consequence of normal operations, monitoring, maintenance, and surveillance. Additionally, the presence of the TAPS and the Dalton Highway would continue to support increased human activity on the North Slope. Eiders appear to be attracted to roadside areas prior to nesting, when these areas are largely snow free and many are flooded (Warnock and Troy 1992). Warnock and Troy (1992) reported slightly fewer than expected spectacled eiders within 800 ft of facilities on the North Slope, but this difference was not statistically significant. Helicopter overflights and other activities associated with TAPS monitoring and maintenance have the potential to disturb nesting eiders in the action area and may result in temporary displacement from nests or, potentially, nest abandonment. Human activities associated with normal operations, monitoring, maintenance, and surveillance are not likely to adversely affect either spectacled or Steller's eiders because so few eiders occur in the TAPS action area, and similar activities have occurred during the past 25 years of operations without apparent effects on either species.

Continuous noise would be generated by PS operations during the 30-year renewal period and has the potential to affect spectacled and Steller's eiders. Noise measurements have not been made in the vicinity, but the original TAPS EIS (BLM 1972) conservatively estimated that noise levels would be 74 dBA at 600 ft from the facility (see Section 3.14). Previous studies of the response of birds to continuous noise have reported habituation in some species but avoidance by others, especially during sensitive periods such as the nesting period (Manci et al. 1988; LaGory et al. 2001). However, pump station noise is not likely to adversely affect either spectacled or Steller's eiders because the density of eiders in the project area is so low. These facilities have operated for the past 25 years without apparent effects on either species.

Under the proposed action, periodic ground-disturbing activities may affect spectacled and Steller's eiders in the vicinity of TAPS. Most of these activities would occur within the ROW and be limited to the existing workpad, where impacts would be minimal. However, runoff from construction areas may affect adjacent habitats off the workpad. Spectacled eiders are known to preferentially use roadside impoundments (as occur along the workpad) during the pre-nesting and brood-rearing periods (Warnock and Troy 1992), and they may be affected by any degradation of these habitats caused by sedimentation. Erosion control practices are identified in the *Trans-Alaska Pipeline Maintenance and Repair Manual,* MR-48 (APSC 2001j) and would effectively minimize the potential for significant sedimentation effects.

Water that accumulates in excavations (e.g., corrosion-repair excavations) and in the secondary containment areas at pump stations is pumped out and discharged to adjacent areas. These discharges are governed by a state permit that requires notification, volume estimates, and descriptions of procedures to minimize erosion and discharge of pollutants (see Section 4.3.6). Consequently, these discharges are not likely to adversely affect eiders.

The proposed action is not expected to result in increased hunting pressure on either spectacled or Steller's eiders. Currently, little, if any, hunting occurs in the breeding areas of the North Slope; no hunting is permitted in the Prudhoe Bay area (Warnock and Troy 1992); and the harvest of either of these species is protected.

Human activities on the North Slope, particularly with regard to food waste management practices, have a potential to support increased populations of predators that feed on waterfowl eggs and young (USFWS 2002). Such predators, which include glaucous gulls, common ravens, grizzly bears, and Arctic foxes, are attracted to human food wastes and structures. Predation may be the single most important factor affecting eider nesting success in some areas (USFWS 2002). The TAPS Environmental Protection Manual (APSC 1998b) includes a number of project requirements designed to eliminate or minimize this potential problem of predator attraction. These measures include improved solid-waste management (e.g., prompt and thorough incineration of garbage, complete enclosure of pump stations with fences, use of bear-proof garbage containers) and the prohibition of the feeding of wildlife and conducting other avoidable activities that may attract wildlife to work areas. Currently, all food wastes generated at PS 1, 2, and 3 are stored in sealed containers and then incinerated prior to disposal. TAPS infrastructure is used by some species for nesting or shelter (e.g., ravens and Arctic foxes) and may support higher densities of these species. TAPS ROW grant renewal is not expected to increase predator populations and, consequently, not likely to adversely affect either the spectacled or Steller's eider.

Normal Valdez Marine Terminal operations are not expected to adversely affect either the spectacled eider or Steller's eider. The spectacled eider does not occur in Prince William Sound, and Steller's eiders are occasionally found there only in winter and only outside of Port Valdez. Water quality impacts from Valdez Marine Terminal effluent discharge to Port Valdez have not resulted in water quality degradation during the past 25 years of operations, and no such degradation is anticipated during the renewal period, when discharges will be substantially reduced. All discharges are regulated by an NPDES permit requiring that effluents be maintained within protective limits (see Section 4.3.8.1 for additional details). Normal Valdez Marine Terminal operations are not likely to adversely affect either the spectacled or Steller's eider.

4.3.18.2 Impacts to Fin Whale, Humpback Whale, Beluga Whale, and Steller Sea Lion

The fin whale, humpback whale, beluga whale, and Steller sea lion all occur in Prince William Sound at various times of the year. These species may be affected by normal operations under the proposed action if effluent discharged from the Valdez Marine Terminal Ballast Water Treatment Facility and sanitary wastewater treatment plant into Port Valdez resulted in water quality degradation of Prince William Sound. However, discharges from the Valdez Marine Terminal facilities are regulated under an NPDES permit that establishes limitations and a monitoring schedule for flow rate, biochemical oxygen demand, total suspended solids, pH, benzene, toluene, ethylbenzene, xylene, total aqueous hydrocarbons, dissolved inorganic phosphorous, ammonia, zinc, and whole effluent toxicity (see Table 3.11-1 in Section 3.11.1.1). Measured discharge levels have been well below permit requirements and can be expected to continue that way during the 30-year renewal period. In general, water quality within Prince William Sound is considered good, and impacts to these species are not expected to result from effluent discharge associated with normal operations under the proposed action.

4.3.18.3 Impacts to Other Species

A number of other protected species or species of concern exist along the ROW or occur in Prince William Sound (Table 4.3-5. The American peregrine falcon, Arctic peregrine falcon, olive-sided flycatcher, gray-cheeked thrush, Townsend's warbler, and blackpoll warbler occur in various habitats and locations along the ROW and may be disturbed by human activities associated with normal operations, monitoring, and maintenance. For the most part, however, these disturbances are expected to result in temporary displacement of individuals until disturbing activities in a specific location cease. Habitat modification associated with the proposed action would have little, if any, impact on these species because ground-disturbing activities generally would be limited to the ROW and previously disturbed areas. Any indirect effects to adjacent habitats resulting from erosion or sedimentation are unlikely to affect populations of these species. Noise generated by the continuously operating pump stations and other equipment may result in a reduction in the use of adjacent habitats by these species. No studies are available documenting the response of these species to disturbance from the TAPS, but any impacts are expected to be limited to the immediate project area, should be relatively minor over the 30-year renewal period, and should be within the range of impacts experienced over the past 25 years of operations. It should be noted that there is no indication that TAPS operations have affected any of these species.

The JPO, in conjunction with the USFWS, has designated five nesting and rearing areas used by peregrine falcons in the vicinity of the TAPS ROW as zones of restricted activity: (1) Franklin Bluffs on the east side of the Sagavanirktok River (MP 15–36); (2) Sagwon Bluffs on the east side of the Sagavanirktok River (MP 57–61 and 59–68); (3) Slope Mountain (MP 113–116); (4) Yukon River (MP 350–355); and (5) Grapefruit Rocks (MP 417–418) (APSC 1998b). This designation provides certain protective restrictions, including (1) restriction of aircraft and ground vehicle use in the areas during the nesting season (April 15 to August 5), (2) prohibition of the construction of permanent facilities, and (3) prohibition of the use of pesticides. These restrictions would serve to limit the impact of the proposed action on peregrine falcons.

Several species of protected marine mammals in addition to those discussed in Section 4.3.18.2 also occur in Prince William Sound. They are the gray whale, minke whale, killer whale, Pacific white-sided dolphin, harbor porpoise, Dall's porpoise, harbor seal, and sea otter. None of these species is considered rare or listed as depleted under the MMPA. Impacts may occur if discharges from Valdez Marine Terminal facilities resulted in degraded water quality in Prince William Sound. As discussed in Section 3.11.1.1, there is no indication that the water quality of Prince William Sound has been significantly degraded by Valdez Marine Terminal operations, and, consequently, normal operations over the 30-year renewal period should not have a measurable impact on any of these species.

4.3.19 Economics

Renewal of the Federal Grant and continued operation of the pipeline would impact the national economy, the state economy, and the regional economies along the pipeline corridor. These effects would include direct and indirect economic impacts of oil production and the pipeline operation itself at the three geographic scales. Section A.8 in Appendix A describes the methodology used to calculate these economic impacts. The impacts of pipeline renewal on Alaska Native corporations and subsistence activities are also included in this analysis. The economic impact of accidental oil spills from the pipeline are evaluated in Section 4.4.4.13. Potential impacts of accidents related to tanker transportation in Prince William Sound are included in the analysis of the cumulative impacts (Section 4.7).

Economic Impact Assessment

As described in Appendix A, Section A.8, the Man in the Arctic Program (MAP) computer model developed at the University of Alaska-Anchorage, Institute for Social and Economic Research, was used to assess potential economic impacts of future TAPS operations. The model uses three modules – an economic module, a demographic module, and a fiscal module – to evaluate possible impacts in those areas over the range of changing conditions being examined. The results are discussed here for the proposed action.

4.3.19.1 Assumptions Used in the Analysis

Various assumptions were required in order to conduct the economic impact analysis.

Included were assumptions relating to pipeline operations, North Slope oil production, world oil prices, and other activities in the Alaskan economy, in particular key sectors that are important sources of potential future employment — namely the seafood, tourism, air cargo, and state and local government sectors. These assumptions are discussed in the following subsections.

4.3.19.1.1 Assumptions Relating to Oil Production, Prices, and Pipeline Transportation. The following assumptions were made relating to oil production, prices, and pipeline transportation:

- *North Slope oil production:* The analysis used forecasts of annual North Slope production published by the DOE's Energy Information Administration (DOE-EIA) (DOE 2001a). Those forecasts include anticipated production from oil fields currently producing oil, production from the anticipated development of identified fields, and production from technically recoverable but as yet undiscovered oil resources. Consideration of probabilities associated with production in each of these categories yields a bounding range of potential production in each year. For the purposes of analysis, the mean value was chosen for all potential production in these categories in each year of the renewal period. Included in the evaluation was production from existing producing and developing fields and the addition of oil from the Prudhoe Bay/Central Area in 2005, the Northeast NPR-A fields beginning in 2010, and the West-NPR-A in 2015. On the basis of this forecast, production levels are expected to increase slightly between 2000 and 2005, and then begin a steady decline throughout the remainder of the renewal period (Table 4.3-6).

- *World oil prices:* The analysis used world crude oil prices forecasted by DOE (DOE 2001b). These forecasts show a drop in crude prices in real dollars over the period 2000-2005, after which prices slowly rise over the period 2006-2020 (Table 4.3-6).

TABLE 4.3-6 Projected North Slope Oil Production and World Crude Oil Prices

Year	North Slope Production[a] (10^6 bbl/d)	Oil Prices[b] (2000 $/bbl)
2000	1.045	27.72
2005	1.084	22.73
2010	0.961	23.36
2015	0.888	24.00
2020	0.723	24.68
2025	0.509	-
2030	0.315	-
2034	0.208	-

[a] Source DOE (2001a).

[b] Source: DOE (2001b).

- *Pipeline operations:* Including operations, contract workers, and special project employment, it was assumed that there would be 1,828 workers operating the pipeline at the beginning of the renewal period. This number would fall to 1,716 in 2008, with declining throughput after 2005 and the closure of a number of pump stations, and remain steady at that level for the remainder of the renewal period (TAPS Owners 2001a).

- *Oil field development activities:* Oil exploration, development, and production in the North Slope fields would continue throughout the renewal period, with no activity assumed to occur in the Arctic National Wildlife Reserve (ANWR). Employment in the oil fields would remain constant, as smaller, more labor-intensive fields replace larger, more productive fields. Development of North Slope gas resources was assumed to occur throughout the renewal period, but no specific projects, such as gas to liquids for transport in the TAPS or a separate gas pipeline, were included in the analysis.

- *Oil industry activities:* Manufacture of oil field equipment and supplies would continue throughout the renewal period, and refining of North Slope oil for the Alaska market would continue at prerenewal period levels.

- *Tanker transportation:* Declining TAPS throughput would gradually reduce the number of tankers needed to carry North Slope crude to West Coast ports, and the reduction in refined products from North Slope oil, also as a result of declining throughput, would gradually increase the demand for imported refined petroleum products from outside the state.

- *Government oversight:* Employment in government oversight activities was assumed to be constant throughout the renewal period.

4.3.19.1.2 Assumptions Relating to Other Activities in the Alaskan Economy. Assumptions made concerning other economic activities in the state were as follows:

- *Key sectors:* Activities in Alaskan economic sectors with employment growth potential, in particular seafood processing, tourism, and air cargo, would continue to grow on average throughout the renewal period. Growth trends in seafood, however, can be cyclical, and tourism and air cargo make only small contributions to overall economic activity in the state. Federal and state government employment would remain relatively stable, and military employment would remain constant throughout the period.

- *State and local government finances:* Declining petroleum revenues with declining production, as assumed above, would mean that additional sources of funds would be needed by the state to cover slowly increasing General Fund expenditures at the state and local levels. The analysis assumed that the deficit would be covered entirely with cash reserves from the Constitutional Budget Reserve Fund through 2004. A sales tax, reinstitution of a state personal income tax, a cap on the Permanent Fund Dividend, changes in petroleum sector tax rates, reductions in state and local expenditures, and the use of some portion of the earnings of the Permanent Fund are all being considered by the state legislature to cover increasing deficits. While a number of these measures, notably a personal income tax and the use of some portion of the earnings from the Permanent Fund, have already been proposed by various parties to address current state budgetary problems, this analysis does not include any of these options because of the uncertainty surrounding the likely use and timing of any particular fiscal policy option. While for analysis purposes it is assumed that funding will be found to maintain the increasing level of services, policymakers may also choose to bridge the budget gap at least in part by making budget cuts. The selection of any one, or combination, of policy options to address the budget deficit was considered to be beyond the scope of the analysis.

4.3.19.2 National Economic Impacts

The economic impacts of renewing the Federal Grant and continued pipeline operation for an additional 30 years on the national economy would include the impact on domestic oil production and national energy security, balance of trade, federal tax revenues, marine transportation, and overall impact on economic activity in the United States and on investment risk. In general, the impacts of continued TAPS operation would be greater at the beginning of the renewal period, with impacts closely related to the level of TAPS throughput. Throughput is forecast to remain steady at the beginning of the period but start to decline after 2005 and continue to decline throughout the remainder of the renewal period (see Table 4.3-6).

4.3.19.2.1 Domestic Oil Production and National Energy Security. Continued operation of the TAPS and the North Slope fields through the year 2034 would contribute an estimated 8 billion bbl of crude oil to U.S. domestic production over the renewal period (DOE 2001a). While the contribution of North Slope crude to domestically produced oil supplies would decline from 18% in 2004 to 14% in 2020 (DOE 2001b) as a result of declining production, North Slope oil would still make a substantial contribution to the reduction of U.S. dependency on foreign oil supplies. Dependency on oil from outside the United

States can create significant foreign policy issues if the countries supplying the oil are politically or economically unstable. North Slope oil would continue to contribute to the reduction of dependency on foreign oil.

Impacts of Proposed Action on U.S. Domestic Oil Production, Energy Security, Balance of Trade, and Federal Tax Revenues

North Slope oil production would make a substantial, although declining, contribution to domestic oil production and would continue to reduce the need for foreign oil imports, thus improving national energy security and the overall balance of trade. Significant federal tax revenues would be generated with continued TAPS operations, together with marine and shipbuilding employment and employment in the economy as a whole.

4.3.19.2.2 Balance of Trade. The United States would continue to be a net importer of crude oil over the renewal period, with steady growth in domestic consumption and declining domestic production (DOE 2001b). On the basis of world oil price forecasts produced by the DOE, North Slope production over the period 2004-2020 is projected to be valued at $137 billion in 2000 dollars (DOE 2001b). Despite the worsening negative trade balance the United States has in oil, production from the North Slope over the renewal period would help to offset the increasing U.S. dependency on foreign oil, reducing oil imports from 9.9 million bbl/d to 8.8 million bbl/d, a reduction of 11%, in 2004, and from 11.2 million bbl/d to 10.5 million bbl/d, a reduction of 6%, in 2020 (DOE 2001b). In addition, when the cost of domestic oil production is less than the price of imported oil, there are cost savings to U.S. consumers and to the federal government.

