4.5 Cumulative Impacts

This section identifies and evaluates potential cumulative effects of the proposed and no-action alternatives in combination with other past, present, and reasonably foreseeable actions. The goal is to ensure compliance with federal regulations and guidelines, and to thoroughly address the physical, biological, and social components of the affected environment.

In 1978, the Council on Environmental Policy (CEQ) issued regulations (40 CFR 1500-1508) that require the EA or EIS preparer to consider not only the individual direct and indirect effects of a proposed action and each of its alternatives, but also the potential *cumulative* impact, which is defined as follows (40 CFR 1508.7):

> ...the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

In 1997, the CEQ issued a detailed handbook on cumulative effects assessment (CEQ, 1997). CEQ emphasizes that the handbook "is not formal guidance nor is it exhaustive or definitive; it should assist practitioners in developing their own study-specific approaches" (CEQ, 1997, p. vi). This handbook identifies three basic components of such an assessment:

1. The predicted direct and indirect effects of a described future action;
2. Effects of other past, present, and reasonably foreseeable future actions; and
3. Additive relationships or synergies between (1) and (2) that result in cumulative effects.

The cumulative effects analysis in this report incorporates the procedures and information identified by CEQ as essential to be rigorous, comprehensive, and complete. At the same time, the authors have developed original procedures for screening issues and ranking potential cumulative effects by magnitude and probability. The result is a cumulative effects assessment tailored to TAPS ROW renewal.

Section 3 of this report describes the affected environment, while Sections 4.1 through 4.4 cover direct and indirect environmental consequences of the proposed and no-action alternatives. This cumulative effects analysis differs in scope in three main ways.

First, the analysis considers the effects of the renewal of the TAPS ROW together with the continued operation of the ANS oil fields, the VMT, and the associated marine transportation link. These facilities, although distinct from the pipeline, are clearly related activities. In fact, none of these facilities would be viable economically if the others did not exist. These facilities were treated as a group in the economic analysis in Sections 4.3.3.1 and 4.4.3.1, because the econometric models employed for the different facilities were linked, and it was not feasible to undertake the analysis on a facility-by-facility basis. Because the cumulative economic effects of these assets were addressed in the previous sections, only the highlights are given here.[1]

Second, inclusion of ANS oil fields, the VMT, and the marine transportation link broadens the geographic area covered by this analysis of cumulative effects. The overall project study area is divided into the ANS, Central TAPS, and Valdez/Prince William Sound (PWS) study areas.

Third, the CEQ definition of cumulative impacts obviously includes the ANS fields, VMT, and marine transportation link, but may also include other actions. EISs covering other Alaskan development proposals have included potential oil and gas activities on the North Slope; these documents are incorporated by reference (e.g., FERC, 1993, 1995; FPC, 1976; USACE, 1997, 1999; BLM, 1976; BLM and MMS, 1998; MMS, 1987a, b, 1990, 1991, 1996a, 1998).

This section is organized into five parts. Section 4.5.1 describes the methodology for the cumulative effects analysis. Section 4.5.2 summarizes past, present, and reasonably foreseeable actions and the documented environmental is-

[1]Sections 4.3.3.1 and 4.4.3.1 do not consider the economic impacts of possible projects to commercialize ANS natural gas (discussed in this cumulative effects section). Therefore, the incremental economic effects of gas commercialization must be added to those estimated in Sections 4.3 and 4.4.

sues associated with them. These actions and issues, along with potential direct and indirect effects of the alternatives, form the basis for the cumulative effects analysis. Sections 4.5.3 and 4.5.4 present detailed discussion of the potential cumulative effects of the proposed and no-action alternatives categorized by geographic region, environmental component (physical, biological, or social), and suggested levels of intensity and probability (together comprising significance). Section 4.5.5 contains the conclusions.

4.5.1 Methodology

By R.G.B. Senner

The basic idea behind cumulative effects assessment is that if proposed actions are evaluated singly, the big picture will be missed: the additive result of many actions, each exerting its beneficial or adverse environmental influence over time. This need to avoid the piecemeal assessment of environmental impacts led to inclusion of the cumulative effects requirement in the 1978 CEQ regulations and to the eventual development of the CEQ's cumulative effects handbook (CEQ, 1997) and federal agency guidelines based on that handbook (e.g., EPA, 1999a). Although predictions of direct effects of individual proposed actions tend to be more certain, cumulative effects may have more important consequences over the long term. The possibility of these "hidden" consequences presents a risk to decision-makers, because the ramifications of an individual decision are not always obvious. The goal of identifying potential cumulative effects, therefore, is to allow informed decisions — choices with some awareness of implications and consequences beyond the immediate effects of the project under consideration.

To be reliable, any cumulative effects analysis must use a procedure that is (1) logical and methodical and (2) transparent and reproducible. The following discussion reviews the methods used in this analysis.

Cumulative effects analysis must combine three components: (1) a *scope* that sets boundaries in location and time; (2) past, present, and predicted *issues*; and (3) past, present, and predicted *actions*. The CEQ (1997) has established eight principles (Table 4.5-1) that expand on this idea. These principles guided the analysis of potential cumulative effects of the proposed and no-action alternatives.

Beyond the general principles, a stepwise procedure is required to ensure that the analysis is conducted in a systematic, reproducible way that anyone can independently examine and evaluate. The procedure recommended by CEQ (1997) is followed, with some modifications to account for the fact that, unlike most proposed actions, the TAPS ROW renewal decision will be made almost three decades following construction and after many years of continuous operation and maintenance.

In addition, the discussion is amplified in various places to present policy-relevant material. For example, CEQ Principle 2 indicates that effects should be considered without regard to who has taken (or will take) the action. This principle is followed, but it is also relevant to distinguish between actions and effects that are controllable by the sponsors of the proposed action and those that may be taken by other individuals, firms, or agencies. For example, continued operation of TAPS and the Alaska North Slope oil fields will generate future revenues for federal, state, and local governments (among others). How these revenues are spent, however — whether on infrastructure development, education, health care, or any of the other goods and services provided by government — is beyond the control of the applicants for the ROW renewal. Similarly, construction of the Haul Road (now the James Dalton Highway) was integral to the TAPS project. But the decision to lift public access restrictions was not under the control of the ROW applicants, and whether this policy is maintained or reversed in the future will also be beyond their control.

4.5.1.1 Sequence of Analysis

The cumulative effects analysis followed 11 steps that can be classified into four stages: *scoping*, *organizing*, *screening*, and *evaluating*. Table 4.5-2 compares the CEQ procedure side-by-side with the method actually used in this report, and shows how the individual parts of the CEQ approach were adapted and applied to the two alternatives.

The sequential approach can be compared to a series of filters or meshes, each one finer than the one before. In a step-by-step process, the analysis progressed from broad scoping, through classifying and consolidating, to the selective screening and capture of potential cumulative effects. The basic sequence is to:

- Describe the potential direct and indirect effects of each alternative;
- Identify other external actions that could have additive or synergistic effects with the alternatives;
- Screen all of the issues to capture those effects that are potentially cumulative in nature;
- Rank the potential cumulative effects by *intensity* and *probability*; and
- Present the results in a simple but informative matrix in accordance with CEQ guidance.

The *significance* of a potential cumulative effect is de-

Table 4.5-1. *CEQ principles of cumulative effects analysis.*

	Principle	Explanation
1.	**Cumulative effects are caused by the aggregate of past, present, and reasonably foreseeable future actions.**	The effects of a proposed [or alternative] action on a given resource, ecosystem, and human community include the present and future effects added to the effects that have taken place in the past. Such cumulative effects must also be added to effects (past, present, and future) caused by all other actions that affect the same resource.
2.	**Cumulative effects are the total effect, including both direct and indirect effects, on a given resource, ecosystem, and human community of all actions taken, no matter who (federal, nonfederal, or private) has taken the actions.**	Individual effects from disparate activities may add up or interact to cause additional effects not apparent when looking at the individual effects one at a time. The additional effects contributed by actions unrelated to the proposed [or alternative] action must be included in the analysis of cumulative effects.
3.	**Cumulative effects need to be analyzed in terms of the specific resource, ecosystem, and human community being affected.**	Environmental effects are often evaluated from the perspective of the proposed [or alternative] action. Analyzing cumulative effects requires focusing on the resource, ecosystem, and human community that may be affected and developing an adequate understanding of how the resources are susceptible to effects [i.e., the pathway or mechanism by which the effect is produced on the resource].
4.	**It is not practical to analyze the cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful.**	For cumulative effects analysis to help the decision-maker and inform interested parties, it must be limited through scoping to effects that can be evaluated meaningfully. The boundaries for evaluating cumulative effects should be expanded to the point at which the resource is no longer affected significantly or the effects are no longer of interest to affected parties.
5.	**Cumulative effects on a given resource, ecosystem, and human community are rarely aligned with political or administrative boundaries.**	Resources typically are demarcated according to agency responsibilities, county lines, grazing allotments, or other administrative boundaries. Because natural and sociocultural resources are not usually so aligned, each political entity actually manages only a piece of the affected resource or ecosystem. Cumulative effects analysis on natural systems must use natural ecological boundaries and analysis of human communities must use actual sociocultural boundaries to ensure including all effects.
6.	**Cumulative effects may result from the accumulation of similar effects or the synergistic interaction of different effects.**	Repeated actions may cause effects to build up through simple addition (more and more of the same type of effect), and the same or different actions may produce effects that interact to produce cumulative effects greater than the sum of the [individual] effects.
7.	**Cumulative effects may last for many years beyond the life of the action that caused the effects.**	Some actions cause damage lasting far longer than the life of the action itself (e.g., acid mine drainage, radioactive waste contamination, species extinctions). Cumulative effects analysis needs to apply the best science and forecasting techniques to assess potential catastrophic consequences in the future.
8.	**Each affected resource, ecosystem, and human community must be analyzed in terms of its capacity to accommodate additional effects, based on its own time and space parameters.**	Analysts tend to think in terms of how the resource, ecosystem, and human community will be modified given the action's development needs. The most effective cumulative effects analysis focuses on what is needed to ensure long-term productivity or sustainability of the resource.

Source: CEQ (1997). Bracketed text added by author.

fined in terms of its intensity and probability. Intensity is evaluated in the context of the potential magnitude, geographic extent, and frequency or duration of the cumulative effect. Probability is estimated on the basis of available evidence about the effect or similar effects, including its known past or present occurrence. Finally, the intensity and probability rankings are entered onto a matrix that provides a distribution of the potential cumulative effects with respect to their relative significance (Figure 4.5-1).

Techniques were required that could be easily followed and understood. This is important because each analytical step forms a premise on which the next step is based. If something is wrong in an early step, it can affect all of the following steps and ultimately, the conclusions. The following briefly explains how each stage was conducted to ensure that the next step would be on a solid footing.

Scoping

Step 1: Review potential effects of the alternatives.

The first step in the analysis was to review the predicted direct and indirect effects of the proposed and no-action alternatives on the physical, biological, and social components of the environment. Sections 2, 3, and 4.1 through 4.4

Table 4.5-2. *Procedure for cumulative effects analysis in this report.*

Steps Used in This Analysis	Recommendations from CEQ (1997)
A. Scoping: Identify Issues, Actions, and Boundaries	
1. Review the predicted direct and indirect effects of the proposed and no-action alternatives on the physical, biological, and social environments (Sections 2, 3, and 4.1 through 4.4).	1. Identify the significant cumulative effects issues associated with the proposed action and define the assessment goals.
2. Geographic scope divided into three regions: Alaska North Slope, Central TAPS, and Valdez/PWS.	2. Establish the geographic scope for the analysis.
3. Time frame established as 1974 through 2034.	3. Establish the time frame for the analysis.
4A. Review past environmental impact statements, environmental reports, and the peer-reviewed literature to identify actions and issues of concern.	4. Identify other actions affecting the resources, ecosystems, and human communities of concern.
4B. Interview private and federal, state, borough, and local agency personnel to determine potential future actions that have received preliminary agency notice or review, and to identify new or emerging issues of concern.	
B. Organizing: Characterize and Consolidate Issues	
5. Organize identified issues hierarchically by: a. Proposed or no-action alternative b. North Slope, Central TAPS, or Valdez/PWS c. Physical, biological, or social	5. Characterize the resources, ecosystems, and human communities identified during scoping in terms of their response to change and capacity to withstand stresses.
6. Identify and document issues relating to physical, biological, and social features and to laws, regulations, permits, and stipulations.	6. Characterize the stresses affecting these resources, ecosystems, and human communities and their relation to regulatory thresholds
7A. Consolidate similar issues.	7. Define a baseline condition for the resources, ecosystems, and human communities.
7B. In the detailed discussions of issues and results (Sections 4.5.3 and 4.5.4), explain baseline conditions and impact pathways where data allow.	
C. Screening: Identify Potential Cumulative Effects	
8. From the consolidated issues, identify potential cumulative effects of the proposed and no-action alternatives.	8. Identify the important cause-and-effect relationships between human activities and resources, ecosystems, and human communities.
D. Evaluating: Rank by Magnitude and Probability	
9. Using appropriate evaluation criteria (CEQ, 1997; McMillen, 1993), rank potential cumulative effects by intensity and probability, using a matrix to show the approximate risk associated with each. Intensity is a function of magnitude, geographic scope, and frequency/duration.	9. Determine the magnitude and significance of cumulative effects.
10. Either alternative will be in full compliance with laws, regulations, permits, and stipulations, and will incorporate mitigation measures.	10. Modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects.
11. Monitoring is beyond the scope of this analysis.	11. Monitor the cumulative effects of the selected alternative and adapt management.

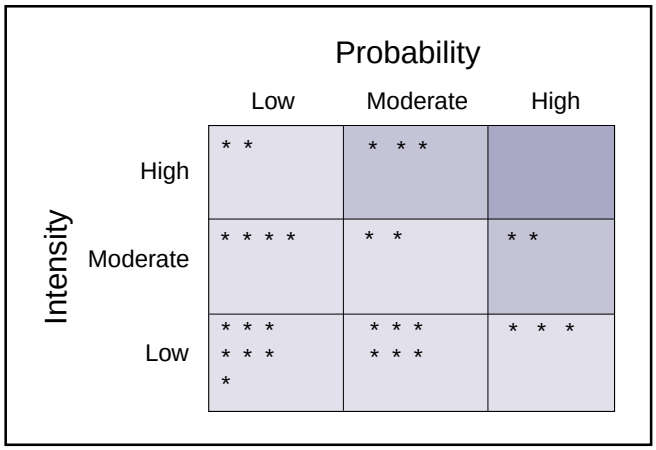


Figure 4.5-1. *Use of a simple matrix to show the distribution of potential cumulative effects (*****) when ranked by* intensity *and* probability. *The level of significance is suggested to approximate* intensity X probability *and to increase toward the upper right portion of the matrix. The shaded area represents the distribution of potential cumulative effects defined as* significant *for this analysis. Adapted from Muhlbauer (1996), p. 12.*

were the basis for much of this review, along with new material on the ANS and Valdez/PWS study areas prepared specifically for this analysis. The predicted beneficial and adverse effects of both alternatives were tabulated by physical, biological, and social categories.

Step 2: Establish geographic scope.

It became apparent that for the physical and biological categories, the geographic scoping used for earlier parts of this report — ANS, Central TAPS, and Valdez/PWS — would be appropriate for the cumulative effects analysis. The impact mechanisms for predicted physical and biological effects, whether direct or indirect, were not dispersed enough to produce notable influences beyond the airshed, lands, waterbodies, and surrounding marine environment of Alaska — with the exception of special cases such as atmospheric changes or a tanker accident on the high seas. In the social category, however, the analysis was left open-ended enough to accommodate economic influences on market environments outside Alaska.

Step 3: Establish time frame.

The CEQ definition (40 CFR 1508.7) and principles of cumulative effects analysis (Table 4.5-1) specify that past effects of actions must be considered along with present and reasonably foreseeable ones. In addition to the forward-looking projection of the proposed action from 2004 to 2034, the proposed term of ROW renewal, it was necessary to look back to construction startup in 1974 to take into account the preceding three decades of TAPS construction, operation, and maintenance under the existing ROW. Therefore, the time frame for the cumulative effects analysis was defined as the 60-year period from 1974 through 2034. This considerable time is divided almost equally between past and future, and thus between the documentation of past effects and the prediction of future outcomes. Because the pipeline system has operated continuously since 1977, there is a reliable basis for projecting the probable future effects of its uninterrupted continuation. Also, the proliferation of ANS oil fields has occurred during approximately the same time as TAPS construction and operation, and the environmental effects of North Slope petroleum development may be the most heavily documented anywhere in the world. From the standpoint of cumulative effects involving North Slope petroleum production, therefore, the 1974-2034 time frame is appropriate, although earlier environmental effects of exploration in NPR-A are also taken into account.

Step 4A: Review other actions and their documented or potential environmental effects.

Many other documents were examined to identify other actions and their associated environmental impact issues that could contribute to cumulative effects of the proposed and no-action alternatives. These included EISs, environmental assessments (EAs) prepared by project sponsors, agency critiques such as the JPO Comprehensive Monitoring Reports, scientific and technical articles published in peer-reviewed journals, and numerous reports documenting studies by government, industry, and consultants during the past 30 years and more.

Step 4B: Interview knowledgeable people.

Representatives of federal and state agencies and local jurisdictions were interviewed to identify development plans that had come to their attention. Agency representatives are typically well-informed about projects proposed by the private sector, because agency review and approval are usually required for such actions. Similarly, staff of the North Slope petroleum producers and of Alyeska were interviewed to identify planned oil and gas projects. Agency and industry representatives were also interviewed to identify recent or emerging environmental issues that had not yet been captured in the literature. These issues were cited as personal communications and added to the data.

Organizing

Step 5: Determine the structure of the analysis.

The cumulative effects analysis was organized first by alternative (proposed or no-action), then by region (ANS,

Central TAPS, Valdez/PWS), and finally by type of issue (physical, biological, social). This approach acknowledged the major differences among the three regions and allowed each region to be discussed cohesively with respect to its distinctive and sometimes unique physical, biological, and social characteristics.

Step 6: Tabulate environmental issues.

Physical, biological, and social issues were tabulated, using information from Steps 1, 4A, and 4B. The issues included beneficial and adverse environmental effects of TAPS construction, operation, and maintenance, and of ANS oil and gas development. All were organized into categories to aid consolidation of similar issues in Step 7A.

Step 7A: Consolidate similar issues.

Similar issues were consolidated into general statements to make further analysis more convenient.

Step 7B: Characterize resources, impact pathways, relevant regulatory factors, and mitigation.

After the potential cumulative effects were identified, each was characterized with respect to the following:

- Magnitude, probability, and associated risk;
- Supporting evidence; baseline information if available;
- Impact pathways;
- Laws, regulations, or stipulations where pertinent; and
- Mitigation opportunities.

Screening

Step 8: Identify potential cumulative effects of the alternatives.