4.3.19.2.3 Federal Tax Revenues. Federal income taxes and royalties on federal lands related to the TAPS would generate significant tax revenues for the federal government over the renewal period. Over the entire 30-year renewal period, these revenues are projected to reach an estimated $11.4 billion (in 2000 dollars) (ECA 1999a).

4.3.19.2.4 Marine Transportation. The current fleet of single-hulled tankers used to transport North Slope crude oil is being phased out in favor of double-hulled tankers under the stipulations of the Oil Pollution Act of 1990 covering the transportation of North Slope oil from Valdez to ports on the West Coast. Replacement of the single-hulled fleet, together with the projected decline in North Slope production, is expected to create a demand for an additional nine 125,000-ton tankers over the renewal period (ECA 1999b). Approximately $1.6 billion (in 2000 dollars) would be spent in U.S. shipyards to accommodate North Slope transportation demand. This level of activity would produce approximately 1,000 shipyard jobs per tanker (GAO 1999), with additional jobs created in the various industries supplying shipyards with equipment, materials, and services. Maintenance activities would also provide additional employment at shipyards. Marine transportation would also produce employment, but at declining levels as North Slope production declines. About 1,330 U.S. seamen would be required at the beginning of the renewal period, declining to 530 seamen by 2034 (TAPS Owners 2001a).

4.3.19.2.5 Overall Economic Activity. North Slope oil production has a much smaller impact on the U.S. economy as a whole than it does on the oil production and transportation sectors in the United States. Oil from the North Slope is priced at the prevailing world level for crude plus pipeline transportation costs. The difference in price between North Slope and non-North Slope oil at West Coast ports is small and is due primarily to differences in quality. The relatively short distance between Alaska and the West Coast does not provide any transportation cost advantage to North Slope oil producers. The price advantage to North Slope oil does not have a significant impact on input costs to West Coast refiners and subsequently on industries using North Slope-derived refinery products. With gradually declining North Slope production over the renewal period, replacement supplies for North Slope oil would have to be found for West Coast refineries and the industries purchasing their products. Assuming the widespread availability of suitable oil from other sources, either from U.S. production or from foreign suppliers, refinery production and refinery product customer industries would be able to continue with little or no impact on product prices or availability.

Renewal of the Federal Grant for an additional 30 years would have a significant impact on providing a less risky investment climate for North Slope oil development. The high cost of oilfield exploration and development means that a fairly long production period is required in order to lower the risk to oilfield investors that the substantial initial cost associated with these projects would not be recovered. A longer renewal period also reduces the risk for public and private investment projects outside the oil sector in Alaska, which require a fairly long-term predictable rate of growth in economic activity and state and local tax revenues for the initial investment to be considered (see Section 4.5.2.19).

4.3.19.3 State Economic Impacts

The impacts of the proposed action on the economy of Alaska would include the impact on population (including net migration), gross state product, employment and unemployment, personal income, and state and local tax revenues. Population and economic impacts in the state were estimated using the MAP model. In general, the impacts of continuing TAPS operation would be greater at the beginning of the renewal period (see Figures 4.3-2 through 4.3-5), with impacts closely related to the level of TAPS throughput (see Table 4.3-6).

4.3.19.3.1 Population. With the renewal of the Federal Grant in 2004, population in the state is projected to grow at a moderate annual average rate of 1.6% over the entire renewal period, with a slightly higher growth rate between 2004 and 2019 (Table 4.3-7; Figure 4.3-2). Growth in the Alaska Native population would be higher than in the

TABLE 4.3-7 State Population Projections

	Population by Year				Average Annual Rate of Growth (%)		
Item	2003	2004	2019	2034	2004 to 2019	2019 to 2034	2004 to 2034
Alaska	667,863	681,565	881,875	1,099,363	1.7	1.5	1.6
Non-Native	505,745	516,542	663,437	800,772	1.7	1.3	1.5
Native	117,873	120,778	174,193	254,345	2.5	2.6	2.5
Military[a]	44,245	44,245	44,245	44,245	0.0	0.0	0.0
Net migration	6,547	7,290	6,635	3,870	-2.3	-7.6	-5.0
Net migration share (%)	1.0	1.1	0.8	0.4	-3.7	-8.9	-6.4

a Includes active duty military personnel and their dependents.

Source: MAP model (see Appendix A, Section A.8).

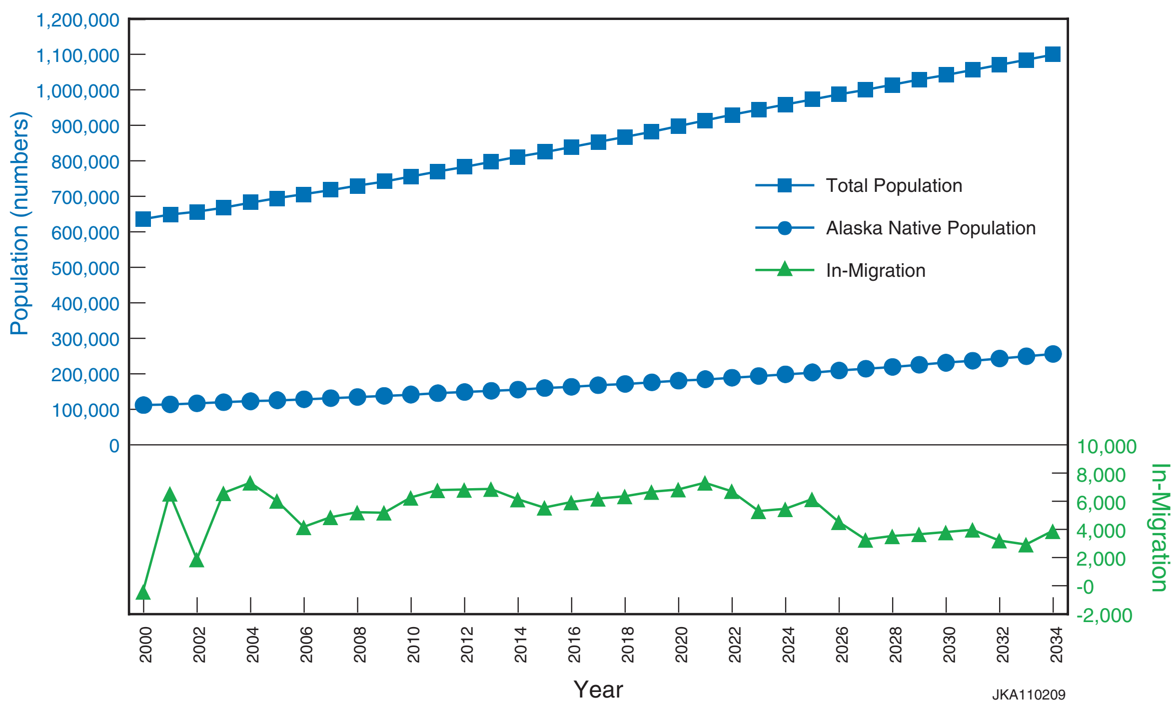

FIGURE 4.3-2 Projected Population with TAPS Renewal

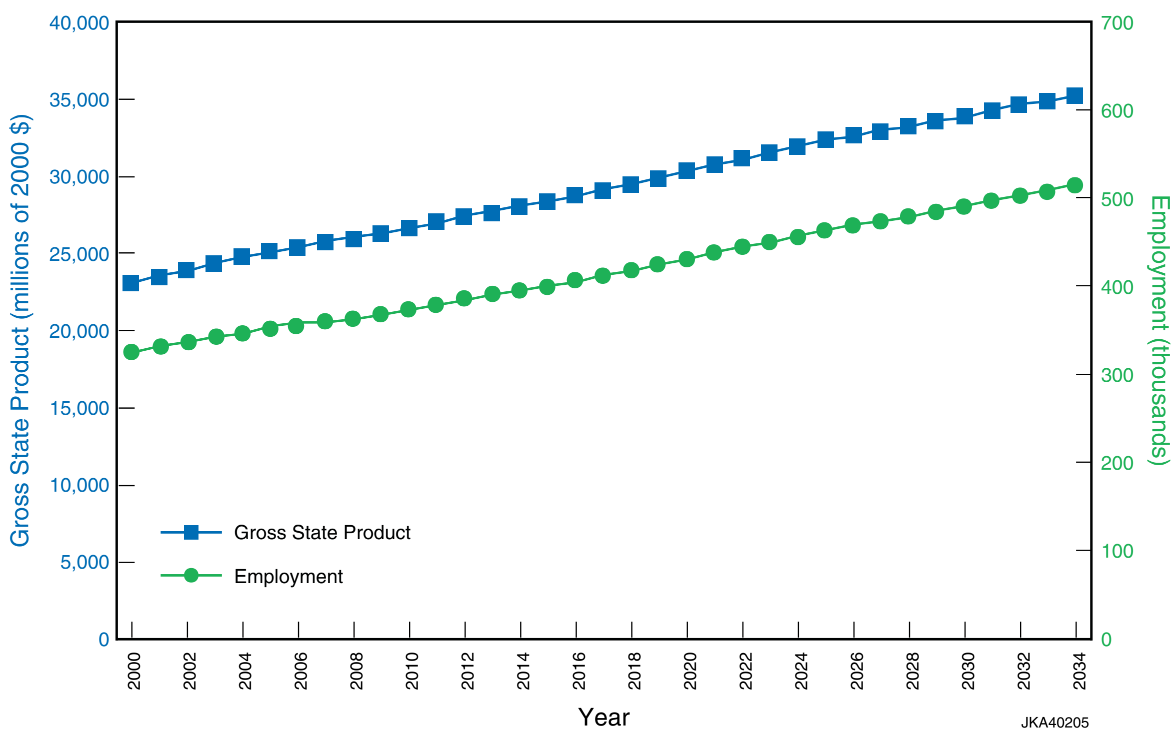

FIGURE 4.3-3 Alaska Gross State Product and Employment with Continued TAPS Operation

FIGURE 4.3-4 Projected Unemployment with TAPS Renewal

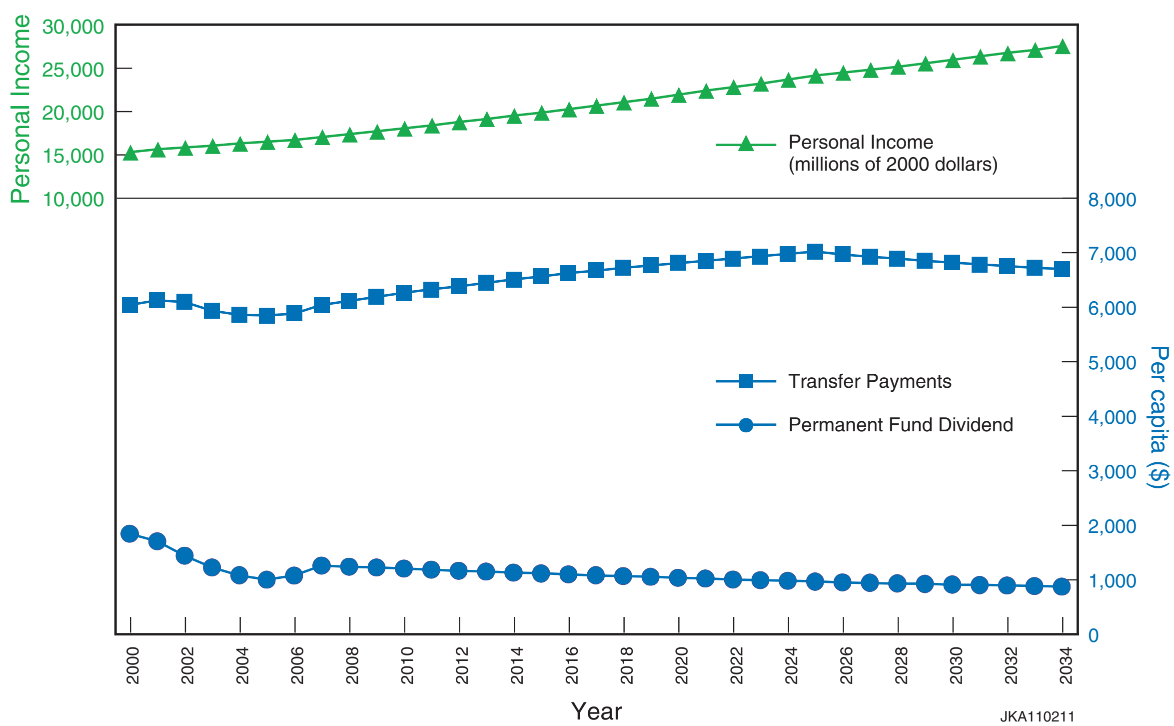

FIGURE 4.3-5 Projected Personal Income with TAPS Renewal

non-Native population, with a decline in the rate of in-migration of the non-Native population expected to occur, particularly between 2019 and 2034, as pipeline throughput and state tax revenues fall.

Impacts of Proposed Action on Population, Gross State Product, Employment, and Tax Revenues

Under the proposed action, North Slope oil production and the pipeline would continue to have a large impact on population, employment, incomes, and tax revenues in Alaska. While TAPS throughput is projected to begin a long decline starting in 2005 (meaning that the impact of the oil sector and supporting industries would diminish over the renewal period), population, gross state product, employment, and personal incomes are projected to increase slightly on average over the renewal period. Unemployment is also expected to increase slightly. The decline of state oil revenues would mean that the state would require additional sources of revenue to cover the moderate growth expected in expenditures at the state and local levels.

4.3.19.3.2 Gross State Product. The GSP, the sum of value added in the production of all goods and services in a year, measures the level of economic activity in the state. Table 4.3-8 and Figure 4.3-3 presents GSP in terms of constant dollars, which are used to exclude the effects of inflation in the economy and fluctuations in natural resource prices when comparing GSP over time. The GSP of Alaska, measured in constant 2000 dollars, is projected to experience a moderate increase of 1.0% over the entire renewal period (2004 to 2034), with a slightly higher annual growth rate over the first 15 years of the period.

In individual industries, GSP growth would be concentrated among industries providing services, especially transportation; communication and public utilities, trade, finance and services; and tourism. Growth in these sectors is projected to average between 1.7 and 2.0% per year, with slightly larger increases in financial services and tourism. Growth in transportation and, in particular, tourism would be markedly higher during the first 15 years of the TAPS renewal period. Transportation includes air cargo, which experienced high growth rates during the 1990s. The sector would be expected to continue to grow fairly rapidly until 2019 in response to market growth and the availability of competitively priced jet fuel refined inside the state, and would then remain stable throughout the remainder of the period. Tourism would experience higher than average annual growth in the first half of the renewal period, based partly on improved facilities and transportation, and also as a result of overall increases in personal income. Other natural-resource-based industries, such as mining, forestry, and fishing, would experience much lower average growth rates than the average state rate, with better growth prospects during the first part of the renewal period.

The GSP related to federal government activity is projected to remain relatively stable throughout the entire renewal period, with only 0.1% annual growth, while state and local activity would each produce annual increases of 0.8%. A slight decline in federal and state government GSP growth rate in the second half of the period would be in contrast to a slight increase in the local government GSP growth.

4.3.19.3.3 Employment and Unemployment. Total employment in Alaska is projected to grow at an annual average rate of 1.3% over the entire renewal period (2004 to 2034) (Table 4.3-9; Figure 4.3-3). The state rate would be outpaced by a number of industries, including transportation, trade, finance, services, and tourism. Each of these sectors would grow at between 1.7 and 2.0% on average each year over the entire renewal period, experiencing slightly lower growth rates during the second half of the renewal period. The natural-resource-based industries, such as mining (which includes the oil and gas sector), agriculture, forestry, and fishing, would all grow at less than the state average rate and would all experience lower growth rates during the second half of the renewal period. The construction industry would experience increased employment growth during the second half of the period, reflecting growth in the trade services and tourism industries.