Each consolidated issue was screened to determine whether it qualified as a potential cumulative effect, using the steps shown in Figure 4.5-2. The screening matrix was used to apply the following sequence of criteria:

- Did the effect occur in the past?
- Is the effect occurring now?
- Has the effect been fully mitigated?
- Could the effect occur in the future?
- If adverse, is the effect unavoidable?
- Is this a potential cumulative effect?
- If no, why not?
- If yes, in combination with what actions?
- How adequate are the evaluation data, in terms of quality and quantity?

CEQ's Step 10 indicates that alternatives should be modified or added to "avoid, minimize, or mitigate significant cumulative effects." Note also that according to this step, "either alternative will be in full compliance with laws, regulations, permits, and stipulations, and will incorporate mitigation measures." This analysis intentionally limits mitigation measures to those under the control of the applicants, on the belief that it is beyond the scope of this effort to recommend mitigation measures the applicants cannot implement. Where appropriate, potential mitigation strategies are addressed in the context of public policy.

Although the screening process yielded potential cumulative effects, it did not address their magnitude, probability, or level of risk relative to the proposed action or no-action alternative. In other words, all of the screened cumulative effects at this stage are equivalent and cannot be weighed against one another. The final stage of evaluating the potential cumulative effects, and suggesting an approximate level of risk that might be associated with each, was completed in Step 9.

Evaluating

Step 9: Organize, evaluate, and rank potential cumulative effects.

Once the potential cumulative effects were identified through the screening process described above, it was necessary to organize, evaluate, and rank them. Evaluating and ranking are the most challenging part of the cumulative effects analysis process, for the following reasons:

- There is no single, widely accepted method for ranking any type of potential environmental impact, whether direct, indirect, or cumulative.
- Guidance on determining the magnitude and significance of cumulative effects provided by the CEQ handbook, while pertinent and useful, leaves the specific approach up to the analyst (CEQ, 1997, pp. 41-45). Appendix A of the CEQ handbook suggests a wide range of analytic methods, but none applies directly to evaluating and ranking cumulative effects relative to one another.
- An extensive review of previous EISs and EAs confirmed that the literature yields no consistent pattern or consensus on methods for ranking or writing about cumulative effects. Lacking this precedent, the analyst must select or devise the method to be used when undertaking each new cumulative effects assessment, as consistent with the CEQ guidance cited above.
- Because the significance of a potential cumulative effect must depend on *context* as well as *intensity* (CEQ, 1997, p. 44), the evaluation must consider the

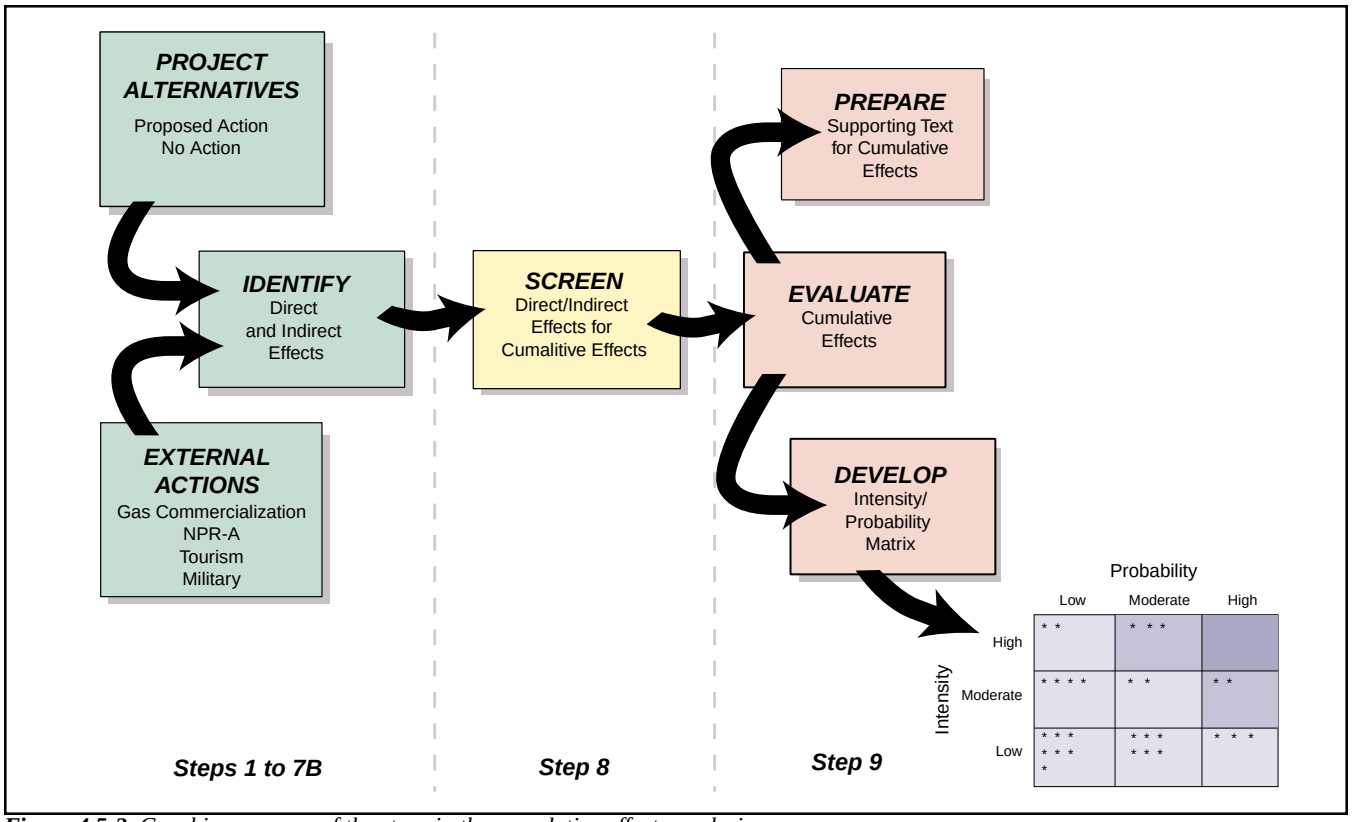


Figure 4.5-2. *Graphic summary of the steps in the cumulative effects analysis.*

unique circumstances (history, geographic setting, characteristics of human communities and ecosystems, etc.) of the action under consideration. Consequently, a one-size-fits-all approach is not likely to work well.

- Criteria for ranking cumulative effects must also vary by environmental component. In this case, the criteria depended on whether the effect related to the physical, biological, or social component of the environment. This situation became more complicated when a potential cumulative effect related to more than one component. For example, the significance of a predicted decline in a local moose population may be low or moderate from a biological standpoint, but high from a social standpoint if local residents depend on the moose population for subsistence.

Given these considerations, the significance of a potential cumulative effect was defined as a function of its *intensity* and *probability. Intensity* is evaluated as high, moderate, or low in the context of magnitude, geographic scope, and frequency/duration, using the criteria defined above. The rationale for the assigned intensity ranking is explained in the discussion of each potential cumulative effect. *Probability* presents a special problem, because of uncertainty regarding future actions and outcomes. Rather than attempting to derive mathematical probabilities, the authors have chosen to weigh the available evidence and make an informed assessment as to how likely a potential cumulative effect is to occur. As a rough guideline, a probability ranking of *low* approximates a probability of less than 0.3; *moderate,* a probability in the 0.3 to 0.6 range; and *high,* a probability greater than 0.6. Although this approach is subjective, each probability assessment is explained in writing, allowing the reader to weigh the assessment on an informed basis.

This approach closely follows National Environmental Policy Act (NEPA) precedent and CEQ guidance in assuring that each potential cumulative effect is assessed in its own specific context, using such factors as magnitude, geographic extent, and frequency/duration to evaluate intensity (CEQ, 1997, p. 44). Based on this contextual analysis, intensity is ranked as low, moderate, or high, along with an estimate of probability (again low, moderate, or high). These two rankings together suggest the level of significance associated with the effect. *Significant* outcomes are defined as those ranked as having (a) high intensity/high probability, (b) high intensity/moderate probability, or (c) moderate intensity/high probability. Finally, the results are presented in a simple matrix format that allows the reader to assess at a glance the distribution of potential cumulative

effects and their relative significance. This approach, adapted from a matrix used by Muhlbauer (1996) in a simple risk assessment model, is shown conceptually in Figure 4.5-1.

4.5.1.2 Detailed Discussion of Methods for Evaluating Cumulative Impacts

The advantages of the approach outlined above are that it (1) closely follows CEQ guidance, (2) employs an orderly and explicit procedure that is transparent to the reader, and (3) is well-grounded in both the NEPA and risk assessment literature. Several authors have recently suggested workable approaches to ranking environmental impacts and assigning levels of significance, and pertinent elements of their methodologies have been incorporated in this analysis. For example, both March (1996) and McMillen (1993) emphasize the central importance of *significance* in good NEPA practice, and both provide systematic frameworks for establishing the significance of potential effects in terms of context and intensity, in compliance with CEQ regulations (40 CFR 1508.27).

March's approach determines significance by applying seven tests in a specific sequence, with each step serving as a threshold test in the context of the particular criterion being applied: environmental receptors, activities that might affect the receptors, legal compliance, risk/uncertainty, cumulative effects, establishment of a precedent, and controversy. However, March's approach does not provide an explicit method for putting all seven test results together and reaching a conclusion about the overall significance of the potential effect. He states that the Department of Energy's (USDOE) "practice, in effect, requires that the forms of evidence in support of significance findings be defined by a professionally knowledgeable group of people taking into account all context and intensity factors, and responding to the criterion stated in [CEQ scoping regulation *40 CFR*] *1500.1 (b)*. We recommend that all NEPA document planning include a similar early step in which the form and scope [of] evidence in support of *significance* determinations are to be specified in detail." Thus, the March approach does not specify what to do with the test results, other than to apply professional judgment to this question at the beginning of the process, during scoping. In particular, no system or technique is provided by which to weigh, compare, or otherwise combine the seven test results to produce an outcome that will be readily understandable, resistant to misinterpretation, and widely acceptable. Thus, March's method, while closely compliant with CEQ regulations and providing excellent guidance on criteria of significance, requires further development with regard to closure.

McMillen (1993) explicitly recognizes this problem: "In reality, any number of criteria can be used in the significance assessment. However, the more criteria used the more difficult it is to develop the test used to identify the degree of magnitude of the impact" (p. 199). The problem is that as criteria are systematically applied, the question of how to integrate them logically becomes increasingly complicated. McMillen's solution is to apply four fundamental criteria of significance: magnitude, geographic extent, duration and frequency, and probability, consistent with the subsequently published CEQ handbook (CEQ, 1997). These criteria are applied through a series of questions with yes/no answers. The questions are given different weights depending on their importance in the view of the practitioner. For example, a question about human health or safety is given greater weight than a question on violation of a permit. The sum of the weighted "yes" responses is then used to determine whether the impact rating for a particular criterion is high, medium, or low.

In the McMillen method, the potential effect being analyzed thus receives four ratings, one each for magnitude, geographic extent, duration and frequency, and probability. Each rating can be high, medium, or low. The four ratings are then combined to achieve a final score for significance (also high, medium, or low). McMillen is not explicit, however, about how the score for significance should be determined. He presents a table (Table 1-2, p. 202) that shows "Criteria for Determining Significant Adverse Biological Impacts," and it is apparent that this table incorporates a weighting system that gives priority to magnitude. But the nature of the weighting system and the underlying rationale for giving priority to magnitude are not explained. The final ranking for significance clearly must depend on the relative weights as well as the relative scores given to the four criteria, but the reasoning behind the weighting is not discussed.

The McMillen method was tested in an earlier version of this cumulative effects analysis for TAPS ROW renewal. While the method is convenient and easy to apply, two difficulties were found. First was the issue of transparency. Although each potential cumulative effect was given a rating with respect to magnitude, geographic extent, frequency/duration, and probability, the reason for each rating, based on the practitioner's judgment, was not documented. If the reader questioned a conclusion, there would be no way to examine the professional judgment that led to it. As noted in the preceding paragraph, another transparency problem in McMillen's method was the lack of explanation

regarding how the ranking system for significance was structured, particularly for the weighting of criteria.

The second concern is that *likelihood* — the probability that a cumulative effect would indeed occur — seemed to be fundamentally different from the *intensity*-related criteria of magnitude, geographic extent, and frequency/duration. Together, however, these two fundamental characteristics — intensity and probability — were what really mattered in assessing the overall significance of the event. Accordingly, an alternative approach was chosen in which *intensity* (based on the context of magnitude, geographic extent, and frequency/duration) and *probability* would be ranked separately (low, moderate, or high), and the two rankings weighed against each other to suggest the *significance* of a potential cumulative effect. In this way, the systematic clarity of the McMillen approach was used, but a new method was developed that has much in common with the separate but allied discipline of risk assessment.

In his *Pipeline Risk Management Manual*, Muhlbauer (1996) presents a basic model in which the risk of a proposed action or policy can be defined by answering three questions:

- What can go wrong?
- How likely is it?
- What are the consequences?

These questions suggest a parallel approach to assessing the significance of potential environmental impacts. Taken in order, they identify the potential impact, assess its probability, and describe its intensity. Answering the first question is equivalent to stating the nature of the potential environmental effect. The second item is a straightforward query about probability, and the third question really asks what the intensity of the potential impact would be, in the context of relevant factors such as McMillen's magnitude, geographic scope, and frequency or duration. Thus, the Muhlbauer model presents a clear and simple framework for assessing environmental effects, whether direct, indirect, or cumulative, that corresponds closely to the guidance presented in the CEQ handbook (CEQ, 1997).

Parallels between risk assessment and environmental impact assessment extend to useful similarities between risk and significance. A standard way of evaluating risk is to define it as a function of consequence and probability, where:

R = risk;
C = consequence;
L = likelihood; and
R = CL.

This suggests the parallel approach used in this analysis, where:

S = significance;
I = intensity;
P = probability; and
S = IP.

Muhlbauer presents a simple hazard matrix that provides a framework for assessing relative risk, based on consequence and likelihood (Figure 4.5-3). In this model, the more important risks are those with higher consequences and higher probability. The advantage to the reader is that the matrix allows a rapid grasp of how the issues are distributed and which ones should be of greater concern. Thus, Muhlbauer's approach was adapted, and the analogous matrix was developed based on intensity and probability shown previously in Figure 4.5-1.

Finally, in developing the approach, the question of objectivity versus subjectivity was faced. This was especially apparent as potential cumulative effects were ranked with respect to intensity and probability. Several lessons were learned. First was the importance of a thoughtful and explicit method with clearly defined criteria and replicable procedures. McMillen (1993, p. 197) is particularly eloquent on this point:

> "Without a well conceived methodology, the defensibility of the document reverts back to the subjective instincts of the analyst (i.e., professional judgement). In which case, if the results of the analyses are disputed, the personal integrity/judgement of the analyst is directly contested. On the other hand, when a methodology is contested, the result is usually an improvement in the methodology, aided by the person or organization that took issue with it (i.e., they point out what is wrong and allow for correc-

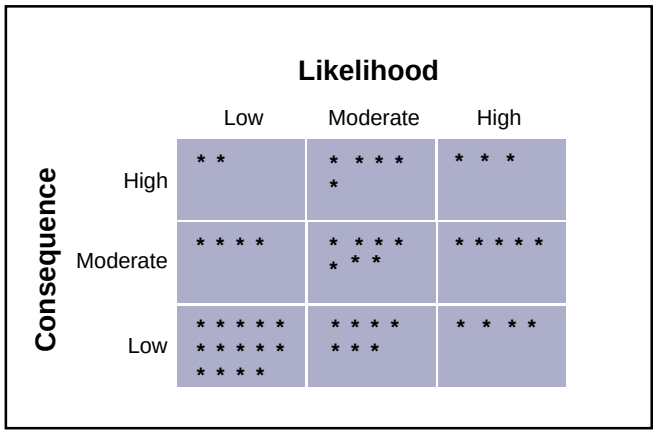


Figure 4.5-3. *Muhlbauer's hazard-consequence-likelihood matrix. In this case, the asterisks represent potential incidents. Each potential incident is ranked by consequence and likelihood, and these two parameters, taken together, represent risk. The shaded areas contain potential incidents that pose the greater risk. Adapted from Muhlbauer (1996), p. 12.*

tions/improvements to be made). When personal judgement is contested, the result is at best a damaged ego, and possibly a destroyed reputation. Given this, the analyst's choice concerning whether or not to use an explicit methodology should be self evident."

Even in the most structured and methodical analysis, however, one cannot achieve total objectivity: Professional judgment will always come into play at some point. Although McMillen emphasizes the importance of developing quantitative (as well as qualitative) criteria in ranking magnitude, geographic extent, frequency/duration, and likelihood, professional judgment is still required. He provides a hypothetical example in which he uses percentages of allowable harvest levels for certain game species to rank the magnitude of the harvest impact as low, moderate, or high. However, even after extensive research to establish game population estimates, determine allowable harvest levels, and compile harvest data, the analyst must still decide what ranges between 0 and 100 percent equate to low, moderate, and high levels of magnitude (McMillen 1993, p. 201).

Along with professional judgment, there will always be predictive errors in assessing the direct, indirect, and/or cumulative effects of any proposed action. Uncertainty about the future is a fact of life. It was concluded that the important goal is to achieve a spirit of objectivity in which the analyst does everything possible to be objective and to base conclusions on documented evidence, but is self-consciously aware of the subjective and uncertain components of the analysis and points them out to the reader. The goal therefore, was to be orderly, methodical, explicit, and transparent — but not truly objective in any absolute sense.

It was concluded that the best approach was to develop measurable criteria for ranking, employ professional judgment in applying the criteria, and most important, explain the logic and rationale for each ranking. With this approach, the reader might disagree with a conclusion but will always be able to trace it back to a specific statement explaining the reasons for that conclusion. The thought processes behind each ranking are thus made explicit so that the reader can judge their validity.

4.5.2 Other Past, Present, and Reasonably Foreseeable Future Actions and Associated Environmental Issues

By R.G.B. Senner and D.L. Maxim

The analysis of potential cumulative effects requires that the predicted direct and indirect effects of a proposed action and its alternatives be examined in combination with potential effects of other past, present, and reasonably foreseeable future actions. To accomplish this, the other past, present, and future actions and their actual or potential direct and indirect effects must be defined.

Sections 4.3 and 4.4 discuss potential direct and indirect effects of the proposed and no-action alternatives on physical, biological, and social components of the environment. This section briefly highlights other actions within the geographic scope of the analysis that could have additive effects with renewal of the TAPS ROW in the case of the proposed action or with removal of above-ground TAPS infrastructure (DR&R) and closure of ANS petroleum production facilities in the case of the no-action alternative. Table 4.5-3 summarizes these other actions, which are discussed in detail below.

4.5.2.1 Other Actions

Development activities and physical change on the North Slope since the mid-1960s have been driven in large part by oil and gas exploration and production (Appendix D). Revenues from petroleum production, in combination with the success of ANCSA-related Native corporations, have had a major economic influence on the Iñupiat people and on the growth and development of North Slope Borough communities. A growing tourism industry and increasing public recreational use of state and federal lands, the latter accelerated by ANILCA, have influenced planning by local, state, and federal agencies. New policies increasingly emphasize and encourage public access and the development of supporting amenities such as campgrounds and public service facilities along the Dalton Highway and at Deadhorse.