TABLE 4.3-8 Projected Alaska Gross State Product by Industry (millions of 2000 dollars)

Industry	GSP by Year 2003	2004	2019	2034	Average Annual Rate of Growth (%) 2004 to 2019	2019 to 2034	2004 to 2034
Alaska	24,359	24,817	29,050	33,446	1.1	0.9	1.0
Mining (including Oil and Gas)	3,521	3,626	4,095	4,134	0.8	0.1	0.4
Agriculture, Forestry and Fisheries	598	599	613	620	0.2	0.1	0.1
Construction	1,287	1,319	1,292	1,410	-0.1	0.6	0.2
Manufacturing	1,180	1,187	1,320	1,474	0.7	0.7	0.7
Transportation (including Air Cargo)[a]	2,849	2,916	3,881	4,853	1.9	1.5	1.7
Communications and Public Utilities	1,367	1,390	1,822	2,331	1.8	1.7	1.7
Wholesale and Retail Trade[a]	2,678	2,729	3,607	4,630	1.9	1.7	1.8
Finance	2,012	2,051	2,796	3,670	2.1	1.8	2.0
Services[a]	3,132	3,198	4,247	5,489	1.9	1.7	1.8
Tourism[a]	1,084	1,128	1,540	1,970	2.1	1.6	1.9
Federal Civilian	1,624	1,627	1,677	1,697	0.2	0.1	0.1
State Government	1,143	1,166	1,318	1,467	0.8	0.7	0.8
Local Government	1,688	1,730	1,945	2,220	0.8	0.9	0.8
Military	1,280	1,279	1,270	1,266	-0.1	0.0	0.0

[a] Tourism includes activity also included in Transportation, Trade, and Services. To avoid duplication, data in the tourism row are not included in the Alaska total.

Source: MAP Model (see Appendix A, Section A.8).

Employment in federal, state, and local government is expected to experience less growth than would be the case for the state as a whole, with overall annual growth rates of 0.8% and 0.9% for state and local government, respectively, and 0.2% for federal government employment. Increases in local government employment are expected toward the end of the renewal period, with falling rates in state and federal government employment.

Unemployment in the state is projected to gradually increase over the 30-year renewal period as declining oil production and pipeline throughput affected tax revenues and the remainder of the state economy. The unemployment rate would increase from 6.6% in 2004 to 7.1% in 2019 and 7.7% in 2034. These forecasts represent an average annual increase of 0.5% in unemployment over the entire renewal period (Table 4.3-10; Figure 4.3-4).

TABLE 4.3-9 Projected Employment in Alaska by Industry

Industry	Employment by Year				Average Annual Rate of Growth (%)		
	2003	2004	2019	2034	2004 to 2019	2019 to 2034	2004 to 2034
Alaska	342,047	348,345	425,000	514,804	1.3	1.3	1.3
Mining (including Oil and Gas)	10,157	10,381	11,251	11,505	0.5	0.2	0.3
Agriculture, Forestry and Fisheries	1,991	2,011	2,370	2,546	1.1	0.5	0.8
Construction	15,818	16,275	16,297	18,135	0.0	0.7	0.4
Manufacturing	15,440	15,464	15,901	16,315	0.2	0.2	0.2
Transportation[a] (including Air Cargo)	20,893	21,376	28,321	35,286	1.9	1.5	1.7
Communications and Public Utilities	6,381	6,454	7,767	9,186	1.2	1.1	1.2
Wholesale and Retail Trade[a]	63,643	64,874	85,752	110,001	1.9	1.7	1.8
Finance	12,523	12,773	17,565	23,246	2.2	1.9	2.0
Services[a]	75,043	76,665	102,487	133,283	2.0	1.8	1.9
Tourism[a]	18,651	19,422	26,510	33,922	2.1	1.7	1.9
Federal Civilian	17,560	17,604	18,276	18,551	0.3	0.1	0.2
State Government	21,403	21,845	24,751	27,601	0.8	0.7	0.8
Local Government	33,449	34,308	38,645	44,227	0.8	0.9	0.9
Military	18,054	18,054	18,054	18,054	0.0	0.0	0.0
Proprietors	29,692	30,263	37,563	46,868	1.5	1.5	1.5

[a] Tourism includes activity also included in Transportation, Trade, and Services. To avoid duplication, data in the Tourism row are not included in the Alaska total.

Source: MAP model (see Appendix A, Section A.8).

TABLE 4.3-10 Projected Labor Force Participation, Employment, and Unemployment Rates

Parameter	Statistics by Year 2003	2004	2019	2034	Average Annual Rate of Growth (%) 2004 to 2019	2019 to 2034	2004 to 2034
Total population	667,863	681,565	881,875	1,099,363	1.7	1.5	1.6
Potential labor force	463,354	472,059	587,413	724,633	1.5	1.4	1.4
Labor force	360,732	367,223	455,064	556,107	1.4	1.4	1.4
Labor force participation rate (%)	78	78	78	77	0.0	-0.1	-0.1
Employment[a]	336,427	343,042	422,966	513,305	1.4	1.3	1.4
Unemployment rate (%)	6.7	6.6	7.1	7.7	0.5	0.6	0.5

[a] Employment of Alaska residents only; does not include nonresidents.

Source: MAP model (see Appendix A, Section A.8).

It is likely that the unemployment impacts presented here underestimate the number of people who would want to work, because the unemployment rate only includes persons who would be registering for unemployment benefits. During the renewal period, the number of employment opportunities in many Alaskan communities is likely to continue to be limited, meaning that additional people would not be actively searching for employment.

4.3.19.3.4 Personal Income. Real personal income (which excludes the effects of inflation on personal incomes over time) is projected to increase at an annual average rate of 1.8% over the renewal period, with a slightly lower rate in the second half of the period (Table 4.3-11; Figure 4.3-5). Per capita incomes would rise slightly faster in the second period, with an overall average annual growth rate of 0.2% over the entire period. The contribution of transfer payments to personal incomes would grow from almost 25% of income in 2004 to more than 30% in 2034.

An important contributor to personal income in the state, particularly in rural areas, is the Alaska Permanent Fund Dividend, a per capita annual payment to individuals by the state from earnings on the investment of royalty payments made to the state by oil companies. The size of the Permanent Fund Dividend depends on the performance of the stock market. Assuming moderate growth in the size of the Permanent Fund, the Permanent Fund Dividend per capita would fall slightly, with growth in state population outpacing growth in the size of the fund. After contributing 4.5% to personal incomes at the beginning of the renewal period, the Dividend share of personal incomes would fall to 4.3% in 2019, and to 3.4% in 2034.

4.3.19.3.5 State and Local Tax Revenues. State tax revenues are projected to decline at an average annual rate of 0.5% over the 30-year renewal period (Table 4.3-12). With the projected level of state and local expenditures (Section 4.3.19.3.6), increasingly large annual budget deficits are likely during the renewal period given the current means of generating revenue in the state.

Taxes levied by the state on the oil industry have been a major source of revenue used to support a wide range of programs. Oil revenues are projected to decline at a fairly rapid rate over the renewal period as North Slope oil production begins to decline after 2005. Losses in oil revenues would be particularly marked in the second half of the renewal period, with an

TABLE 4.3-11 Projected State Personal Income and Alaska Permanent Fund Dividend (2000 dollars, except where noted)

Parameter	Income by Year				Average Annual Rate of Growth (%)		
	2003	2004	2019	2034	2004 to 2019	2019 to 2034	2004 to 2034
Total personal income (millions of 2000 dollars)	15,991	16,247	21,416	27,462	1.9	1.7	1.8
Personal income per capita	23,943	23,837	24,285	24,980	0.1	0.2	0.2
Transfer payments per capita	5,935	5,857	6,765	7,580	1.0	0.8	0.9
Transfer payments share of personal income (%)	25	25	28	30	0.8	0.6	0.7
Permanent Fund Dividend per capita	1,213	1,071	1,040	860	-0.2	-1.3	-0.7
Permanent Fund Dividend share of personal income (%)	5.1	4.5	4.3	3.4	-0.3	-1.4	-0.9

Source: MAP model (see Appendix A, Section A.8).

annual rate of decrease of 6.5%. The average rate of decline is projected to be 5.5% over the entire period (Table 4.3-12). Revenues from production taxes, corporate income taxes, and property taxes would all decline significantly over the renewal period, with the steepest declines in royalties and production taxes in the second half of the renewal period. Only moderate growth in nonpetroleum revenues from existing sources together with declining investment earnings would mean that state revenues would likely continue to fall throughout the renewal period with declining North Slope production (see Section 4.3.19.1.2).

Despite falling TAPS throughput, tax revenues collected by incorporated communities and boroughs are projected to grow at an annual average rate of 0.8% over the entire renewal period, with larger increases over the second 15 years (Table 4.3-13). This projection is based on the assumption that state transfers to local governments would not be affected by declining state oil revenues with declining TAPS throughput. Despite increasingly large state budget deficits that are projected with the current means of generating revenue (see above) and the uncertainty regarding selection of any particular option to increase revenues or reduce expenditures at the state level and the consequent impact on state transfers to local governments, this analysis assumed that the necessary state revenues would be found to support projected local government expenditures over the renewal period. The impact of declining North Slope production would be reflected at the

Options for Addressing the Deficit

Various fiscal policy options have been identified as means of addressing current revenue shortfalls, including a sales tax, reinstitution of a state personal income tax, a cap on the Permanent Fund Dividend, changes in petroleum sector tax rates, state and local expenditure reductions, and the use of a portion of the earnings on the Permanent Fund currently used for the Permanent Fund Dividend. While a number of these options, notably a personal income tax and the use of some portion of the earnings from the Permanent Fund, have already been proposed by various parties to address current state budgetary problems, this analysis does not include any of those options in the estimation of the impact of declining pipeline throughput rates on state and local tax revenues. No such options are included in the analysis because of the uncertainty surrounding the likely use and timing of any particular fiscal policy option.

TABLE 4.3-12 Projected State Revenues (millions of 2000 dollars)

Revenue Source	Revenue by Year 2003	2004	2019	2034	Average Annual Rate of Growth (%) 2004 to 2019	2019 to 2034	2004 to 2034
Total oil revenues	1,451	1,382	696	256	-4.5	-6.5	-5.5
Bonuses	17	17	12	9	-2.0	-2.0	-2.0
Rents	16	16	16	17	0.2	0.2	0.2
Property taxes	39	36	12	8	-7.2	-2.4	-4.8
Royalties	699	715	415	116	-3.6	-8.2	-5.9
Production taxes	407	404	153	42	-6.3	-8.2	-7.3
Corporate taxes	151	139	42	27	-7.7	-3.0	-5.4
Miscellaneous petroleum revenues	113	46	34	26	-2.0	-2.0	-2.0
Federal-state shared petroleum revenues	11	11	11	11	0.2	0.2	0.2
Nonpetroleum revenues	448	452	513	579	0.9	0.8	0.8
Investment earnings	1,874	1,884	1,836	1,569	-0.1	-1.0	-0.6
Federal grants	1,224	1,277	1,570	1,874	1.4	1.2	1.3
Total state revenues	4,998	4,995	4,615	4,278	-0.5	-0.5	-0.5

Source: MAP model (see Appendix A, Section A.8).

local level in terms of falling oil-related property tax revenues, which would drop from more than 25% of property tax revenues in 2004 to about 4.0% in 2034. Federal and state transfers to local government, which together are projected to constitute about 45% of total local revenues, would continue to grow at a relatively stable rate over the entire period, offsetting the shortfalls in local revenue resulting from declining petroleum property taxes.

4.3.19.3.6 State and Local Expenditures. State government expenditures are projected to grow at an annual rate of 0.7% over the entire renewal period, with slightly higher growth during the second half of the period (Table 4.3-14). Expenditures on education would grow from about one-fifth of overall state spending in 2004 to more than one-third in 2034. They would grow at an annual rate of 0.9% over the entire renewal period, with slightly lower growth during the second half of the period. Expenditures for general government (0.9%) and social services (1.3%) are also expected to grow slightly faster than overall state expenditures, also with slightly less growth during the second half. Despite the growth in education spending, education expenditures are not expected to keep pace with population growth, resulting in a 0.7% decline in per capita expenditures over the entire renewal period, while overall state per capita expenditures would also be expected to decrease at an annual rate of 0.9%.

At the local level, growth in educational expenditures for the renewal period (1.3%) is projected to be higher than the overall rate of local expenditure growth (0.8%) (Table 4.3-15). As a result, educational expenditures would continue to make up a large portion of total expenditures, increasing from 34% of all expenditures in 2004 to 39% in 2034. As is the

TABLE 4.3-13 Projected Local Revenues (millions of 2000 dollars, except where noted)

	Local Revenues by Year				Average Annual Rate of Growth (%)		
Revenue Source	2003	2004	2019	2034	2004 to 2019	2019 to 2034	2004 to 2034
Local revenues[a]	1,957	1,971	2,261	2,715	0.9	1.2	1.1
Property taxes[b]	697	692	763	1,001	0.7	1.8	1.2
Petroleum	189	176	57	40	-7.2	-2.4	-4.8
Nonpetroleum	508	516	706	961	2.1	2.1	2.1
Petroleum share of total property taxes (%)	27	25	7.5	4.0	-7.8	-4.1	-6.0
Other taxes	156	159	218	296	2.2	2.0	2.1
State transfers	969	985	1,117	1,225	0.8	0.6	0.7
Federal transfers	134	136	162	193	1.2	1.2	1.2
Charges and miscellaneous revenue	740	734	682	692	-0.5	0.1	-0.2
Total general revenues[c]	2,697	2,705	2,943	3,407	0.6	1.0	0.8

[a] Local revenues are the sum of property and other taxes and state and federal transfers.

[b] Property taxes are the sum of petroleum and nonpetroleum property taxes.

[c] Total general revenues are the sum of local revenues and charges and miscellaneous revenues.

Source: MAP model (see Appendix A, Section A.8).

case at the state level, however, expenditures on education are not expected to keep pace with population growth, meaning that per capita expenditures would decline by 0.4% over the entire renewal period. Overall local per capita expenditures are also expected to decrease, with an annual rate of –0.8%.

4.3.19.4 Sensitivity of Impacts to Changes in TAPS Throughput and Changes in World Oil Prices

4.3.19.4.1 Changes in TAPS Throughput. The purpose of the analysis was to determine the short-term impact on the economy from the fluctuations in TAPS throughput that are within the design capacity of the pipeline. While additional investment in pipeline and oilfield infrastructure would be needed to accommodate higher production levels, producing additional employment and income in the state, the effect of these investments was excluded from the analysis because of uncertainty over their likely magnitude and timing. Estimation of the economic impacts of continued TAPS operation used forecasts of annual North Slope production from the DOE-EIA forecast (DOE 2001a). This forecast combines estimates of current production and production from identified developments with production from undiscovered resources. Probability estimates at the 5% and 95% confidence levels were established for production from undiscovered

TABLE 4.3-14 Projected State Government Expenditures (millions of 2000 dollars, except were noted)

Item	Expenditures by Year				Average Annual Rate of Growth (%)		
	2003	2004	2019	2034	2004 to 2019	2019 to 2034	2004 to 2034
General government	894	910	1,046	1,181	0.9	0.8	0.9
Education	1,802	1,834	2,112	2,386	0.9	0.8	0.9
Social services	901	921	1,121	1,344	1.3	1.2	1.3
Transportation	522	529	575	614	0.6	0.4	0.5
Environment	339	345	394	441	0.9	0.8	0.8
Capital outlay and debt service	1,386	1,325	1,175	1,299	-0.8	0.7	-0.1
Total state expenditures	5,843	5,863	6,423	7,264	0.6	0.8	0.7
Expenditures per capita (2000 dollars)	8,750	8,603	7,283	6,608	-1.1	-0.6	-0.9

Source: MAP model (see Appendix A, Section A.8).

TABLE 4.3-15 Projected Local Government Expenditures (millions of 2000 dollars, except were noted)

Item	Expenditures by Year				Average Annual Rate of Growth (%)		
	2003	2004	2019	2034	2004 to 2019	2019 to 2034	2004 to 2034
Education	1,259	1,280	1,552	1,855	1.3	1.2	1.3
Noneducation expenditures	930	933	993	1,034	0.4	0.3	0.3
Personnel expenditures	1,293	1,307	1,474	1,688	0.8	0.9	0.9
Interest on debt	274	255	165	218	-2.9	1.9	-0.5
Total expenditures	3,756	3,775	4,184	4,795	0.7	0.9	0.8
Expenditures per capita (2000 dollars)	5,624	5,539	4,745	4,361	-1.0	-0.6	-0.8

Source: MAP model (see Appendix A, Section A.8).

fields in order to estimate possible upper and lower bounds for overall production levels presented in these forecasts. For the purposes of this analysis, the estimation of impacts of the proposed action used the annual mean value of the forecasted production upper and lower bound. Table 4.3-16 shows selected forecasted production levels for the upper and lower bound and the mean of the two estimates. Because actual production levels might vary from the mean value depending on physical considerations (e.g., recovery success rates), and economic considerations (e.g., world crude oil prices, pipeline transportation costs) impacts on the economy of the state might also vary. To bound these impacts, effects from production at the lowest (the 95% case) and highest forecasted production levels (5% case) have been estimated.