In the Central TAPS study area, physical change has been less dramatic, but communities such as Delta Junction and Glennallen have grown in size and in the number and variety of public accommodations available, aided in part by economic-development planning by Alaska Native corporations. Public accommodations along the Richardson Highway have increased in number since TAPS construction, and the overall level of human activity, particularly year-round recreational use, continues to grow. The continued presence of the U.S. Army base at Ft. Wainwright and the U.S. Air Force base at Ft. Eielson, both near Fairbanks, has had a sustained positive economic influence on the region. In addition, proposals have been advanced for the partial conversion of the U.S. Army base at Ft. Greely near Delta Junction to a prison and alternatively, for its use as a

Table 4.5-3. *Past, present, and reasonably foreseeable future actions.*

	Past Actions	Present Actions	Reasonably Foreseeable Future Actions
PIPELINE CORRIDOR			
Oil and Gas Related	• Construction, operation, and maintenance of TAPS. • Construction/operation of MAPCO/Williams refinery. • Oil/fuel spills along TAPS ROW.	• Planned rampdown of several pump stations as flows are reduced. • Planned maintenance; small "digs". • Oil/fuel spills along TAPS ROW.	• Gas commercialization-construction issues depending on gas option chosen. • Oil/fuel spills along TAPS ROW. • Planned pipeline maintenance and small "digs". No large digs planned.
Transportation, Tourism/ Recreation	• Construction of Haul Road (now Dalton Highway). • Opening of Dalton Highway to all commercial traffic (1980s) then to public (1990s).	• Use of Dalton Highway by all commercial operators, then by public (tour buses, private vehicles, hunting, fishing, hiking, camping, sightseeing).	• Development of rest stops, lodges, or hotels along the Dalton Highway. • Dalton Highway: Increased recreational traffic/improved access, changes in land-use patterns, increased hunting, fishing.
Other Industry	• Installation of fiber optics line.	• None	• Localized facilities particularly near population centers or south of Brooks Range.
Military	• None	• No present military activities	• Delta National Missile Defense System Facility
Economic/ Cultural	• Alaska Native Claims Settlement Act. • Alaska National Interest Lands Conservation Act. • Chartering of Native Corporations. • Creation of Permanent Fund.	• Deposits to Permanent Fund.	• Deposits to Permanent Fund (with proposed action).
NORTH SLOPE			
Oil and Gas Related	• Oil field development including: - Prudhoe Bay Unit - Kuparuk River Unit - Duck Island Unit (Endicott) - Milne Point Unit - Tarn • Area-wide enhancement of existing facilities.	• Oil field development including Badami Unit and Alpine/Colville River.	• New oil field developments (would not apply under no-action alternative): Northstar Unit, Liberty, NPR-A, other unspecified fields. • Development of ANWR not required to sustain sufficient throughput. • Gas commercialization options: - New pipeline to market - New pipeline with LNG tankers - Gas-to-liquid conversion and transport through TAPS
Tourism/ Recreation	• Access to Deadhorse for tourists by opening of Dalton Highway. • Regularly scheduled commercial airline flights to Deadhorse. • Tourist use of existing Deadhorse facilities. • Escorted tours of oilfield facilities provided by field operators. • Increased hunting, fishing, resource use at north end of Dalton Highway.	• Continued tourist activities in Deadhorse. • Increased hunting, fishing, resource use at northern terminus of Dalton Highway, Prudhoe Bay area.	• Development of additional tourist facilities in Deadhorse. • Alteration of oil field facilities for tourism. • Increased traffic in Deadhorse or within oil field facilities. • Increased hunting, fishing, resource use at northern terminus of Dalton Highway, Prudhoe Bay area.
Other Industry	• Development of oil field services industries in Deadhorse.	• Continued service industry development. • Cleanup of contaminated and often abandoned service industry sites.	• No new industries expected.
Military	• DEW Line stations.	• No present military activities.	• None expected.
Economic/ Cultural	• Alaska Native Claims Settlement Act. • Alaska National Interest Lands Conservation Act. • Chartering of Native Corporations. • Creation of Permanent Fund.	• Deposits to Permanent Fund.	• Deposits to Permanent Fund (with proposed action).

Table 4.5-3 (cont'd). *Past, present, and reasonably foreseeable future actions.*

	Past Actions	Present Actions	Reasonably Foreseeable Future Actions
VALDEZ/PRINCE WILLIAM SOUND			
Oil and Gas Related	• Construction and operation of crude oil refinery • Construction and operation of Valdez Marine Terminal (VMT). • Modifications to VMT such as vapor recovery and ballast water treatment process. • *Exxon Valdez* oil spill, subsequent cleanup, and associated research and monitoring.	• Operation of refinery. • Operation of VMT. • Operation of SERVS tanker escort system.	• Gas commercialization (construction issues depending on which gas option is chosen). • Use of double-hull tankers.
Tourism	• Escorted tours of VMT. • Extreme and heli-skiing in nearby mountains based in Valdez. • Tour boat industry.	• Escorted tours of VMT. • Extreme and heli-skiing in nearby mountains based in Valdez. • Tour boat industry.	• Construction of new hotels/tourist facilities in Valdez. • Increased boat/cruise ship traffic with potential for construction of additional dock/harbor facilities.
Other Industry	• Fishing.		• None expected.
Economic/ Cultural	• Alaska Native Claims Settlement Act. • Alaska National Interest Lands Conservation Act. • Chartering of Native Corporations. • Creation of Permanent Fund.	• Deposits to Permanent Fund.	• Deposits to Permanent Fund (with proposed action).

National Missile Defense System (NMDS) site.

At Valdez on Prince William Sound, the sustained economic influence of VMT operations has contributed to population and infrastructure growth. The PWS region has also experienced an increase in recreational tourism in recent years. The *Exxon Valdez* oil spill (EVOS) brought international attention to Valdez and to PWS, resulting in greater awareness and study of the PWS ecosystem, its recreational opportunities, and the need for stricter regulation of the growing human presence in the region. Recent construction of a road connecting the port of Whittier to Alaska's highway system will bring further recreational growth to the PWS region.

Despite the proliferation of other activities on the ANS, in the Central TAPS study area, and in Valdez/PWS region, the petroleum industry continues to provide the greatest impetus for change in these regions. In particular, two categories of oil and gas activities are logical candidates for inclusion in this cumulative effects analysis. These are:

- First, expansion and further development of existing and new ANS oil fields are likely. In the aggregate, these fields are included in the baseline TAPS throughput assumption provided in Appendix A.
- Second, commercialization of ANS natural gas reserves is "reasonably foreseeable" during the ROW renewal period, provided market conditions become more favorable.

Although logically separate, these developments are linked. Commercialization of ANS gas, for example, may provide economic impetus for further exploration and development of oil and gas reserves.

Alaska North Slope Crude Oil Production

Appendix A provides the baseline ANS production and TAPS throughput assumption used in this report. Rather than employing a field-by-field analysis, this assumption is based on forecasts by the USDOE through 2020 and extended through 2034. In this context, it is useful to examine the possible distribution of production fields. Table 4.5-4 shows past (through 1996) and possible future ANS production as presented in the NPR-A (BLM and MMS, 1998) and Northstar (USACE, 1999) EISs. Fields are divided into onshore and offshore categories.

Historically, onshore production accounted for 97.1 percent of ANS production through 1996. Offshore production will probably account for a greater percentage of future ANS production; the specific percentage depends on whether "speculative" future production is included. However, onshore production is projected to account for the majority of total production: nearly 81 percent if expected production is included, compared to 76 percent if speculative production is also included.

Table 4.5-4. *Past and potential future crude oil production from North Slope fields. This analysis is based on the premise that the majority of future ANS oil production will come from onshore fields.*

Activity	Onshore (billion bbl)	Offshore (billion bbl)	Subtotal (billion bbl)
Production to date (through 1996)	11.23	0.34	11.57
Percent of total	97.1%	2.9%	100.0%
Expected future production			
Existing fields	6.15	0.26	6.41
Planned fields	0.53	0.27	0.80
Subtotal	6.68	0.53	7.21
Possible future production	1.85	0.46	2.31
Possible OCS projects (unleased)	0.00	1.20	1.20
NPR-A			
Northeast Planning Area*	0.28	0.00	0.28
Western Planning Area*	0.39	0.00	0.39
Subtotal	0.67	0.00	0.67
Speculative future production	4.00	2.00	6.00
Total future (expected, possible, NPR-A)	9.20	2.19	11.39
Percent of total	80.8%	19.2%	100.0%
Total future (including speculative)	13.20	4.19	17.39
Percent of total	75.9%	24.1%	100.0%

*NPR-A values are calculated as the geometric mean of endpoints of reported range.
Source: Adapted from data given in BLM and MMS (1998): Table IV.A.5–7; USACE, 1999: Table 10-3.

Commercialization of ANS Natural Gas Reserves

The North Slope has over 30 trillion cubic feet (tcf) of proven natural gas reserves, and more may be discovered (CERA, 1999a; Sherwood and Craig, 2000).[2] To date, the vast majority of gas produced has been only in association with crude oil. The balance of gas production is returned to the reservoir (reinjected) to enhance oil recovery. Some gas has been used as fuel for production operations and for TAPS Pump Stations 1 through 4.[3] Thus, the gas has some utility, but it is effectively "stranded" because local markets are minimal and high transportation costs to a suitable market preclude commercialization. In the future, substantial amounts of this natural gas could be produced for sale possibly in Asian or North American markets without adversely affecting oil recovery (CERA, 1999a).