The largest impact of production at the lower bound (the 95% case) of the production range would be the impact on oil revenues collected by the state, which are projected to fall by almost 35% compared with the mean forecast case by 2019, and by 30% by the end of the renewal period (Table 4.3-17). The decline in oil revenues would be reflected in a 7.0% decline in overall state revenues compared with the mean forecast by 2019, and by 5.7% by 2034. Elsewhere in the economy of the state, differences between the impacts of low case and the mean case would be small, with relatively minor impacts on employment, gross state product, and personal incomes. Minor decreases in population would be experienced in the state at the low end of the production range compared with the mean case.

Production at the upper bound of the forecast is projected to produce huge increases in oil revenues (61.7%) and large increases in state revenues (9.3%) compared with the mean forecast by the end of the renewal period. Production at the 5% probability level would only produce slight increases in gross state product compared with the mean case. Population in the state would increase only slightly compared with the mean case.

TABLE 4.3-16 Forecasted Range for North Slope Oil Production (millions of bbl/d)

Year	High-Probability Case	Mean Case	Low-Probability Case
2005	1,069	1,084	1,084
2010	742	961	1,091
2015	577	888	1,282
2020	402	723	1,302
2025	257	509	1,014
2030	162	315	624
2034	106	208	416

Source: DOE (2001a).

4.3.19.4.2 Sensitivity of Impacts to Changes in World Oil Prices.

4.3.19.4.2 Sensitivity of Impacts to Changes in World Oil Prices. Political and economic instability in many of the world's oil producing countries, combined with potential production restrictions by groups of oil producing countries, make fluctuations in world crude oil prices likely. Within a certain range, relatively minor changes in oil prices that may not affect pipeline throughput rates and the level of oil field investment still have the potential to affect the economy of the state through their effects on state revenue collections, employment, gross state product, incomes, and employment opportunities for migrants from outside the state. State oil revenues include oil and gas production (severance) taxes, royalties, property taxes, corporate income taxes, and settlements from tax and royalty disputes. The impacts of minor price changes on the Alaska economy are shown in Table 4.3-18. Price changes shown are a 10% increase and a 10% decrease in the world price of crude oil over the price assumed for the baseline proposed action case in each year of the renewal period. Changes in the levels of economic activity are compared with the corresponding levels estimated for the baseline proposed action case.

A 10% increase in the world price of crude oil is projected increase oil revenues by 6.2% over the baseline proposed action case. State oil revenues change by less than the change in world oil prices because not all oil revenues are related to the value of oil production. Property taxes on North Slope developments are based on facility construction costs rather than on revenues from production. Therefore, at higher oil prices, the taxes on oil property tend to

TABLE 4.3-17 Projected State Economic Effects of Changes in TAPS Oil Throughput Rates (millions of 2000 dollars, except where noted)

	Effects by Year				Change Compared with Mean Forecast (%)		
Parameter	2003	2004	2019	2034	2004	2019	2034
95% Probability Case							
Total population (number)	667,863	681,565	881,698	1,099,363	0.0	0.0	0.0
Net migration (number)	6,547	7,290	6,620	3,870	0.0	-0.2	0.0
Total employment (number)	342,047	348,345	424,884	514,802	0.0	0.0	0.0
Gross state product	23,310	23,877	27,645	30,651	0.0	-1.0	-0.3
Personal income per capita (2000 dollars)	23,943	23,837	24,280	24,980	0.0	0.0	0.0
Permanent Fund Dividend per capita (2000 dollars)	1,213	1,071	1,039	860	0.0	0.0	0.0
Permanent Fund Dividend share of personal income (%)	5.1	4.5	4.2	3.4	0.0	0.0	0.0
Total state revenues	4,998	4,995	4,292	4,036	0.0	-7.0	-5.7
Oil revenues	1,451	1,382	455	178	0.0	-34.5	-30.4
Local revenues	2,697	2,705	2,942	3,407	0.0	0.0	0.0
5% Probability Case							
Total population (number)	667,863	681,565	882,106	1,099,381	0.0	0.0	0.0
Net migration (number)	6,547	7,290	6,412	3,874	0.0	-3.4	0.1
Total employment (number)	342,047	348,345	425,032	514,813	0.0	0.0	0.0
Gross state product	23,310	23,877	28,471	30,931	0.0	1.9	0.6
Personal income per capita (2000 dollars)	23,943	23,837	24,284	24,980	0.0	0.0	0.0
Permanent Fund Dividend per capita (2000 dollars)	1,213	1,071	1,040	860	0.0	0.0	0.0
Permanent Fund Dividend share of personal income (%)	5.1	4.5	4.3	3.4	0.0	0.0	0.0
Total state revenues	4,998	4,995	5,159	4,677	0.0	11.8	9.3
Oil revenues	1,451	1,382	1,148	414	0.0	65.0	61.7
Local revenues	2,697	2,705	2,943	3,407	0.0	0.0	0.0

Source: MAP model (see Appendix A, Section A.8).

TABLE 4.3-18 Projected State Economic Effects of Changes in Crude Oil Prices (millions of 2000 dollars, except where noted)

	Effects by Year				Change Compared with Baseline (%)		
Item	2003	2004	2019	2034	2004 to 2019	2019 to 2034	2004 to 2034
10% Increase in Oil Prices							
Total population (number)	667,863	681,565	881,888	1,099,369	0.0	0.0	0.0
Net migration (number)	6,547	7,290	6,770	3,871	0.0	2.0	0.0
Total employment (number)	342,047	348,345	425,077	514,807	0.0	0.0	0.0
Gross state product	23,310	23,993	27,998	30,762	0.5	0.2	0.1
Personal income per capita (2000 dollars)	23,943	23,837	24,281	24,980	0.0	0.0	0.0
Permanent Fund Dividend per capita (2000 dollars)	1,213	1,071	1,040	860	0.0	0.0	0.0
Permanent Fund Dividend share of personal income (%)	5.1	4.5	4.3	3.4	0.0	0.0	0.0
Total state revenues	4,998	5,107	4,736	4,308	2.3	2.6	0.7
Oil revenues	1,451	1,494	753	272	8.1	8.2	6.2
Local revenues	2,697	2,705	2,943	3,407	0.0	0.0	0.0
10% Decrease in Oil Prices							
Total population (number)	667,863	681,565	881,826	1,099,360	0.0	0.0	0.0
Net migration (number)	6,547	7,290	6,477	3,871	0.0	-2.4	0.0
Total employment (number)	342,047	348,345	424,889	514,804	0.0	0.0	0.0
Gross state product	23,310	23,761	27,869	30,724	-0.5	-0.2	-0.1
Personal income per capita (2000 dollars)	23,943	23,837	24,288	24,980	0.0	0.0	0.0
Permanent Fund Dividend per capita (2000 dollars)	1,213	1,071	1,040	860	0.0	0.0	0.0
Permanent Fund Dividend share of personal income (%)	5.1	4.5	4.3	3.4	0.0	0.0	0.0
Total state revenues	4,998	4,882	4,522	4,207	-2.3	-2.0	-1.7
Oil revenues	1,451	1,270	639	240	-8.1	-8.2	-6.2
Local revenues	2,697	2,705	2,942	3,407	0.0	0.0	0.0

Source: MAP model (see Appendix A, Section A.8).

constitute a smaller share of state oil revenues. Overall oil revenues, therefore, tend to increase less than proportionally with increases in oil prices. General revenues at the state level would increase 0.7% over the base case on average over the entire renewal period. Small additional increases in gross state product would also occur because slightly higher levels of oil-sector-related spending and expenditures by state and local government would increase the overall level of economic activity in the state. The increase in oil prices would also have the effect of slightly increasing average population growth and net migration in the second half of the renewal period compared with the baseline.

A 10% decline in oil prices would have a slightly depressing effect on the Alaskan economy in all respects compared with the proposed action case (Table 4.3-18). State government (-1.7%), and especially oil (-6.2%), revenues are projected to fall compared with the baseline proposed action case, with smaller differences in gross state product compared with the base case. A decrease in oil prices would lead to a slightly smaller number of in-migrants arriving in the state in the second half of the renewal period compared with the base case.

4.3.19.5 Regional Economic Impacts

The impacts of continued TAPS operation on the regional economies along the pipeline corridor include impacts on population (including net migration), employment, personal incomes, and local government finances and public service employment. Economic activity in the pipeline corridor region is expected to be affected slightly more than is projected to be the case at the state level as activity is closely related to TAPS employment and the local income generated, and local property taxes on the pipeline. Transfers to local jurisdictions from the State and Federal government would continue to create significant local employment and income.

It was assumed for the analysis that state transfers to local governments would not be affected by reductions in state oil revenues with declining TAPS throughput. While increasingly large state budget deficits are projected with the current means of generating revenue, a number of fiscal policy options have been considered by various parties to address the current and likely future fiscal situation (see Section 4.3.19.3.5). Given the uncertainty surrounding the use and timing of any particular option to increase revenues or reduce expenditures, however, and the consequent impact on state transfers to local governments, the analysis assumed that the necessary state revenues would be found to support projected local government expenditures over the renewal period.

4.3.19.5.1 Population. Little variation in population growth is expected along the pipeline corridor with continued TAPS operation, with the same growth rates projected for the pipeline corridor (1.6%) over the entire renewal period as for the state as a whole (Table 4.3-19). Within the corridor, annual average growth rates would range from 1.3 to 1.7%, with slightly higher rates expected for Anchorage, the North Slope Borough, and the Yukon-Koyukuk Census Area. With the exception of the Fairbanks North Star Borough, slightly lower growth rates are expected in the second half of the renewal period.

4.3.19.5.2 Employment. Moderate employment growth would occur along the pipeline corridor as a whole following the renewal of the Federal Grant, with total employment in the region projected to grow at an average annual rate of 1.4% over the entire period. A slightly higher than average rate of growth for the entire period would be expected in Anchorage, with lower rates of growth in the entire region in the second half of the renewal period (Table 4.3-20).

4.3.19.5.3 Personal Income. Personal incomes in the pipeline corridor region as a whole are projected to grow by 1.8% between 2004 and 2034, with a slightly higher growth rate between 2004 and 2019. Slightly higher than average growth in income would occur in Anchorage (1.9%) over the entire period, with incomes in the remainder of the region likely to grow at between 1.3% and 1.6% during this period. Growth in incomes would be expected to fall slightly throughout the region

TABLE 4.3-19 Projected Pipeline Corridor Region Populations[a]

Location	Population by Year				Average Annual Rate of Growth (%)		
	2003	2004	2019	2034	2004 to 2019	2019 to 2034	2004 to 2034
Pipeline corridor total	400,806	408,673	528,302	657,841	1.7	1.5	1.6
Anchorage	280,111	286,049	378,248	475,519	1.9	1.5	1.7
Fairbanks North Star Borough	86,794	88,071	106,800	129,609	1.3	1.3	1.3
North Slope Borough	7,421	7,586	9,671	11,835	1.6	1.4	1.5
Southeast Fairbanks Census Area	7,433	7,585	9,311	11,266	1.4	1.3	1.3
Valdez-Cordova Census Area	10,670	10,884	13,422	16,321	1.4	1.3	1.4
Yukon-Koyukuk Census Area	8,377	8,498	10,851	13,290	1.6	1.4	1.5

[a] The MAP model gives census area population projections only up to 2025. For the 2026 to 2034 period, the pipeline corridor population estimates were determined by using the annual state population growth rates for that period.

Source: MAP model (see Appendix A, Section A.8).

TABLE 4.3-20 Projected Pipeline Corridor Region Employment

Location	Employment by Year				Average Annual Rate of Growth (%)		
	2003	2004	2019	2034	2004 to 2019	2019 to 2034	2004 to 2034
Pipeline corridor total	222,953	227,116	279,406	339,517	1.4	1.3	1.4
Anchorage	161,670	164,752	207,312	257,425	1.5	1.5	1.5
Fairbanks North Star Borough	42,338	42,922	49,722	57,062	1.0	0.9	1.0
North Slope Borough	8,168	8,466	9,545	10,255	0.8	0.5	0.6
Southeast Fairbanks Census Area	2,009	2,045	2,376	2,709	1.0	0.9	0.9
Valdez-Cordova Census Area	5,648	5,749	6,700	7,745	1.0	1.0	1.0
Yukon-Koyukuk Census Area	3,120	3,182	3,751	4,321	1.1	1.0	1.0

Source: MAP model (see Appendix A, Section A.8).

during the second half of the renewal period. With exception of Anchorage and Valdez-Cordova, per capita income growth is also expected to fall during the second half of the period, with declining per capita incomes in the North Slope Borough during this period (Table 4.3-21).

4.3.19.5.4 Local Government Revenues and Expenditures and Public Service Employment. Population, employment, and personal incomes in the pipeline corridor region are generally expected to experience moderate growth over the entire renewal period. At the state level, however, declining TAPS throughput is projected to contribute to a steadily worsening state deficit. This analysis assumed that the required revenue from various possible sources would be found to fund state expenditures, including state transfers to local governments (Section 4.6.2.19). With the availability of state funds for local expenditure programs, together with moderate population and economic growth in the pipeline corridor region, the impact of TAPS renewal on local public finances and public service employment in the region is, therefore, not expected to be significant.

4.3.19.6 Alaska Native Corporations

A number of Alaska Native corporations (see Section 3.23.6) provide contracting services in support of oilfield exploration, development, and production, and of the pipeline. Although these services likely would continue over the renewal period, providing employment and income to Alaska Native corporation shareholders, the level of expenditures on these activities is likely to diminish with declining pipeline throughput. A moderate decline in the size of the Permanent Fund Dividend per capita as growth in the Alaskan population exceeds growth in the size of the Fund would have a minor effect on personal incomes of corporation shareholders.

Earnings on investments made by some of the corporations have the potential to partially offset the slight decline in personal incomes among shareholders.

4.3.19.7 Subsistence

Many subsistence activities have cultural significance to Alaska Natives, and these activities may not necessarily be replaced by greater participation in the market economy with increases in personal income in Alaska Native communities. Income growth, however, partly from the Permanent Fund Dividend, has led to some changes in the way subsistence activities have been undertaken, in particular hunting and fishing, through further encouragement of the use of modern equipment to supplement more traditional forms of subsistence activities.
A slight increase in incomes with the renewal of the TAPS might affect the productivity of subsistence activities and create other socioeconomic impacts (see Section 4.3.20). Slightly more income would be available for investment in subsistence-related equipment, and the demand for subsistence products would decline slightly as the amount of income available for the purchase of consumer market goods would rise. Population growth during the renewal period would tend to increase pressure on subsistence resources.

4.3.20 Subsistence Impacts

Assessing impacts of the proposed action on subsistence is a challenging task, involving complex relationships among changes in the biological resource base, human demography, the economics of various components of Alaska society, recreational/sport hunter and angler practices and harvest levels, and subsistence harvest patterns. In evaluating subsistence impacts, one must consider a variety of potential effects. Negative impacts, if occurring, would be those leading to reduced subsistence harvest levels or efficiency — such as declining resource populations, changing subsistence resource locations, increased competition for resources, disruption of subsistence activities, reduced access to resources, or some combination of these factors that could be linked directly or indirectly to the TAPS and its continued operation. Positive impacts, if occurring, would occur as factors leading to increased subsistence harvest levels or efficiency — such as improving habitat, increasing resource populations, changing

TABLE 4.3-21 Projected Pipeline Corridor Personal Income (millions of 2000 dollars, except where noted)

Component	Personal Income by Year				Average Annual Rate of Growth (%)		
	2003	2004	2019	2034	2004 to 2019	2019 to 2034	2004 to 2034
Total Pipeline Corridor							
Personal income	10,021	10,177	13,416	17,196	1.9	1.7	1.8
Personal income per capita ($)	25,002	24,902	25,394	26,186	0.1	0.2	0.2
Permanent Fund Dividend share of personal income (%)	4.9	4.3	4.1	3.3	-0.3	-1.5	-0.9
Anchorage							
Personal income	7,594	7,721	10,327	13,456	2.0	1.8	1.9
Personal income per capita ($)	27,109	26,992	27,302	28,009	0.1	0.2	0.1
Permanent Fund Dividend share of personal income (%)	4.5	4.0	3.8	3.1	-0.3	-1.4	-0.9
Fairbanks North Star Borough							
Personal income	1,744	1,762	2,198	2,662	1.5	1.3	1.4
Personal income per capita ($)	20,097	20,005	20,578	21,308	0.2	0.2	0.2
Permanent Fund Dividend share of personal income (%)	6.0	5.4	5.1	4.0	-0.4	-1.5	-0.9
North Slope Borough							
Personal income	137	140	177	208	1.6	1.1	1.3
Personal income per capita ($)	18,412	18,392	18,256	17,990	0.0	-0.1	-0.1
Permanent Fund Dividend share of personal income (%)	6.6	5.8	5.7	4.8	-0.2	-1.2	-0.7
Southeast Fairbanks Census Area							
Personal income	143	146	183	217	1.5	1.1	1.3
Personal income per capita ($)	19,271	19,246	19,700	19,960	0.2	0.1	0.1
Permanent Fund Dividend share of personal income (%)	6.3	5.6	5.3	4.3	-0.4	-1.3	-0.8
Valdez-Cordova Census Area							
Personal income	241	245	313	388	1.7	1.4	1.5
Personal income per capita ($)	22,609	22,494	23,340	24,334	0.2	0.3	0.3
Permanent Fund Dividend share of personal income (%)	5.4	4.8	4.5	3.5	-0.4	-1.5	-1.0

TABLE 4.3-21 (Cont.)

Component	Personal Income by Year				Average Annual Rate of Growth (%)		
	2003	2004	2019	2034	2004 to 2019	2019 to 2034	2004 to 2034
Yukon-Koyukuk Census Area							
Personal income	162	164	218	265	1.9	1.3	1.6
Personal income per capita ($)	19,349	19,243	20,071	20,430	0.3	0.1	0.2
Permanent Fund Dividend share of personal income (%)	6.3	5.6	5.2	4.2	-0.5	-1.4	-0.9

Source: MAP model (see Appendix A, Section A .8).

Impacts of Proposed Action on Subsistence

The conclusion drawn in this analysis is that any negative impacts to subsistence under the proposed action would be extremely small. This conclusion is based on a finding of very small restrictions on the use of certain areas traditionally used for subsistence, and the continued possibility of disrupting the movement of a few terrestrial land mammals because of the TAPS or TAPS-related vehicles and activity. The analysis acknowledges the presence of large negative impacts (e.g., competition for fish and game by nonlocals using the Dalton Highway), as well as positive impacts (economic conditions providing cash for modern technology used in subsistence), but notes that these are not exclusively consequences of renewing the TAPS ROW.

resource locations (closer to subsistence users), improving access to resources, improving ability to acquire and pay for the operation of more efficient transportation or harvest technology, or some combination of these factors, once again linked directly or indirectly to the TAPS. Drawing on the discussion of subsistence resource populations and anticipated impacts on these resources under the proposed action (Sections 3.18–3.22, and Section 4.3.14), in conjunction with descriptions of subsistence harvest patterns (Section 3.24), the conclusion of this analysis is that any negative impacts to subsistence under the proposed action would be extremely small.

The evaluation of likely impacts on subsistence under the proposed action attempted to identify all possible consequences of the TAPS, on subsistence, both negative and positive, and weigh those consequences against one another. Anticipated impacts of the TAPS and its continued operation include the following:

- Increased disruption of movement patterns of certain terrestrial mammals and fish;
- Increased constraints on hunting and fishing as a result of TAPS infrastructure and its operation;
- Increased access by nonlocals (often urban residents), using TAPS maintenance roads or employed at TAPS facilities, competing for subsistence resources or disrupting subsistence activities;
- Increased use by rural residents using TAPS maintenance roads to gain access to subsistence resources;
- Increased numbers of people hunting and fishing, including nonlocal people (often urban residents) and individuals engaged in sport hunting and fishing, as well as subsistence users;
- Increased financial ability of rural subsistence users to acquire and operate

new and more efficient transportation and harvest technology; and

- Increased financial ability of nonlocals (often urban residents) to pursue sport hunting and fishing through access to new and more efficient transportation and harvest technology, and general financial means to conduct these activities.

Many of the potential negative impacts listed above relate to issues identified by individuals pursuing a subsistence way of life and were described as subsistence concerns in Section 3.24.1. Such information is based at least in part on traditional ecological knowledge, which is the accumulation of knowledge and beliefs handed down through generations regarding the relationship among living beings with one another and with their environmental surroundings (Berkes 1993). Usually associated with indigenous sociocultural systems, traditional ecological knowledge can provide a source of insights from people intimately familiar with their surroundings. These insights can be useful for (among other things) the assessment of environmental impacts (Sallenave 1994). Available testimonies on subsistence concerns point consistently towards a decline in subsistence and blame much of this decline on the TAPS. However, even such consistent assertions are not necessarily conclusive, for although the observations of life-long subsistence hunters and anglers regarding declining harvests and increasing difficulty of subsistence activities are very compelling, the assignment of cause in such a complex setting is another challenging matter. In the present context, although testimonial evidence is supported by other indications of growing pressure on certain subsistence resources, other evidence tends to identify causes other than the TAPS.

The following sections explore key considerations underlying the evaluation of subsistence impacts, to provide greater support for the conclusions of the assessment. The first examines recent evaluations of impacts on subsistence resources in areas crossed by the TAPS to provide a sense of the types of impacts that researchers have identified. The second section discusses potential consequences of renewing the TAPS ROW on subsistence resources, placing these in the context of other impacts on subsistence resources. The final section discusses subsistence impacts that are anticipated as a consequence of renewing the TAPS ROW.

4.3.20.1 Recent Change in Subsistence: An Overview of Potential Causes and Consequences in the Vicinity of the TAPS

Several recent studies have examined the impacts of development on subsistence in Alaska. These studies provide a sense of possible causes of subsistence change in the late 20th century, both for the state as a whole and for selected portions of the state associated with the TAPS. Examining these studies provides a sense of the degree to which certain factors can have an impact on subsistence activities and, ultimately, subsistence harvests. As discussed in Section 3.24.1, for Alaska Natives the ultimate effects of changes extend beyond mere economic impacts to other key components of their sociocultural systems.

One of the leading sources of impact on subsistence in Alaska in recent decades has been growing population and expanding human presence in the state as a whole. Simply put, more people means more potential hunting, fishing, trapping, and gathering, placing increased demand on resources also used for subsistence. In a study of factors contributing to differences in subsistence harvests in the 1980s, Wolfe and Walker (1987) considered a number of possible variables and their effect on subsistence in 98 rural communities in Alaska. They concluded that subsistence harvests tend to increase in settlements (1) away from urban centers; (2) not connected by roads to population centers; (3) with lesser amounts of new settlement nearby; and (4) with lower average personal income. The results of that study are important because they identify a range of variables associated with development in general leading to differences in subsistence harvests — development that has been occurring in much of Alaska to varying degrees since the onset of statehood (see Haycox 2002).

More recently, researchers have examined impacts of oil development on the North Slope (Pedersen et al. 2000) — both a topic and a geographic area of particular interest for this EIS. Focusing in particular on the North Slope communities of Nuiqsut and Kaktovik, that study examined subsistence changes between the mid-1980s and the mid-1990s. The study concluded that ongoing displacement from traditional use areas, due to physical barriers and security measures in the industrial site, was a significant impact on subsistence. It also noted that residents of these communities blamed the failure of the 1985 whale harvest on noise from oil development activities altering whale migration patterns. However, the studies of Nuiqsut and Kaktovik identified considerable variability in the harvests of different resources (notably whales), the increased availability of certain resources (notably caribou), and household composition as other factors affecting levels of subsistence harvest (see also Wolfe, R.J., et al. 2000). Impacts on subsistence once again appear to be linked to a variety of causes.

An analysis of impacts on subsistence fishing in the Copper River Basin, in part due to regional and state population growth, appears in a study by Simeone and Fall (1996). Generally, more people from outside the Copper River Basin (especially Fairbanks and Anchorage) began to fish in the Copper River Basin from the 1960s to the present. The rate of growth in competition did not accelerate during TAPS construction and other development in the region during the 1970s, in part due to poor salmon runs. Similarly, although competition increased during the 1980s, regulatory controls on non-basin residents helped to dampen its overall effect on the subsistence fishery. As a result of changes in state law during the 1990s, the ADF&G has not been able to provide a priority for rural residents (see Section 3.24.1). As a result, the growth in nonlocal pressure on fishing in the Copper River basin has been considerable. Although local subsistence harvest levels remain reasonably stable, the continuing sense of pressure on the fishery remains high.

As a final note, a series of studies in Prince William Sound and other parts of south-central Alaska have examined impacts on subsistence from the Exxon Valdez oil spill (Fall 1999a; Fall and Utermohle 1999; see also Impact Assessment, Inc. 2001). The results of these studies reveal noteworthy negative impacts on subsistence and related sociocultural issues following this accident. However, to remain consistent with the organization of this EIS, these topics are examined in other parts of the document — Section 4.4.4.14 (impacts of spills on subsistence) and Section 4.7.8.1 (cumulative impacts on subsistence, which includes tanker accidents).

The studies discussed above provide information on a range of factors that have affected subsistence harvests in recent decades. They have included inquiries associated explicitly with oil development and with geographic areas containing portions of the TAPS, establishing their relevance for this EIS. The results indicate the range of sources for subsistence impacts in Alaska during the late 20th century. Although none are directly linked with the TAPS, they include types of impacts that likely have accompanied the TAPS and likely would occur under the proposed action. Many of the greatest impacts on subsistence have accompanied development in Alaska in general. These impacts are not associated directly with the TAPS, their indirect association more a consequence of population growth and changes in human settlement, transportation infrastructure, and income that has accompanied a largely oil-based economy.

4.3.20.2 Potential Subsistence Impacts of Renewing the TAPS ROW

As discussed above, several factors can affect subsistence. To evaluate the likely impacts of renewing the TAPS ROW, attention now turns to impacts that may be associated with the TAPS. The discussion begins with factors relating to the biological status of key subsistence resources, followed by a consideration of changing access and increasing pressure on certain resources as a consequence of such change, and concludes with a consideration of economic factors.

The populations of key subsistence resources in harvest areas identified in Section 3.24.2 generally are sufficient to support subsistence harvests, although in all cases these populations fluctuate considerably over time. As noted in Section 3.24.2, rural communities in the vicinity of the TAPS use a wide range of resources for subsistence. This discussion focuses on a few main species shown by subsistence harvest patterns to be particularly important to subsistence as well as desirable by sport hunters and anglers.

Of the large mammals harvested for subsistence, moose and caribou are heavily relied on in the rural communities examined in this EIS. Moose populations have experienced considerable fluctuation over the past few decades, with the main reasons for this fluctuation being the amount of predation, the severity of winters, and the relationship to carrying capacity (e.g., Boertje et al. 1996; Carol 2002; McCracken et al. 1997) (see Section 3.21.1.1). In game management units (GMUs) crossed by the pipeline, moose populations have supported both sport and subsistence harvests at reasonably constant rates between 1996 and 2000 (ADF&G 2000). That stated, as shown in Section 3.24.4 estimated sport harvests have increased since the mid-1980s in many of the uniform coding units associated with subsistence harvest areas for rural communities in the vicinity of the TAPS. This tends to support concerns about competition from sport hunting.

Caribou similarly are subject to impacts from many sources, particularly predation and the severity of winters. Caribou population is monitored by herd rather than by geographic area, although herds occur in certain regions, many of which lie in the vicinity of the TAPS (see Section 3.21.1.2). Most of the herds used by rural communities considered in this EIS have experienced substantial population increases since the late 1970s (TAPS Owners 2001a). Although the Nelchina herd size has declined recently, this is considered a consequence of harsh winters, overgrazing, and increased predation, not a result of pipeline impacts. Moreover, population levels for the Nelchina herd remain well above those recorded late in the 1970s — an important consideration for subsistence users in the Copper River Basin who harvest animals from this herd. Population levels of the Delta herd, a small herd in the southern part of the central Yukon River drainage, are low and remained so through the 1990s. This obviously is an important consideration for subsistence users who exploit this herd, although available evidence does not indicate that the TAPS has been a source of population declines in this herd. Estimated sport harvests in subsistence use areas examined in this EIS indicate increased numbers of caribou taken, as well as increasing percentages of sport harvests compared to subsistence harvests (see Section 3.24.4). Such data appear to support concerns expressed by subsistence users, although these impacts are not necessarily a consequence of the TAPS. Studies of the effects of pipelines on herd movements are inconclusive, suggesting that caribou behavior also is based on local habitat, insect activity, road proximity, group size, and group composition (Coltrane and Lanctot 2001; Lawhead and Prichard 2002; Smith et al. 1994).

Salmon repeatedly appear as a particularly important subsistence resource for many of the rural communities examined in this EIS. As noted in Section 3.24.2, grouping the presentation of community harvest patterns reflects salmon fisheries for three of the regions defined — the Yukon River drainage, the Copper River Basin, and Prince William Sound.

Salmon returns on the Yukon River have experienced severe reductions in the past 5 years, with the chinook run some 40% below the 10-year average, and summer and fall chum runs even worse. No commercial fishing was authorized in 2001, and very limited openings were permitted in 2002. Subsistence fishing time was limited to enhance escapement, and subsistence harvests were slightly below long-term averages. Although salmon runs in the Copper River Basin have not experienced declines anywhere near the magnitude of those recorded for the Yukon River, they continue to show broad fluctuations — with particularly high subsistence harvests recorded in 1999 for the upper Copper River.

Salmon populations in Prince William Sound also have experienced fluctuations, although a marked decline in pink salmon occurred in the early 1990s (links with the Exxon Valdez oil spill not conclusively established — see Section 3.19.1.3). Thus, in all three regions, salmon populations have shown considerable fluctuations that have had important impacts on subsistence users. However, researchers usually agree that such fluctuations are a function of commercial fishing (by far the largest volume harvest), bi-catch, and ocean survival due to a range of climatic, environmental, and natural biological conditions. Impacts of competition from sport fishing generally would be a small fraction of those associated with natural conditions or commercial fishing, much smaller still when limited to individuals associated in some capacity with the TAPS or gaining access via a TAPS-specific service road.

A final biological impact deserving attention concerns possible impacts of the TAPS on subsistence resource locations. Such impacts can affect a range of species, including fish whose movement can be hindered at low water crossings for vehicles. However, the main concern is migratory species, notably caribou, where many individuals have expressed concern that spring and fall migrations so important for subsistence users is disrupted either by TAPS infrastructure or human activity (e.g., traffic) associated with TAPS operation (e.g., ADF&G 2001; Moses 1993). Although scientific evidence indicates that human activities can affect the movement patterns of caribou (Horejsi 1981; Lenart 2000; Murphy and Lawhead 2000; Tyler 1991; Wolfe, S. et al. 2000), disruption associated with the TAPS does not appear to have occurred at a scale involving more than relatively few individuals (see Section 3.21).

As discussed above, constraints on subsistence use in areas occupied by oil-development infrastructure or personnel have been shown to be a concern on the North Slope (Pedersen et al. 2000; see also Haynes and Pedersen 1989). Restrictions on subsistence use because of the TAPS, however, are extremely small. Explicit constraints on subsistence because of the TAPS are limited to TAPS facilities, such as the grounds of pump stations. Although the State of Alaska prohibits the use of firearms in the Dalton Highway Corridor (5 mi on either side of the Dalton Highway) from the Yukon River north to the Arctic Ocean (ADF&G 2002f), this restriction is not explicitly because of the TAPS. Moreover, for the portion of the Dalton Highway Corridor managed by the BLM (all but the northernmost 110 mi), this restriction does not hold for subsistence use by individuals from certain places (Alatna, Allakaket, Anaktuvuk Pass, Bettles, Evansville, Stevens Village, and localities in the corridor) (Office of Subsistence Management 2001). The subsistence harvest areas of only two of the rural communities examined in this EIS intersect the Dalton Highway Corridor — Anaktuvuk Pass and Nuiqsut (see Map 3.24-1). Restrictions involve very small parts of these very large areas — less than 1% each of the 11,300-mi^2 area for Anaktuvuk Pass area and the 13,200-mi^2 area for Nuiqsut. State restrictions on firearms use and harvesting large game applies to the Prudhoe Bay Closed Area, a roughly rectangular tract surrounding the oil exploration and development infrastructure near Prudhoe Bay (ADF&G 2002f). This restriction applies to less than 1 mi of the TAPS, and once again is not in place specifically because of the TAPS. The Prudhoe Bay Closed Area reduces the subsistence use area of Nuiqsut residents, again by a very small amount. Section 4.1.5 discusses a new agreement from Phillips to permit greater access to the Alpine and Tarn developments for subsistence hunting and fishing, reducing the size of the area subject to restrictions for security and safety reasons. These fields are closer to Nuiqsut, with Alpine as close as 6 mi from the community (Pedersen et al. 2000).