Three proposals for gas commercialization have been advanced over the years:

- Transport of natural gas by a new pipeline to a new terminal near Valdez, where the gas would be liquefied for shipment to markets in liquefied-natural-gas (LNG) tankers,
- Transport of natural gas by a new pipeline through portions of Alaska and Canada to the Midwest and Pacific Coast regions of the United States, and
- Operation of a gas-to-liquids (GTL) conversion facility on the North Slope with transport of the resulting GTL liquids through the existing TAPS pipeline and subsequent shipment in conventional tankers to locations in the Far East and the United States.

None of these projects has yet proven economically viable, largely because of the substantial capital investments required and projected energy prices and markets. The LNG and Alaska-Canada pipeline options have been the subject of previous EISs and have received major federal and state approvals to proceed. No EIS has been written for a GTL project, but several parties have expressed interest in a GTL alternative.

The LNG option, known as the Trans-Alaska Gas System (TAGS), and the Alaska-Canada gas pipeline option, known as the Alaska Natural Gas Transportation System (ANGTS), are included in the cumulative effects discussions of some North Slope EISs [e.g., NPR-A (BLM and MMS, 1998) and Northstar (USACE, 1999)], although not in others [e.g., Beaufort Sea Planning Area Sale 144 (MMS, 1996a), Sale 170 (MMS, 1998), Chukchi Sea Oil and Gas

[2]By some estimates (Sherwood and Craig, 2000), there are 194 tcf of undiscovered natural gas resources for Alaska and the Alaska federal offshore areas. Details of these reserve estimates can be found in Sherwood and Craig (2000).

[3]Four percent (1 tcf) of Alaska's gas reserves occur within fields in the Cook Inlet basin (Sherwood and Craig, 2000). Alaska exports small amounts (0.06 tcf/yr) of LNG from fields in Cook Inlet to Yokohama, Japan (Sherwood and Craig, 2000).

Lease Sale 126 (MMS, 1991)]. Both possibilities are discussed in the Northstar EIS (USACE, 1999), but both were believed highly speculative at that time, based on prevailing energy prices, demand, and probable transportation costs. An economic analysis prepared by the State of Alaska (Condon et al., 1998) found that gas commercialization was not economically feasible at prevailing prices. CERA (1999a) prepared an updated analysis of ANS commercialization options, which generally reached the same conclusions.

In the years since many of these analyses, crude oil and natural gas prices have risen dramatically. However, it is important to note that energy prices must remain high enough over the lifetime of the project to justify the multi-billion-dollar investments such projects require. Future crude-oil prices are very difficult to forecast, but many observers do not believe that today's prices are sustainable in the longer term. For example, the State of Alaska Department of Revenue forecasts that world crude oil prices will decrease in the year 2002 and thereafter (ADOR, 2000). Therefore, despite recent energy price increases, the economic attractiveness of various options for commercialization of Alaska natural gas remains uncertain.

Nonetheless, companies are interested in projects to free stranded natural-gas reserves. ExxonMobil, for example, has reportedly invested more than $110 million studying North Slope gas commercialization options and has dedicated $400 million over the past 20 years to develop gas conversion technologies (Portman, 2000). And BP recently announced plans to build an $86 million GTL pilot plant in Nikiski, Alaska. Another scheme, the Alaska natural gas-to-liquids (ANGTL) project, has also been proposed. Favorable economic developments (chiefly recent increases in energy prices) have also been the impetus for renewed interest in both the TAGS and ANGTS options. It is still too early to know whether or when gas commercialization will prove economically feasible or to identify a favored option (Sherwood and Craig, 2000). Changing costs and market conditions may make such projects viable in the future.

For purposes of the cumulative effects analysis, one or more gas disposition projects are assumed to be "reasonably foreseeable." The three options noted above are not necessarily mutually exclusive; however, simultaneous implementation of TAGS and ANGTS would require the discovery of additional reserves (CERA, 1999a). It is thus assumed that for the proposed action, gas disposition projects go forward at some time during the TAPS ROW renewal period (2004-2034). Since there is no clear basis to select any one alternative, the incremental effects of all three options are considered.

Because it is assumed that the North Slope production and support infrastructure would be dismantled in the no-action alternative, it is difficult to imagine circumstances that would permit gas commercialization if the TAPS ROW were not renewed. Therefore, no gas disposition projects are included in the cumulative effects analysis of the no-action alternative.

Brief summaries of the TAGS (LNG), GTL, and ANGTS options are provided below. Sufficient detail is presented for each option to provide a basis for estimating possible cumulative impacts, but it is important to emphasize that these options are still in the conceptual stage. Any actual projects may differ from those described here and must be evaluated on the basis of project-specific EISs.

LNG Option. The TAGS concept involves construction of a gas pipeline to carry conditioned natural gas from the North Slope to Valdez, where it would be liquefied by a cryogenic process for shipment in specially designed tankers to various countries — probably Japan, Korea, Taiwan, and in the future, mainland China.[4] The LNG is vaporized and the gas used in power plants and or for other uses.

The TAGS project includes a North Slope gas-conditioning facility, 800-mile-long large-diameter (42-inch) chilled buried pipeline adjacent to TAPS, and ten mainline compressor stations along the pipeline route to maintain required operating pressures. Also included are an LNG plant with associated storage tanks, two berths for accommodating LNG tankers at Anderson Bay 3.5 miles west of the VMT, loading facilities, and specially designed cryogenic LNG tankers. Nominal specifications and relevant characteristics of each of these system elements are shown in Table 4.5-5. The pipeline portion of this system (BLM and

[4]The U.S. is a net importer of natural gas and is a candidate market for ANS gas; however, it is unlikely to be an attractive destination for Alaskan LNG. There are only four LNG receiving facilities in the U. S.. Two (Everett, MA, and Lake Charles, LA) are in operation and two others (Cove Point, MD, and Elba Island near Savannah, GA) are shut down, but may be reopened (USDOE, 2000). Seaborne transportation costs for LNG are a significant component of the total cost, and ports on the U.S. East Coast are not logical destinations for Alaska LNG (CERA, 1999a). Environmental sensitivities would probably preclude locating LNG facilities on the West Coast. The Federal Power Commission prepared a final EIS for the so-called El Paso Alaska system, which envisioned an LNG option similar to TAGS except that the LNG facilities would be located at Point Gravina, Alaska (FPC, 1976). The El Paso concept envisioned shipment in LNG carriers to a receiving terminal near Point Conception, California. FPC staff concluded that this LNG option was less attractive than a gas export pipeline, in part because of environmental issues related to facility siting in California. Regardless of the ultimate destination of ANS natural gas, the U.S. would still benefit from its development and commercialization, because this would reduce U.S. net imports of gas and the balance of trade deficit in energy.

Table 4.5-5. *Basic elements of the proposed Trans-Alaska Gas System (TAGS).*

Element	Where Located	Additional Details
Gas conditioning facility	North Slope	300-acre facility to remove entrained liquid hydrocarbons and carbon dioxide
Pipeline	Central TAPS study area	800-mile-long, large-diameter (36- to 42-inch) chilled buried pipeline; ten mainline compressor stations located along route
Liquefied natural gas (LNG) plant and marine loading facility consisting of 2 berths capable of accommodating LNG tankers with a capacity of 165,000 cubic meters	Anderson Bay, approximately 3.5 miles west of the VMT	Facility occupies 390 acres; includes 2.1-billion-cubic-feet-per-day gas liquefaction plant; four 800,000-bbl storage tanks; and marine loading facility
LNG tankers	Ply routes from Valdez to Asia	Fifteen 125,000-cubic-meter LNG tankers involving 275 tanker loadings per year at design terminal throughput of 14 million tons (29.3 million cubic meters) per year

Sources: BLM and MMS (1998), FERC (1993), BLM and USACE (1988)

USACE, 1988) and the LNG production, storage, and marine transportation components (FERC, 1993, 1995) have been described in previous EISs.

There are substantial economies of scale in the construction and operation of these facilities. Therefore, this project must be large enough to reduce gas transportation costs to a competitive level. For both the LNG and the pipeline export project (CERA, 1999a), the projected gas volume is approximately 2 billion cubic ft (bcf) per day. The capacity of the liquefaction facilities (CERA, 1999a) would be compatible at 14 million tons per year (29.3 million cubic meters). A fleet of 15 tankers of 125,000-cubic-meter capacity would make about 275 loaded voyages per year to receiving terminals in the Pacific Rim once LNG production was at full capacity (FERC, 1993). The tanker berths were designed to accommodate these vessels and also to accommodate the next generation tankers of up to 165,000-cubic-meter capacity (FERC, 1993).

Additional relevant characteristics of TAGS are summarized in Table 4.5-6. Recent estimates of construction costs for this project are $4 billion for the pipeline and $8 to $10 billion for the other elements, including the tanker fleet (CERA, 1999a). Public revenue impacts of this project, including property taxes, severance taxes, and royalties, were estimated to be approximately $377 million annually (BLM and USACE, 1988), but could be higher or lower depending on future energy prices. This source does not provide a time profile of annual revenues, but the economic life of the project is given as 30 years (BLM and USACE, 1988). Other characteristics are summarized from recent EISs. Based on an assumed construction period of 10 years, the earliest time the facility could be operational would be 2010, assuming a year 2000 start date. This assumption is made for illustrative purposes only, as explained above.

Relative to TAPS, TAGS would cost less [TAPS cost $8 billion when constructed and would cost nearer to $25 billion today (APSC, 1999c)], would generate less revenues, and would employ fewer people for both construction and operation.

As with other gas commercialization proposals, TAGS has the potential to cause physical, biological, and economic, social, and cultural impacts. Although some of these impacts (e.g., increased state and local revenues, reduced deficits in the balance of trade in energy) are common to all gas commercialization options, others are project-specific. For example, the TAGS project entails the construction of an LNG plant and port facilities at Valdez, whereas ANGTS transports natural gas to destination markets in gaseous form via pipeline.

Table 4.5-6. *Additional features of the proposed Trans-Alaska Gas System.*

Feature	Data
Land affected	Construction 23,216 acres; operation 8,425 acres
Construction period	8 to 10 years; peak work force 10,500
Operations	550 direct jobs and 1,250 indirect jobs
Property taxes	$188 million annually
Severance taxes and royalties	$64 million annually severance tax $125 million annually royalty
Construction cost	Pipeline: $4 billion Other facilities (including tankers): $8 to $10 billion

Sources: CERA (1999a), BLM and MMS (1998), FERC (1993), BLM and USACE (1988)

GTL Option. The foundation for GTL technology is the Fischer-Tropsch (FT) process for converting carbon-based materials such as methane and coal into high-quality petroleum liquids such as naphtha and diesel fuel. Numerous FT pilot and production plants are operating throughout the world (HWLF Inc., 1998).

The type and quantity of by-products and process wastes differ among alternative GTL processes. These factors affect capital and operating costs. Some potential by-products/wastes include water and "tail gas" containing hydrogen, carbon monoxide, carbon dioxide, and light hydrocarbon gases such as methane, ethane, propane, butane, and, depending upon process, nitrogen.

The FT conversion rate of natural gas to liquids is approximately 100 million cubic feet of natural gas to yield 10,000 bbl of liquids (Howard et al., 1998). Figure 4.5-4 shows the estimated liquids production rate (bbl/day) as a function of the field life for various values of possible natural gas reserves. The 30 tcf of natural gas presently stranded on the North Slope could equate to a liquids production rate of approximately 274,000 bbl/day, assuming a 30-year project duration.

The GTL liquids produced by FT have a higher value than crude oil extracted directly from the ground.[5] Therefore, it may be necessary to modify TAPS facilities to handle "batched" operations, including the installation of extra tankage at Pump Station 1 and Valdez to handle GTL liquids. However, unlike either the LNG or ANGTS options, no new pipeline would have to be built because TAPS has enough excess capacity.

The chemical conversion of natural gas to liquid hydrocarbons creates a product that is free of polluting agents and that as a transportation fuel could command premium prices, particularly for certain markets such as the U.S. West Coast (Sherwood and Craig, 2000).

Estimated capital costs for GTL units range from $25,000 to $50,000 per bbl/day (Arthur D. Little Company, 1998; ExxonMobil, 2000). The capital cost varies with design output because there are reported (Arthur D. Little Company, 1998) economies of scale for these units.

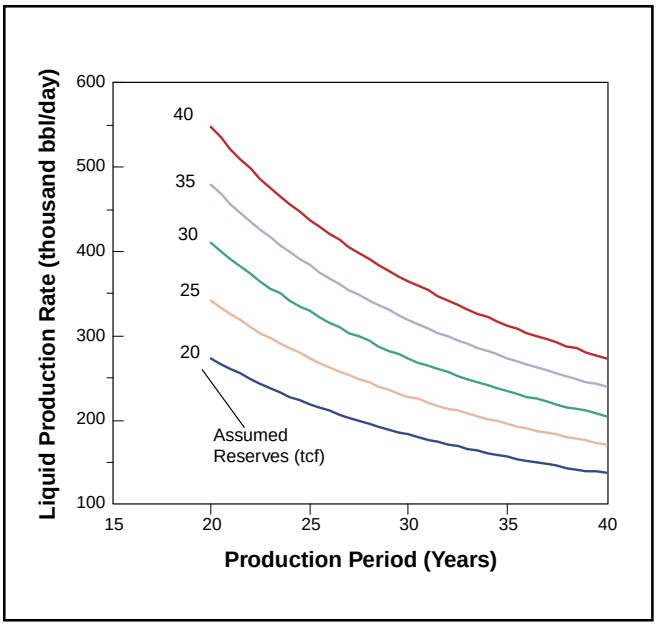


Figure 4.5-4. *Estimated liquid production rate (thousand bbl/day) as a function of assumed natural gas reserves (tcf) and production period (years).*

A potential conceptual design for the North Slope by ExxonMobil (ExxonMobil, 2000) could include an initial plant of 75,000 to 100,000 bbl/day capacity, which would be located near the existing Prudhoe Bay Unit Central Gas Facility. The GTL plant would occupy less than 50 acres and be connected to existing Prudhoe Bay Unit facilities (pipelines, transmission lines, roads, etc.) and house facilities to handle wastes. Facilities for fractionation of GTL liquids would be located at the VMT. Present shipping berths and conventional tankers would be used. The estimated capital cost of these facilities is $3 to $4 billion based on a capacity of 75,000 to 100,000 bbl/day.

In this conceptual plan, the GTL plant would be assembled from 20 to 25 modules (ExxonMobil, 2000), each weighing up to 10,000 tons, fabricated elsewhere, and transported to the North Slope by ocean-going barges during a single summer sealift season. To facilitate implementation, infrastructure upgrades would be made, including a dredged channel to West Dock 2 at Prudhoe Bay, additions/upgrades to dock and berths, and an expansion of the staging area, causeway, and roads.

Liquids from the GTL process could be transported in conventional tankers. Assuming that a 100,000 bbl/day facility were constructed, tanker traffic would increase by approximately 42 tanker loadings/year assuming 7 bbl/ton and shipment in tankers of 125,000 deadweight tons.

As noted above, a GTL proposal has not reached the stage of preparation of a draft EIS, but a USDOE-spon-

[5]There are two reasons for the difference in values. First, GTL products contain naphtha and diesel. Second, these products are free of sulfur, nitrogen, and aromatics — excellent liquids for subsequent conversion to petrochemicals and refining operations. Naphtha is used to make gasoline or is converted to olefins and subsequently into a variety of plastics. Diesel can be used directly. GTL diesel is reportedly cleaner in engine tests. Compared to conventional diesel fuel, GTL diesel offers a 10 to 50 percent reduction in the emissions of hydrocarbons, carbon monoxide, nitrous oxide, and particulate matter (Portman, 2000; Bohn and Benham, 1999; USDOE, 2000). Waxes can be used for such products as candles and in the lumber industry, and white oils can be used for aluminum processing and in the cosmetics industry (ExxonMobil, 2000.)

sored study (INEEL, 1999) concluded that current GTL technology would be economically comparable to the large-scale LNG manufacture-and-export plan. As with other concepts to commercialize ANS natural gas, the GTL option would have both economic and environmental impacts. A GTL project could extend the economic lifetime of the TAPS pipeline, would spread out the cost of TAPS transportation over a greater number of barrels, and would improve the economics of marginal oil fields thus freeing potentially stranded ANS oil and gas[6].

Export Pipeline Option. U.S. natural gas imports totaled approximately 3.585 tcf in 1999. Compared to crude oil, the United States is more self-sufficient in natural gas. Net imports of natural gas (3.38 tcf in 1999) were approximately 15.8 percent of domestic consumption (21.36 tcf), according to estimates in USDOE (2000a). As recently as 1986, net imports only accounted for approximately 4.2 percent of U.S. consumption (USDOE, 1999). Figure 4.5-5 provides a time series of net imports of natural gas imports (tcf) and net natural gas imports as a percentage of domestic demand from 1960 to the present. Domestic production of natural gas is concentrated in Texas, Louisiana, Oklahoma, and New Mexico.

The majority (95.4 percent) of U.S. imports was supplied by natural gas shipped through pipelines, rather than by LNG. Compressed natural gas was imported via pipeline from Canada and Mexico; imports of Canadian natural gas accounted for 3.367 tcf or 98.4 percent of pipeline imports in 1999.

Many alternatives for transportation of Alaskan natural gas to the contiguous 48 states by a pipeline though Canada were evaluated carefully in the late 1970s. In 1976, BLM completed an EIS on the subject and the Federal Power Commission (FPC) completed an environmental and economic comparison of various alternatives with other LNG options then under consideration (FPC, 1976). The gas export pipeline concept, ANGTS, envisioned the construction of a chilled, large-diameter natural-gas pipeline from Prudhoe Bay across Alaska and through Canada to the United States for delivery to U.S. markets. The scale of the ANGTS project would be approximately the same as that of the LNG project (2 bcf/day), approximately 22 percent of U.S. net imports of natural gas in 1999.

Several alternative pipeline routes were evaluated. The preferred northern route described in the ANGTS EIS included an inland, 195-mile-long, buried pipeline extending east from Prudhoe Bay to the Canadian border about 4.5 miles inland from the Beaufort Sea. From there, the pipeline would travel southeast through the Mackenzie Delta into Alberta. Once in Alberta, the pipeline would join the North American pipeline grid and deliver natural gas to locations as far removed as California and Pennsylvania. In addition to transporting ANS natural gas into the U.S., this pipeline would carry natural gas from Mackenzie Delta deposits to southern Canada.

Another northern route entails construction of a buried offshore pipeline from Prudhoe Bay to the Mackenzie Delta. The pipeline would then head south into Alberta and connect to the North American pipeline grid.

Other more southerly routes were evaluated, including a route (the Alcan route) which would follow the existing TAPS ROW from Prudhoe Bay south towards the community of Delta. The pipeline would then head southeast and enter the Yukon Territory of Canada. The distance from Prudhoe Bay to Canada would be approximately 730 miles. Once in Canada, the route would travel through the Yukon Territory and then to Alberta. From there, the pipeline would be connected to the North American pipeline grid by existing or new pipelines for gas distribution in the contiguous 48 states.