Increased access by nonlocal, or recreational/sport hunters and anglers to the subsistence use areas near the TAPS corridor accompanied the State of Alaska decision to open the Dalton Highway north of the Yukon River to the general public in 1994. Increased access also would have accompanied the construction of airstrips along the corridor to support TAPS construction (see Section 3.15.1), although there is no evidence that a large number of sport hunters or anglers use these airstrips. Although several testimonies suggested that this increase is dramatic and adverse, data on sport fisheries do not show a significant increase in sport harvests (see Section 3.24.4). In contrast, approximated sport harvests (based on nonrural residency) in uniform coding units associated with subsistence harvest areas near the TAPS do indicate high sport harvests in many areas. That stated, the impacts of opening the Dalton Highway to the general public are not attributable to the TAPS. During the time that the road served as industrial infrastructure to support pipeline construction and operation, it was closed to the general public, severely limiting any new harvest pressure. The decision to open the road to public use was made by the State of Alaska well after the road was constructed, and it was this decision that increased access to formerly remote areas. Other geographic areas near the TAPS, notably GMUs 13 and 20B, also have experienced increased recreational hunting and angling pressure in the past decade or two as well. But access to these areas already was available, and the increase witnessed likely resulted from population growth and economic expansion near these units since the 1970s, not from the TAPS operations in particular. Finally, it appears that the effects of increased pressure often can be mitigated by wildlife management measures, such as the Copper River subsistence fisheries discussed above in Section 4.3.20.1 (Simeone and Fall 1996). When this is not done, the increased pressure can be significant, although management efforts, such as reduced seasons or bag limits, can also affect subsistence users if they are subject to these measures.

Economic change, notably in increased disposable incomes to devote to subsistence and recreational hunting and fishing, has complicated the evaluation of TAPS effects on subsistence. Little specific data exist to support the precise evaluation of these impacts. For recreational hunters and anglers, income is just one of several factors leading to general growth in their numbers and the geographic extent of their activities. For rural subsistence users, growing incomes can help to acquire new transportation and harvest technology. Indeed, frequently it is households with steady income that become highly productive and share large quantities of subsistence food with the community (Wolfe 1987). Moreover, growing incomes do not uniformly replace subsistence harvests in small communities, since social and cultural values are enduring motivations in addition to economic considerations for subsistence activities.

4.3.20.3 Evaluating Potential Subsistence Impacts of Renewing the TAPS ROW

The evaluation of subsistence impacts of the TAPS ultimately requires a comparison of all likely effects of the proposed action, both positive and negative. Under current conditions, which probably provide an indication of likely impacts of ROW renewal, subsistence users in Alaska appear to be experiencing a number of negative impacts, many of them quite serious. However, as discussed, many of these impacts are not a consequence of the TAPS, but rather are the result of a larger number of people competing for the same resources, other activities (e.g., commercial fishing) competing for the same resources, varying severity of weather and predation reducing resource populations, and other potential causes.

In part as a consequence of TAPS operation, people can acquire technology that improves both transportation to subsistence resources and the process of harvesting such resources. Individuals pursuing subsistence also may benefit from improved access to subsistence resources — although the benefits of better access likely are slight, and further restrictions on the use of access roads following the events of September 11, 2001, are reducing them even further. Finally, populations of certain subsistence species have grown in recent years — the best documented being caribou, with the Central Arctic herd having increased more than fivefold (to about 27,000) between 1978 and 2000 and the state total to more than 857,000 in 2000 (Lenart 2000). Thus, one can get to subsistence resource areas more easily, traveling a greater distance if necessary, possibly have access to a greater number of resources, and harvest those resources more efficiently, at least in part due to the TAPS or a consequence of conditions that developed during the TAPS existence. Such impacts on subsistence would also be likely under the proposed action.

On the other hand, past and present operations of the TAPS also have generated negative impacts on subsistence. Certain localities within traditional subsistence use areas are no longer available for subsistence. Moreover, continuing use of the Richardson and Dalton Highways for TAPS-related activities, and low-flying aircraft to monitor the TAPS, may have disrupted the movement of small numbers of subsistence resources, most likely caribou.

Two questions are central to this evaluation: (1) to what degree are the above effects, both positive and negative, a consequence of the TAPS; and (2) what are the net effects of TAPS-related impacts? Each question can be addressed in turn.

The identification of cause for potential impacts is particularly challenging in the case of subsistence under the proposed action. Many of the conditions characterizing modern Alaska are consequences, at least in part, of the presence of the oil industry, which has had an enormous impact on the state since the 1970s (Strohmeyer 1997). The inextricable association of the oil industry with the TAPS means that the latter is somehow related to many of the impacts listed above currently affecting subsistence. However, many of the relationships are indirect — such as contributions to an economy that provides the impetus for people (potential competitors for subsistence resources) to move to Alaska, provides the disposable income and time necessary to pursue sport hunting and fishing, and provides the cash necessary to purchase recreation- and subsistence-related equipment. Moreover, many of such impacts involve other causes as well. The economic conditions present in Alaska, resulting from growth and development in several economic sectors, provide a good example. Another example is the issue of competition from nonlocal hunters and anglers, who gain access to subsistence areas, who have the economic ability to pursue recreational hunting and fishing, and who reside in Alaska in large numbers for many reasons besides the TAPS or the oil industry. Testimony by subsistence users often identifies the TAPS as generating many negative impacts on subsistence, but upon closer reflection the causal framework appears to be much more complex. The issue related to the Dalton Highway is a good case in point. Many of the concerns of subsistence users focus on increased competition from nonlocal hunters and anglers gaining access via this key transportation link in north-central Alaska. However, the real impact was not the construction of the highway but opening it to public use; the former was related to the TAPS, the latter was not.

A more precise evaluation of both the magnitude of individual impacts and the net effects of all impacts taken together is a difficult undertaking in the absence of quantitative data on most impacts. The access issue, which underlies many concerns about competition by nonlocal (often urban) residents for fish and game, likely is affected relatively little by TAPS access roads because of their relatively small number and restricted length (providing primarily local access in some areas). Moreover, such access roads likely will have less effect given the additional restrictions placed on their use since September 11, 2001, as noted above.

Economic and demographic conditions in modern Alaska likely contribute both positive and negative impacts to subsistence. The populations of most subsistence resource species appear to be adequate, with some growing considerably, as discussed in Sections 3.18 through 3.22. However, the geographic distributions of these various resource populations, and the question of whether they have become more inaccessible over time, are separate issues. Here the evidence is unclear. Traditional ecological knowledge indicates that the TAPS has adversely affected caribou migration, making this key subsistence resource more inaccessible (see Section 3.24.1). In contrast, biological studies indicate that apart from effects on individual animals, most caribou, moose, and other terrestrial species, negotiate the TAPS and the Dalton Highway with at most temporary delays (see Section 4.3.17.4). Mitigation measures, in turn, adequately address possible hindrances to fish passage that might arise due to TAPS-related activities (see Section 4.3.16.2). Finally, although there are constraints on subsistence activities on land occupied by TAPS facilities, the area involved is extremely small (fractions of 1%). This EIS assumes that that the magnitude of these impacts would be similarly small.

Given the available evidence, the conclusion drawn here is that any negative impacts on subsistence of renewing the Federal Grant would be extremely small. This conclusion is based on two consequences of grant renewal:

- Continued limited access to (very small) parts of certain traditional subsistence harvest areas; and
- The continued use of the Dalton and Richardson Highways to maintain TAPS operations, along with various access roads and airspace over the TAPS, and continued human activity around the TAPS — disrupting the movement of small numbers of terrestrial mammals.

Although both of these impacts are associated with grant renewal, as discussed above the consequences would be extremely small. The continued presence of TAPS personnel in remote areas as possible competitors for fish and game is also a possible concern, but the degree to which these individuals pursue sport hunting and fishing is unknown (and the impacts likely quite small and probably geographically limited). Any potential impacts on subsistence due to accidents, such as oil spills, would not be part of normal operations under the proposed action and are considered instead in Section 4.4.4.14. Although subsistence possibly has experienced substantial negative impacts over the past several decades, these impacts are primarily the result of other causes.

4.3.21 Sociocultural Systems

The proposed action of renewing the Federal Grant for the TAPS ROW would play an important role in the ongoing interaction between Alaska Native and rural non-Native sociocultural systems and the oil industry. This interaction, as well as continued modernization in Alaska made possible largely from oil revenues, would contribute to further sociocultural change. Sociocultural systems by their very nature evolve in response to shifting challenges from their natural and human environmental surroundings. Thus, sociocultural change is not inherently good or bad. The challenge in evaluating impacts to sociocultural systems ultimately becomes one of evaluating the nature of the changes likely to occur under a particular set of conditions, such as the proposed action.

Impacts of Proposed Action on Sociocultural Systems

A series of impacts on sociocultural systems are anticipated under the proposed action. Taken together, the overall impact would likely be small and slightly negative.

Possible positive consequences would include (1) continued access to cash employment, even in rural areas – important to supplement subsistence in mixed economies, and (2) continuation of state-funded programs and public services, important to many rural communities and to both Native and non-Native sociocultural systems.

On the other hand, possible negative consequences would include (1) continued growth in importance of cash economy and Alaska Natives' (especially) need to participate in an economy for which they may not be particularly well prepared; (2) continued fragmentation of rural Alaska Native and non-Native sociocultural systems, as some individuals leave to pursue other opportunities; and (3) continued loss of isolation from conventional modern American culture and the many rapid changes that tend to accompany interaction with it.

4.3.21.1 Alaska Native Sociocultural Systems

As discussed in Section 3.25, several Alaska Native sociocultural systems are traditionally associated with the area containing the TAPS ROW. At the time of initial Euro-American contact, most of these systems were very different from one another. Over the course of the past century or two (depending on the sociocultural system in question), each has evolved in part due to varying types of interaction with, and impacts of, Western society. The modern forms of these sociocultural systems are very different from those of the past, in part as a result of this interaction and the many changes that accompanied it. Conversely, certain characteristics of modern Alaska Native sociocultural systems increasingly resemble one another — such as their governing bodies and two-tiered Native corporate affiliations — also consequences of interacting with Western society. The proposed action would continue many of the conditions present during the first three decades of the TAPS' existence. This section attempts to identify those conditions that would affect sociocultural systems. The conclusion reached, discussed in greater detail below, is that the proposed action would contribute to continued change in Alaska Native sociocultural systems that likely would be negative, although very small in magnitude.

The basis for many of the impacts on Alaska Native sociocultural systems under the proposed action is the amount of revenue generated and its broad implications. Inasmuch as the TAPS is linked to the oil industry in Alaska as a whole, renewal of the Federal Grant would make important direct and indirect economic contributions to the Alaskan economy and society as a whole, including contributions to Alaska Native sociocultural systems. The likely consequences of some of these contributions are positive, some are negative, and some are both.

One of the most important impacts of the proposed action for Alaska Native sociocultural systems would be continued access to the many types of state-funded public services, programs, and infrastructure — such as the General Fund community support programs. These programs provide a range of state-funded assistance under the state revenue sharing program, the safe communities (municipal assistance) program, legislative grants, and capital project matching grants, which provide funds to eligible communities for a range of infrastructure development and maintenance activities and public services (ADCBD 2002a,b). Access to such services has implications well beyond convenience in rural communities, having yielded tangible results, such as improved Alaska Native health and educational attainment (e.g., ADHSS 2001a; North Slope Borough 1999). Beyond the obvious benefits of public expenditures, such programs and services are extremely important in providing a quality of life in rural settings that in many cases helps to maintain resident populations. For Alaska Native communities, maintaining cohesive communities helps strengthen sociocultural bonds and preserve working societies.

Many state programs would not be possible in their present form without revenues paid to the state by the oil industry (see Sections 4.3.19 and 4.6.2.19). The loss or substantial reduction of these programs would be keenly felt by Alaska Natives living in rural settings, including many of the sociocultural systems examined in this EIS. Recent budget shortfalls by the State of Alaska have placed the continuation of many state-funded programs in jeopardy. Such fiscal conditions make the continued contribution of oil revenues to the state budget even more important for the continuation of state programs. Contributions of APSC to various community programs, such as educational programs, likely would continue under the proposed action, although these do not necessarily have a rural focus.

Another important consequence of continuing TAPS operations would be continued access to wage employment for many Alaska Natives at levels likely similar to those currently found. As discussed in Section 3.24.1, the economic foundation of rural communities in Alaska can be characterized as mixed subsistence-cash economy systems (Wolfe and Walker 1987). Subsistence continues to play an extremely important role in many of these communities, with its importance for Alaska Natives extending beyond economic considerations to sociocultural and ceremonial roles. However, access to cash helps to round out the economy and purchase the necessities that cannot be obtained through other means. Moreover, the cash and subsistence components of mixed economies tend to be both integrated and interdependent. Many subsistence activities require cash to purchase equipment, supplies, and fuel. At the same time, subsistence activities are highly cash efficient — with relatively small sums of money invested in subsistence production yielding substantial quantities of food (which would be much more costly to buy outright). Beyond any convenience, security, or improved quality of life that cash might provide, in Alaska rural economies do not function without it. Access to more cash in such settings, in turn, often promotes increased subsistence involvement and productivity (Wolfe 1987).

Among the beneficiaries of employment under the proposed action would include individuals living in the vicinity of the pipeline and involved in its operation or maintenance. APSC compliance with agreements established under Section 29 of the Federal Grant provides a base level for this employment (see APSC 1998c; Naylor and Gooding 1978), with 2001 Native hires reaching 517 (APSC 2002b). However, the dominance of the oil industry in the Alaska economy means that its effects are widespread — providing jobs in areas not directly related to the TAPS, or for that matter, the oil industry through indirect economic impacts.

For Alaska Natives, however, increased reliance on cash and increased involvement in a cash economy can also have negative consequences. Although money provides the means of purchasing goods and services necessary for survival and enhances subsistence activity, it also provides the means of acquiring substances detrimental to a healthy existence (Kettl and Bixler 1991; Kraus and Buffler 1979). Moreover, the acquisition of cash requires Alaska Natives to compete in a job market where competition and participation can be difficult (in part because of cultural differences, with educational deficiencies also often a problem) (Hudson 1985), thereby providing another source of potential pressure in a category of sociocultural systems that has experienced considerable change over the past century or so, and particularly rapid change since 1971.

Alaska Native employment on the TAPS construction during the 1970s provided a sense of the varied impacts of cash that are possible (Strohmeyer 1997). Full-time earnings well exceeded levels to which most Alaska Natives were accustomed — in a single month exceeding what many families in villages earned in a year and enabling the purchase of many items that improved rural life. But exposure to relatively large amounts of cash caused tensions with those who remained in the villages. Many individuals seeking cash income left villages for long periods (if not permanently), undermining a key part of the collaborative tradition that formed the foundation for the subsistence economy. Individuals who profited from pipeline employment in some cases sought changes to traditional sociocultural systems. And some of those who returned to rural life from work on the TAPS brought illegal drugs with them, the first appearance of these substances in Alaska Native villages. Many Alaska Natives noted both the positive and negative implications of monetary resources during public scoping for this EIS.

A final general consequence of the revenues generated by the oil flowing through the TAPS is the continued rapid modernization of Alaska. As has occurred throughout much of the United States in recent decades, information flows with increased freedom, and people move with increased ease throughout virtually all of Alaska in 2002. Isolation from broad, frequent contact with other sociocultural systems is no longer a condition in most of the state, including rural settings. Accompanying this continued reduction in isolation is exposure to growing amounts of ideas and people from sociocultural systems very different from those of Alaska Natives. Such exposure introduces the potential for increasingly rapid sociocultural change, and the potential displacement of both village residents lured by other opportunities and key components of sociocultural systems supplanted by constructs imported from elsewhere.

To develop a sense of potential impacts under the proposed action, it is useful to examine such changes when the TAPS was first constructed and brought on line to provide a sense of what is possible. Access of Alaska Natives to cash, both during construction and operation, certainly occurred at levels greater than pre-TAPS. Alaska Natives consequently increased their participation in the modern Alaskan economy (Naylor and Gooding 1978). On the whole, they also experienced an increase in certain social problems, including substance abuse and suicide (Andon 1997; Kettl and Bixler 1993; Hlady and Middaugh 1988; Kraus and Buffler 1979; McNabb 1990). As discussed in Section 3.25.1.3, however, such social problems emerged well before the TAPS was there, grew following the onset of statehood, and continued to increase in a period that featured both the TAPS and other sources of sociocultural change, including wage labor from other sources not related to the pipeline. Thus, such consequences are not exclusively a consequence of the pipeline, although the TAPS likely contributed to the general conditions that led to such problems.

As defined here, sociocultural systems are collections of adaptive mechanisms that change to meet various challenges posed by natural and social surroundings. Alaska Native sociocultural systems have experienced rapid changes for more than a century in the face of increased interaction with Euro-Americans, the pace increasing beginning in the middle of the 20th century (Morehouse et al. 1984). The construction and operation of the TAPS occurred in the midst of this more recent phase of accelerated change, and in many ways is inextricably interwoven with other major sources of impact such as ANCSA (Berry 1975; Berger 1985). Access to wage labor and additional cash through the TAPS no doubt had an impact on Alaska Native sociocultural systems, but the amount and type of impacts are unclear because of the presence of other changes as well, including the following:

- An increase in Alaska Native political awareness and activity;
- The emergence of regional and village corporations;
- Growing social, political, and economic interaction with the Euro-American (primarily modern American) world (see Reckord 1979); and
- Reduced isolation of many rural Alaska Native villages because of dramatic improvements in transportation and communication.

For the 8 Alaska Native sociocultural systems and the 21 rural (largely) Alaska Native communities considered in this study, the impacts of continuing the TAPS would vary, but probably would be relatively small. Each of these sociocultural systems has incorporated many elements from Euro-American society — a consequence of more than a century of contact history, with sociocultural changes since the 1950s particularly rapid and widespread (see Haycox 2002; Schneider 1986). As a result, modern Native sociocultural systems feature many of the characteristics found in modern American society, particularly in the area of technology. Similarly, as noted, the economies of Alaska Native sociocultural systems are mixed and hence rely to some degree on cash. This is not to say that these sociocultural systems do not differ from the remainder of American society (see Jorgensen 1995) or that they somehow lack the value of less acculturated systems. Rather, it is an acknowledgment that the Alaska Native sociocultural systems have adapted to many conditions thrust upon them by Western society. Their survival is testimony to the success and considerable capacity of their adaptive strategies.

In the case of the Eyak, near Prince William Sound, anticipated sociocultural impacts under the proposed action would be small. Academics using language ability and blood quantum as criteria concluded decades ago that there were only a few surviving Eyak (DeLaguna 1990). However, the Native Village of Eyak, a federally recognized Tribe, reports a current membership of more than 500, more than 100 of whom claim Eyak descent (Heinrichs 2002). The Native Village of Eyak represents an Alaska Native sociocultural system that combines Native people from different Native (including Eyak, Tlingit, Alutiiq, and Athabascan) and non-Native ancestry, configured and adjusted to address the needs of a culturally mixed Tribal membership. The demonstrated ability of this sociocultural system to adapt to remarkably difficult challenges over the past two centuries is an indication of its resiliency. As a consequence, any negative impacts of normal operations under the proposed action are expected to be small.

In contrast, the two Iñupiat sociocultural systems examined in this EIS show relatively greater uninterrupted continuity with their traditional culture. Much of their traditional sociocultural system remains — including the continued importance of kinship, the traditional leadership of whaling captains, high economic and cultural reliance on traditional subsistence resources, respect for knowledge of traditional cultural behavior, widespread proficiency in the Iñupiaq language, and, in the case of the Tareumiut, even persistence of a traditional settlement system with its largely sedentary base.

In addition to their sociocultural continuity, the Iñupiat have been particularly adept at regional political organization and assertion. In particular, they have benefited more financially from the oil that flows through the TAPS, largely as a result of local taxing authority of the North Slope Borough and resulting employment and capital improvement programs. Such financial success has introduced a larger amount of change than most Alaska Native sociocultural systems have experienced recently. Many Iñupiat interact frequently with non-Natives — in work relationships in the oil fields, in commerce in the communities, and with a vast array of state and federal agency personnel. At the same time, North Slope Iñupiat have been uniquely able to exercise strong influence over the pace and direction of change.

Oil revenues also provide resources for many changes generally considered positive, such as jobs, access to quality modern health care, infrastructure, and a range of social programs (Strohmeyer 1997). Ultimately, the continuation of the TAPS likely would fuel the mechanisms of change among Iñupiat sociocultural systems, but much of it filtered through the Iñupiat leadership of the North Slope Borough government and the Tribal councils. Such changes would continue to include many desirable things made available through access to cash resources, such as expanded participation in subsistence; improved communication, infrastructure, and public services; and increased ability for people to remain in villages if they so choose.

For the remaining Native sociocultural systems examined, anticipated impacts under the proposed action would lie somewhere between those described above. For the Chugach Alutiiq, a sociocultural system much changed through its contact history with Euro-Americans, relatively few impacts are anticipated to accompany the proposed action. Continued access to cash incomes associated with general growth in the Alaska economy, much of it tied to the oil industry, is likely. However, as world market conditions reduce commercial fishery incomes, net growth in the cash sector for the Chugach Alutiiq village economies examined in this EIS may not occur. Ultimately, more than two centuries of adaptation to (often severe) impacts of interacting with Euro-Americans has produced a Chugach Alutiiq sociocultural system that should be able to accommodate the impacts under the proposed action. Any negative consequences likely would be small.

For the four regional Athabascan sociocultural systems — Ahtna, Tanana, Koyukon, and Gwich'in — likely impacts under the proposed action would be similarly minimal. Despite their relative geographic isolation (particularly the Tanana, Koyukon, and Gwich'in), all of these sociocultural systems have changed considerably from precontact times. Currently they combine features from Native and non-Native systems, and the proposed action would continue the incremental adoption of characteristics from the latter — once again in part made possible through continued access to cash via wage labor. Once again, these sociocultural systems have shown a strong ability to adapt and adjust to changing conditions introduced by Western society. Sociocultural impacts under the proposed action should not exceed their ability to adapt successfully.

In general terms, the proposed action would help to promote continued change in the Alaska Native sociocultural systems considered in this EIS, with all of its positive and negative connotations. These sociocultural systems in a sense are accustomed to the TAPS and the impacts associated with it. Moreover, the issue of modernization and its accompanying reduction in physical and sociocultural isolation, although in part a consequence of the TAPS and the oil it carries, also is a growing characteristic of contemporary Alaska in general. Nevertheless, a lingering concern with respect to modern Alaska Native sociocultural systems is the high incidence of what appear to be indicators of sociocultural imbalance — namely suicides and substance abuse. Although the reasons for these problems remain unclear, several studies cited above suggest that the growing importance of a cash economy and increased influence of the modern American society may be important contributing factors. Despite an existing familiarity with the TAPS and an inability to isolate TAPS-related changes from other changes associated with the modern world, persisting evidence for social problems among Natives in an Alaska greatly influenced by the oil industry leads to the conclusion that impacts on Alaska Native sociocultural systems under the proposed action likely would have a net negative effect. The magnitude of the impacts associated specifically with the TAPS is difficult to estimate, but it likely would be small.

4.3.21.2 Non-Native Sociocultural Systems

Impacts on rural non-Native sociocultural systems also likely would originate in economic issues, although rural non-Native economies once again are mixed and involve some combination of wage labor and subsistence. In rural settings, the proposed action would provide some access to cash income in settings where such income can be elusive — through both direct employment on TAPS-related activities and indirect employment generated by the availability of TAPS-related cash in rural communities (see Section 4.3.19). The proposed action also would enable the State of Alaska to continue providing public services, government programs, and infrastructure in rural settings at current levels (as noted in Section 4.3.21.1) something extremely important in isolated places (also discussed in Section 4.3.19). Actual impacts on the sociocultural systems of rural non-Natives probably would primarily consist of continuing the existing trends of further loss of individuality and isolation, disruption of established interaction patterns, and growing exposure to modern American society (see Coates 1993; Johnson 1992; Lounsbury 1992; Scott 1998).

The anticipated impacts on rural non-Native sociocultural systems under the proposed action are as important to consider as those for Alaska Native sociocultural systems. In a similar manner, they are not necessarily bad given that adaptation to changing situations is inherent in sociocultural systems. It is impossible to identify the TAPS as the primary source of likely changes during the renewal period, given the many sources of change in a rapidly modernizing Alaska. Nevertheless, the TAPS no doubt would contribute to change in non-Native sociocultural systems, providing more cash and introducing outsiders to rural Alaska (Scott 1998). When all considerations are weighed, impacts on rural non-Native sociocultural systems under the proposed action likely will be negative, though very small.

4.3.22 Cultural Resources

Operation of the TAPS under a renewed Federal Grant may involve ground disturbing activities that have the potential to affect known cultural resources adversely. However, those adverse impacts could likely be mitigated in various ways, such as through avoidance, data recovery, and monitoring. Any mitigation measures would be determined on a case-by-case basis through consultation with the Alaska SHPO and any federally recognized Tribes, as appropriate. The possibility also exists that previously unreported resources could be encountered during continued operation of the pipeline and its associated facilities. Impacts from oil spills, which are discussed in Section 4.4.4.16, examine the effects of accidents on cultural resources.

Impacts of Proposed Action on Cultural Resources

Although continued operation of the pipeline for 30 more years under a renewed grant could have the potential to affect known and previously unreported cultural resources adversely, mitigation measures would be developed through consultation on a case-by-case basis with the Alaska SHPO and any Alaska Native Tribes, as appropriate. Such mitigation might include avoidance, data recovery, and monitoring.

Three types of cultural resources could be encountered in the vicinity of the TAPS: archaeological sites, traditional cultural properties, and historic structures. Only archeological sites are currently known to exist in the ROW. However, the review of information on cultural resources conducted for this EIS identified deficiencies and gaps in the current data (see Section 3.26). Of particular note is the absence of any reported traditional cultural properties along the ROW. Given the presence of Alaska Natives throughout the area and the general difficulty in obtaining information on traditional cultural properties (which Alaska Natives tend to guard closely), it is likely that such resources actually occur within or immediately adjacent to the TAPS along its 800-mi length or in the vicinity of associated facilities. However, strict compliance with Stipulations 1.9.1 and 1.9.2 of the Federal Grant and Section 106 of the NHPA would help compensate for the inadequacies in the data and provide a measure of protection for any unreported cultural resources that are encountered.

Under Stipulation 1.9.1, prior to any ground-disturbing activities in areas that have not been modified by previous TAPS-related activities, APSC must consult with an archaeologist. APSC must also consult with the Alaska SHPO and any affected Alaska Native Tribes, as appropriate, as required under Section 106 of the NHPA. Under Stipulation 1.9.2 of the Federal Grant, APSC is also required to contact the Authorized Officer and an archaeologist immediately if any known or previously unrecorded archaeological or historical resources are encountered. In addition, the JPO has begun negotiations with the Alaska SHPO to establish a programmatic agreement for the protection of cultural resources along the TAPS.

Specifically with regard to traditional cultural properties, APSC's coordination with the Alaska SHPO and the appropriate Alaska Native Tribes for the region to be affected, also required under Section 106 of the NHPA (16 USC §470f), would avoid any adverse impacts to traditional cultural properties or establish mitigation measures for such impacts.

The final resource to be considered is the TAPS itself, which, over the next 30 years, may be eligible for listing on the NRHP as a historically significant structure. The TAPS is an example of significant engineering and construction, and it played an important role in the history of Alaska and the United States. The continued operation of the TAPS is unlikely to result in an adverse impact to this potentially significant structure. If any large or central portions of the pipeline, including associated facilities (e.g., pump stations), were to be dismantled during the 30-year renewal period, APSC would be required to coordinate with the Alaska SHPO under Section 106 of the NHPA (16 USC §470f).

4.3.23 Land Use and Coastal Zone Management

4.3.23.1 Land Use

Only land already within the existing ROW would be needed under the proposal action. Valid legal access for TAPS operation and maintenance exists on all parcels, with one exception currently under negotiation (Hansen 2002). However, repair operations during the renewal period could require authorization to use federal or state public lands or private lands outside the ROW.

Impacts of Proposed Action on Land Use and Ownership

Renewal of the Federal Grant resulting in continued operation and maintenance of the TAPS would be expected to have some impacts on land use along the pipeline. No major additional changes in current land use activities would be expected. However, the Ahtna and Chugach Corporations' concerns about trespassing and land use conflicts, respectively (which they attribute to the existence of the pipeline), could continue if the grant is renewed. Data are inconclusive regarding past, present, and future impacts of the TAPS and related facilities on subsistence activities.

Under the proposed action, some effects on federal, state, and private land use in the vicinity of the pipeline would occur. Historical trends in commercial, municipal, and residential development would be expected to continue. The proposed action would not preclude recreational, wildlife habitat conservation, military, mining, agricultural, or subsistence activities that currently occur in the vicinity of the pipeline. The restrictions on recreational use of the TAPS corridor and access roads across the corridor, which were instituted for security purposes after September 11, 2001, would continue for an unknown period of time. However, some land use conflicts have occurred on Native lands near the pipeline and could continue if the grant is renewed.

Federal and state lands in the vicinity of the pipeline include National Parks; federally designated Wilderness Areas; National Wildlife Refuges; National Wild and Scenic Rivers; and state recreation areas, sites, and parks. These lands are used primarily for recreation, wildlife habitat conservation, subsistence, and protection/preservation of ecological resources. Past operation and maintenance of the TAPS have not interfered with these land uses and have not impacted the protected resources in the ACECs managed by the BLM. Consequently, on the basis of past trends, the proposed action would be unlikely to interfere with or otherwise impact federal or state land uses.

The operation and maintenance of the TAPS also has not interfered with military, mining, or agricultural activities. The pipeline crosses Fort Greely, Eielson Air Force Base, and Fort Wainwright. On the basis of past trends, future interference with these activities would not be likely under the proposed action.

The evaluation of subsistence impacts under the proposed action indicates that any impacts from the TAPS would be very small (see Section 4.3.20). That conclusion rests on the presence of restrictions to subsistence use in extremely small parts of subsistence use areas for certain rural communities, and the disturbance of migration patterns of small numbers of terrestrial mammals (mainly caribou) used for subsistence. Although available data indicate the presence of certain other impacts on subsistence in the vicinity of the TAPS, these impacts are not necessarily associated with the pipeline or its operation.

Some access and use conflicts have occurred (and are continuing) along the southern half of the pipeline on Native lands owned by the Ahtna and Chugach Corporations. The Ahtna Corporation, which owns land south of Paxson, has experienced trespassing, which it attributes to the presence of TAPS access roads near a heavily used snowmachine and ORV use area. Ahtna Corporation believes that snowmachine and ORV users gain entry to Ahtna land via the TAPS access roads (Hart 2002). The Chugach Corporation, which owns land in the Valdez area, is concerned that the existence of the TAPS on their land precludes other uses (Rogers 2002). Continued operation and maintenance of the TAPS could result in continued trespassing on Ahtna land. In addition, the Chugach Corporation's concern about TAPS' preclusion of use on their lands could continue.

Although construction of the 400-mi Dalton Highway (built to service TAPS) has increased access to remote areas north of the Yukon River, the highway would remain whether or not the renewal occurs. Airstrips constructed for TAPS development and maintenance would also likely remain in existence regardless of renewal.

Changes in pump station operations are possible during the renewal period. Some pump stations could be upgraded or removed. One or more tanker berths could also be shut down or removed at the Valdez Marine Terminal. Other than some temporary increase in noise during construction or removal, which could be audible to recreationists, no direct or indirect impacts on land use are anticipated.

Continued operation and maintenance of the pipeline would entail the risk of spills. Spill scenarios for the proposed action and potential impacts on land use are discussed in Section 4.4.4.17.1.

4.3.23.2 Coastal Zone Management

The TAPS ROW begins in the North Slope Borough Coastal Zone and ends in the Valdez Coastal Zone. In compliance with the ACMP, both coastal zones have fully approved CMPs that include enforceable policies to regulate development activities. Activities must also be consistent with applicable ACMP statewide standards. The Alaska Division of Governmental Coordination (ADGC) and State of Alaska resource agencies conduct consistency reviews to ensure that proposed development activities are consistent with existing CMPs. Consistency reviews are conducted on TAPS maintenance activities before they occur (Laughlin 2002; State of Alaska 2001). On September 10, 2002, ADGC determined that the TAPS Owner's application was consistent with applicable CMPs. In addition, the BLM notified the TAPS Owners on October 17, 2002, that the consistency requirements had been satisfied by the state determination.

TAPS Compliance with Coastal Zone Management Policies

The northern and southern ends of the pipeline pass through the North Slope Borough and Valdez Coastal Zones, respectively. Pipeline operation and maintenance are currently permitted activities consistent with the CMPs for those zones and are in compliance with enforceable policies and applicable ACMP statewide standards. Continued operation and maintenance of TAPS under the proposed action would not be expected to alter this status.

The North Slope Borough CMP requires that development activities not substantially interfere with subsistence activities in the borough or jeopardize the continued availability of subsistence resources (North Slope Borough 1988). ACMP consistency reviews are conducted by the ADGC and State of Alaska resource agencies to ensure that the operation and maintenance of the TAPS are consistent with the North Slope Borough CMP and in compliance with enforceable policies as well as applicable ACMP statewide standards. The analysis conducted for this EIS concluded that any negative subsistence impacts under the proposed action would be very small (see Section 4.3.20). As a result, the TAPS is not expected to interfere substantially with subsistence activities in the North Slope Borough.

The Valdez CMP allows for a variety of development activities in the coastal zone, including utility corridors, and prioritizes water-related or water-dependent activities (Valdez 1987). ACMP consistency reviews are conducted by the ADGC and State of Alaska resource agencies to ensure that the operation and maintenance of the TAPS and related facilities, including the Valdez Marine Terminal, are permitted activities consistent with the Valdez CMP and in compliance with enforceable policies, as well as applicable ACMP statewide standards. On the basis of past compliance, it is expected that the continued operation and maintenance of the TAPS would continue to be consistent with the Valdez CMP and in compliance with its enforceable policies and ACMP statewide standards.

Changes in pump station operations are possible during the renewal period. Some pump stations could be upgraded or removed. One or more tanker berths could also be shut down or removed at the Valdez Marine Terminal. Other than some temporary increase in noise during construction or removal, no direct or indirect impacts within the North Slope Borough or Valdez coastal zones are anticipated.

Continued operation of the TAPS would involve the risk of an oil spill that could affect coastal resources. Both the North Slope Borough and Valdez CMPs recognize this risk and require oil spill prevention and response plans consistent with the statewide ACMP standards (see Section 4.4.1) (North Slope Borough 1988; TAPS Owners 2001a). The North Slope Borough CMP also requires risk analyses for various spill scenarios (North Slope Borough 1988). The TAPS is in compliance with these requirements. Spill scenarios for the proposed action and potential impacts on coastal zones are discussed in Section 4.4.4.17.2.

4.3.24 Recreation, Wilderness, and Aesthetics

4.3.24.1 Recreation

The proposed action would likely cause some effects on recreation on federal or state lands in the vicinity of the pipeline. Existing access to public lands would remain. The current restrictions on access to the ROW corridor would continue for an unknown period of time. On federal lands, the current recreational opportunities and the trend of increased use in the vicinity of the pipeline would continue. However, recreational opportunities and use levels could be expected to decline at state recreation areas, sites, and parks as a result of decreased state funding due to declining oil revenues during the 30-year renewal period. If the state reduces funding for state recreation areas, sites, and parks because of reduced oil revenue, maintenance of these facilities may be reduced, thus diminishing the attraction and use of them, or they may be closed because of the state's inability to maintain sanitation, health, and safety conditions of public facilities at acceptable levels.

The construction of the Dalton Highway, which was an indirect effect of the construction of the TAPS, has resulted in increased access to public lands north of the Yukon River, an increase in recreational opportunities, and a small increase in recreational use in some areas (BLM 2001b). Whether or not the TAPS ROW grant is renewed, the Dalton Highway would remain open to the public because it is now a state highway. The airports near the TAPS ROW corridor would also likely remain operational and continue to provide air access to remote recreation areas (TAPS Owners 2001a). Consequently, since the current road and air access would continue regardless of renewal, the historical trend of increased recreational opportunities and use in some areas would also be expected to continue.

Impacts of Proposed Action on Recreation, Wilderness, and Aesthetics

Although no new impacts would result from renewal of the Federal Grant, impacts that have occurred over the past 25 years would likely continue. Increased recreational opportunities and use of public lands along the length of the pipeline would be expected to continue. The current security restrictions on recreational use of the ROW would continue for an unknown period of time.

The current views of the pipeline from the easternmost ridges in the Wilderness Area within the Gates of the Arctic NPP would remain. Noise from vehicular traffic on the Dalton Highway and aircraft traffic along the ROW would continue to be heard from ridgelines along the eastern boundary of the Wilderness Area.

The existing aesthetic impacts from the TAPS and related structures would continue. A temporary increase in impacts would occur in localized areas during pump station upgrading or removal or during the removal of one or more tanker berths at the Valdez Marine Terminal. After completion of removal activities, the visual impact would be diminished in those areas. Because of variations in aesthetic perceptions and values, some visitors might have an adverse reaction to views of the TAPS and related facilities, while others would not.

On BLM lands along the Dalton Highway and the TAPS ROW corridor, the current recreational opportunity spectrum classes of roaded natural, roaded modified, and rural would remain under the proposed action, along with their associated management objectives. The past trend of an increasing number of visitors at Coldfoot Visitor Center, Marion Creek Campground, and the Yukon Crossing Contact Station would likely continue. Gates of the Arctic NPP, including the Wilderness Area within it, and the Arctic, Yukon Flats, and Kanuti National Wildlife Refuges all have experienced a small increase in recreational use in the last 25 years that would also be expected to continue under the proposed action. The trend of increased use at White Mountains National Recreation Area would also likely continue. However, decreased use would likely occur at some state recreation areas, sites, and parks because of reduced state funding, which could result in closure of some of these state facilities.

The Richardson Highway, which existed as a paved highway decades before the construction of the TAPS, would continue to provide access to public lands in the vicinity of the southern half of the TAPS. Under the proposed alternative, the BLM would likely continue to manage for the roaded natural, semiprimitive motorized, and semiprimitive nonmotorized recreational opportunity spectrum classes currently available on BLM lands along the southern half of the pipeline.

Currently existing recreational opportunities on the Delta and Gulkana National Wild and Scenic Rivers (WSRs) would not be affected by the proposed action. The grant renewal would not interfere with the objectives of the BLM's river management plans (BLM 1983a,b) and would not entail construction of any impoundments, structures, or diversions on either river (TAPS Owners 2001a). Increased recreational use of both WSRs would be expected to continue.

Because Wrangell-St. Elias NPP has not documented an increase in use during the last 25 years, implementation of the proposed action alternative would not be expected to affect future use. On the basis of past trends, the amount of recreational use at Chugach National Forest (near the Valdez Marine Terminal) would also likely be unaffected by the TAPS ROW renewal. Use levels at state recreation areas, sites, and parks along the southern half of the pipeline would be expected to continue. Current recreational opportunities would continue at Wrangell-St. Elias NPP, the Chugach National Forest, and undeveloped state lands.

APSC visitor sites and viewing stations along the length of the pipeline that are currently open would likely remain open to the public throughout the renewal period, although additional closures could occur if deemed necessary for security. The current ban on recreational use of the TAPS corridor, in effect since September 11, 2001 (Stearns 2002), would continue for an unknown period of time.

Changes in pump station operations would be possible during the renewal period. Some pump stations could be upgraded or removed. One or more tanker berths could also be shut down or removed at the Valdez Marine Terminal. Other than some temporary increase in dust and noise from machinery and traffic during construction or removal, no other impacts would be anticipated.

4.3.24.2 Wilderness

No federal or state designated or proposed Wilderness Areas exist within or adjacent to the TAPS ROW corridor (ADNR 2001d; APSC 1993; Delaney 2001). The Wilderness Area within Gates of the Arctic NPP is the only federally designated Wilderness Area within a few miles of the TAPS. Its eastern boundary is within 2 to 3 mi of the TAPS at its closest point (Ulvi 2001).

Under the proposed action, indirect effects on the Wilderness Area within Gates of the Arctic NPP would continue. No impacts would likely occur to the values that qualify it for wilderness designation. The pipeline is visible from some points along the easternmost ridges in the Wilderness Area, but that impact on the viewshed did not preclude wilderness designation in 1980. Although increased access to the vicinity of the TAPS has occurred from construction of the Dalton Highway and airports within the TAPS corridor, the National Park Service has noted only a slight increase in recreational use in the eastern portion of the Wilderness Area (Ulvi 2001). This use trend would likely continue under the proposed action.

Vehicular traffic from the highway and aircraft traffic along the TAPS corridor can be heard from ridgelines along the eastern Wilderness Area boundary. However, this small, localized impact did not preclude wilderness designation in 1980. Even without the renewal of the TAPS, some noise would continue to be heard along the eastern boundary of the Wilderness Area because the Dalton Highway would remain open to the public. In addition, noise from snowmachines, motorboats, and airplanes currently and historically used within the Wilderness Area would continue. Such usage is allowed in Alaskan Wilderness Areas pursuant to provisions of the ANILCA of 1980.

Whether or not the Federal Grant is renewed, the pipeline corridor does not meet the criteria for federal wilderness designation as defined by the Wilderness Act of 1964. Both the TAPS corridor and adjacent areas have been altered by man and do not offer outstanding opportunities for solitude and primitive recreation because of the proximity of the highways. Since the areas do not meet these essential criteria, federal wilderness designation is not possible. Consequently, the proposed action would not affect the suitability of the TAPS corridor for wilderness designation.

The existence of the TAPS has not precluded state designations of wilderness in Alaska in the vicinity of the pipeline. Implementation of the proposed action would not affect the potential for future designations.

Changes in pump station operations would be possible during the renewal period. Some pump stations could be upgraded or removed. Because of the distance between the nearest pump station and Gates of the Arctic NPP Wilderness Area, no direct or indirect impacts on wilderness are anticipated.

The continued operation and maintenance of the TAPS would entail the risk of a spill. It is unlikely that a TAPS spill would affect the Gates of the Arctic NPP Wilderness Area because of its distance from the pipeline. Spill scenarios for the proposed action and potential impacts on wilderness are discussed in Section 4.4.4.18.2.

4.3.24.3 Aesthetics

The TAPS ROW passes through areas that contain outstanding visual resources. About half the 800-mi length of the TAPS is above ground and clearly visible from the air. Most of the above-ground segments, including pump stations and related structures, also are visible from adjacent public roads. The pipeline is within sight of some BLM and state recreation sites and is visible from ridgelines along the eastern boundary of the Wilderness Area within Gates of the Arctic NPP. The TAPS is also visible from some BLM-managed ACECs and at a few points within the Delta and Gulkana National Wild and Scenic River corridors, including where the pipeline is suspended above the Gulkana River. The pipeline is also suspended above the Tanana River within sight of the Richardson Highway and above the Yukon River on the same bridge that carries the Dalton Highway. In addition, the Valdez Marine Terminal is clearly visible from the City of Valdez (TAPS Owners 2001a; APSC 1993). These localized existing aesthetic impacts would continue under the proposed action.

Occasional and temporary visual air impacts have occurred in the past during tank-vent flaring at PS 1. However, testing conducted since the completion of recent flare upgrades indicates that even vapor generation from a full pipeline inrush does not cause opacity. Consequently, emission impacts near PS 1 would likely either not occur or occur only very infrequently under the proposed action (Devereux 2001).

The entire TAPS corridor is managed by the BLM for energy transportation according to Class IV VRM objectives that allow major modifications to the existing landscape. Efforts are made to minimize visual impacts, particularly to ACECs and WSRs (BLM 1989; Overbaugh 2001). Stipulations in the Federal Grant also include provisions intended to minimize visual impacts.

Because perception of aesthetics involves a value judgment, some visitors might have an adverse reaction to views of the TAPS and related facilities, while others would not. Because of existing mitigation, ROW stipulations, and variations in aesthetic perceptions and values, only intermittent and localized impacts to visual resources would be expected to occur under routine operations.

APSC viewing stations along the length of the pipeline that are currently open would likely remain open to the public throughout the renewal period, although additional closures could occur if deemed necessary for security. The current ban on recreational use of the TAPS corridor, in effect since September 11, 2001 (Stearns 2002), would continue for an unknown period of time.

Changes in pump station operations would be possible during the renewal period. Some pump stations could be upgraded or removed. One or more tanker berths could also be shut down or removed at the Valdez Marine Terminal. A temporary and localized increase in the currently existing aesthetic impact would occur during upgrade or removal activities due to the presence of machinery and personnel and a potential increase in dust in some locations. However, the long-term aesthetic impact would decrease somewhat in areas where pump stations were removed, although visual evidence of the former presence of the pump station would likely remain.

Continued operation and maintenance of the TAPS would entail the risk of an oil spill that could potentially affect visual resources in the vicinity of the pipeline. Spill scenarios for the proposed action and potential impacts on aesthetics are discussed in Section 4.4.4.18.3.

4.3.25 Environmental Justice

The environmental justice analysis rests primarily on Executive Order 12898, which establishes the need to consider high and adverse impacts to minority and low-income populations (see Section A.14). The relatively large proportion of Native (indigenous) peoples residing in Alaska and relying on subsistence provides a much more complex setting than most in which environmental justice is evaluated. In response to these special characteristics, a number of steps were taken during the preparation of this EIS to provide an improved understanding of Alaska Native issues, including the challenges associated with evaluating environmental justice impacts.

Environmental Justice under the Proposed Action

In the absence of high and adverse effects in any particular impact area, no negative environmental justice impacts would be expected.

Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments," requires that the federal government consult with Tribal governments during the preparation of an EIS. As the lead federal agency associated with the EIS, the BLM established government-to-government exchanges with all Tribal governments in Alaska and more focused exchanges with 21 federally recognized Tribes directly affected by the TAPS (BLM 2001a). A number of steps were taken to establish these relationships. Initially, certified letters were mailed to all Tribal governments in Alaska recognized by the Bureau of Indian Affairs, informing them of the anticipated application to renew the Federal Grant. A systematic evaluation of Tribal peoples in the vicinity of the TAPS led to the identification of 16 directly affected communities (BLM 2001a); 5 additional federally recognized Tribes were subsequently added, bringing the total to 21. These 21 Tribes received more detailed mailings explaining the ROW renewal, the EIS process, and the various sources of additional information. Meetings were held with a number of Tribal organizations, both single Tribes as well as multiple Tribes, to discuss the EIS process and related issues in greater detail (Table 5.3-1).

In addition to government-to-government interaction, several other steps have been taken to integrate Alaska Natives within the EIS process. One of the most important was the addition of an Alaska Native to the JPO staff to serve as liaison with Tribal peoples before the onset of the EIS process. Although only one scoping meeting took place in a predominantly Alaska Native community, the remaining five occurred in communities that featured large numbers of Natives in residence or nearby. EIS staff attended key Alaska Native meetings, such as the Alaska Inter-Tribal Council and Alaska Federation of Natives meetings in fall 2001. Efforts taken to establish and maintain government-to-government interchanges during various stages of the EIS process helped to improve information exchange as well as interpretations of impacts under environmental justice and other impact areas related to Alaska Natives.

As stated above, environmental justice concerns require the presence of high and adverse impacts. As discussed in detail throughout Section 4.3, evaluations of anticipated environmental consequences of the proposed action do not indicate the presence of high and adverse impacts under normal operating conditions of the TAPS (see Table 2-1). In the absence of such consequences, no negative environmental justice impacts are expected, regardless of the presence of disproportionately high percentages of minority and low-income populations in areas that might experience effects from the TAPS (see Section 3.29).

In contrast, certain disproportionately positive impacts likely will affect environmental justice populations under the proposed action. One of the most obvious is the Permanent Fund Dividend, which is paid to every eligible citizen of Alaska. Although data on average family size for minorities as defined in this document are unavailable from the 2000 census, because the average size of White families (3.13 persons) is smaller than the average size of families in the state of Alaska as a whole (3.28 persons), the average size of non-White families would have to exceed 3.28 (to bring the average to 3.28)

(U.S. Bureau of the Census 2002b). On average, minority families therefore would experience more financial benefits per family than nonminority families in the state. Moreover, the Permanent Fund Dividend tends to contribute a larger percentage of the income of minority populations (who tend to have lower incomes than nonminorities) and low-income families than of other families in Alaska. As a result, continuation of the dividend under the proposed action would provide disproportionately greater financial benefits for environmental justice populations than for the state population as a whole. Another disproportionately positive impact affecting Alaska Natives would occur under Section 29 of the Federal Grant, establishing a base level of Alaska Native employment with APSC at 20% of total hires — 1.3% higher than the percentage of Alaska Natives in the state (see Section 3.25.1).