Selection of a southerly route through or near Fairbanks would permit gas to be provided to the Fairbanks/North Star Borough as well as offer the possibility of fueling TAPS Pump Stations 5 through 9 with natural gas.

Recently, interest in a gas pipeline has been revived, with both northern and southern routes being discussed. The total capital cost for each of these routes is estimated to be between $5 and $6 billion depending on the route,

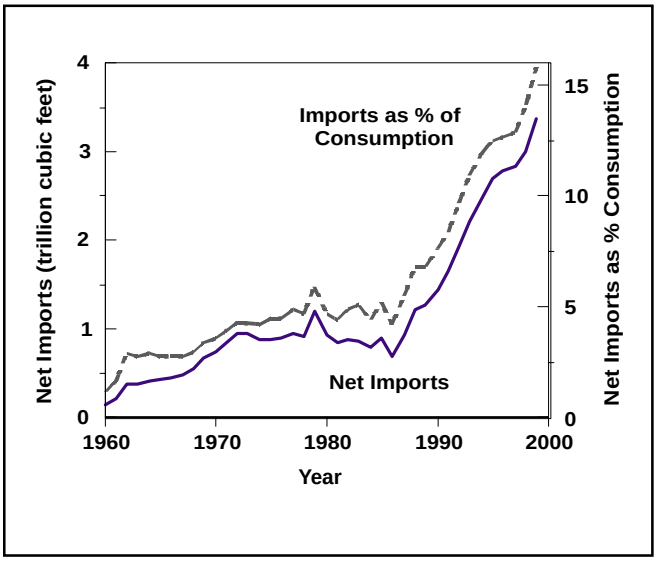


Figure 4.5-5. *Net natural gas imports and net imports as a percentage of domestic consumption according to USDOE (2000a) estimates.*

[6]See Appendix A for a discussion of TAPS throughput projections.

and the pipeline would take more than 7 years to complete (CERA, 1999a). If any export pipeline were built, Alaska would benefit from the sale of currently stranded gas reserves and increased investment in oil and gas exploration in Alaska. Either route would increase the tax base of the North Slope Borough and contribute to state revenues from oil and gas. If the original project had been implemented in the late 1970s, state revenues and royalty payments from ANGTS were projected to be $67 million in 1990. Actual revenues and royalties depend on world energy prices, gas transportation costs, and the terms of the royalty agreement.

The facilities in the pipeline project include a central gas conditioning plant, the gas pipeline (48-inch, 2 bcf/day), compressors, gas chillers, valves, metering stations, and communication sites. In qualitative terms, the construction-related impacts would be similar to those associated with TAPS. During one to several years of construction, there will be temporary disruptions such as worker camps, ports, airstrips, helipads, snow-ice roads, fuel storage sites, material sites, equipment repair facilities, and sewage treatment facilities. Permanent structures such as the buried pipeline, river crossings, compressor stations, repeater stations, permanent roads, and helipads would remain for the duration of the project. The type and number of the permanent structures will depend on the route chosen. For the alternative originally recommended, approximately 4,633 acres of land would be required along the 195-mile segment in Alaska. During operation, the pipeline would require less land (3,720 acres) and fewer people than during construction.

After construction, workers will be used for operations, maintenance, and pipeline inspection. Because the ultimate reserves of natural gas in this region have yet to be determined, the useful life of the facilities is unknown. However, according to FPC (1976) the physical life of the pipeline is expected to be more than 50 years, with a 100-year life "within the realm of possibility" (FPC, 1976). Upon completion of service, DR&R activities would be initiated. Table 4.5-7 summarizes salient characteristics of the ANGTS project.

The extent and location of various physical, environmental, economic, and sociocultural impacts in Alaska depend on the specific route selected. Under a northern alternative, only a short stretch of the entire pipeline would be in Alaska and it could potentially be buried offshore. A southerly route would be longer and could require additional permanent facilities. Most physical, biological, and sociocultural impacts in Alaska were not projected to be substantial in any of the applicable EISs (e.g., BLM, 1976).

Economic impacts (e.g., property taxes paid to state and local government, employment, Alaska purchases) of a gas export pipeline also vary with the route selected. Selection of the Alcan route for the export pipeline would also permit natural gas to be supplied to Fairbanks. All routes for the gas-export pipeline would generate revenues from royalties, and all routes would have similar impacts on the U.S. balance of trade in natural gas. However, the net wellhead price, and therefore, royalties and taxes, might vary with the route. Bradner (2000) reported that internal studies by state agencies show that because the northern route is shorter and crosses no major mountain ranges, it offers savings that translate into increased wellhead prices.

Table 4.5-7. *Overview of ANGTS project.*

Overview of ANGTS Project	
System Elements	• Gas gathering, conditioning, compression, and chilling facilities on ANS • Pipeline (and block valves) connecting above facilities to major pipelines in North American grid • Gas compressor/chiller stations along pipeline • Ancillary facilities (e.g., taps along pipeline, material stockpile sites, helipads, airstrips, seaport areas, communications sites, meter station, water and fuel storage, garage and repair facilities, electrical generation facilities, living quarters, etc.)
Route	Several under consideration (see text).
Throughput	2 bcf/day with possible future expansion
Capital Cost	Detailed costs under study but are likely to depend upon route. CERA (1999a) estimates costs in $5 to $6 billion range
Economic Life	Unknown, dependent upon new discoveries, energy prices, and transportation costs. Could be >50 years.

Sources: FPC (1976), CERA (1999a), BLM (1976).

National Missile Defense System Facility

Plans are now being developed that would locate a launch site for a NMDS in Alaska (U.S. Army Space and Missile Defense Command, 1999). Modifications to the Anti-Ballistic Missile Treaty now being negotiated with Russia would permit the United States to place 100 ground-based interceptor missiles in Alaska, although the administration budget currently funds only 20 missiles. A decision on whether and where to build the $10.5 billion system was expected by late 2000. If authorized at that time, the system could have been operational as early as 2005. However, the program schedule slipped, and the deployment decision was postponed and left for the new administration. No new timetable for a Record of Decision has been announced.

A draft EIS was completed for this system (U.S. Army Space and Missile Defense Command, 1999). The EIS considered three possible sites: the Yukon Training Area near Eielson Air Force Base, south of Fairbanks; Clear Air Station, near Anderson; and Ft. Greely, near Delta Junction. The draft EIS indicated that the Ft. Greely site (at $626 million) would be more expensive than that at Clear, but construction at Clear would disturb 135 acres of wetlands. Construction on the site at Ft. Greely would also ease economic dislocations from the scheduled shutdown of this facility in 2001. Ft. Greely is important to the Delta Junction economy.

Construction of the missile site at Ft. Greely would employ about 300 people for 5 years and result in indirect local expenditures of approximately $62 million per year, which would create about 620 indirect jobs in the Delta Junction and Fairbanks areas during construction (U.S. Army Space and Missile Defense Command, 1999). Once the system was operational, approximately 360 people would be needed to run the base, and operations spending would create an estimated 108 indirect jobs. The economic benefit would help to offset the effects of decommissioning Ft. Greely — the closure will eliminate more than 600 military and civilian jobs. Although local opinion favors the NMDS project, some residents are concerned that the influx of additional personnel will create hunting pressure on local game populations.

The cumulative effects analysis assumes that the decision is made to proceed with the NMDS installation and that the Ft. Greely site is selected.

4.5.2.2 Types of Issues Creating the Potential for Cumulative Effects

Once other past, present, and reasonably foreseeable future actions have been identified, environmental issues associated with those actions must be factored into the cumulative effects analysis. Because of the different natures of the physical, biological, and social environmental components, potential impact issues were organized in the manner most useful and appropriate for the subject. Issues were sorted into broad categories that allowed similar effects to be aggregated. The consolidated issues were the basis for screening and ranking.

In the cumulative effects analysis, the consolidated issues were organized as follows:

1. **Physical Issues**
   - Terrestrial Environment (Land Forms)
   - Oil and Other Spills
   - Permitted Discharges
   - Air Quality
2. **Biological Issues**
   - Obstructions to Movement
   - Disturbance and Displacement
   - Habitat Loss/Alteration/Enhancement
   - Mortality
   - Hunting, Trapping, Fishing, and Recreational Effects
3. **Social Issues**
   - Economics
   - Social Change
   - Subsistence
   - Visual/Recreational
   - Environmental Justice
   - Land Use

The issues were screened to determine whether they might interact with the potential direct or indirect effects of the proposed action and the no-action alternative. The screening process is described in Section 4.5.1. Every issue that received a "yes" during screening as a potential cumulative effect was evaluated, ranked with respect to intensity and probability, and discussed by a specialist in the pertinent subject area (Sections 4.5.3 and 4.5.4).

4.5.3 Results: Proposed Action

This section presents the results of the cumulative effects analysis conducted for the proposed action. Potential cumulative effects are discussed with respect to physical, biological, and social resources and in the context of their most likely geographic locations — ANS, Central TAPS study area, and/or Valdez/PWS. The results were derived by following the procedure for cumulative effects analysis described in Section 4.5.1.

This analysis considers the effects of the renewal of the pipeline ROW along with the continued operation of the ANS oil fields, the VMT, and the associated marine transportation link. All of these facilities are related and interdependent, and none would be economically viable if the others did not exist. The project study area is divided into the Alaska North Slope, Central TAPS, and Valdez/PWS study areas.

The CEQ definition of "cumulative effects" obviously includes the ANS fields, VMT, and marine transportation link but may also include other actions. Other EISs covering Alaska developments have included potential oil and gas activities on the North Slope (ADNR, 1997, 1998, 1999; FERC, 1993, 1995; FPC, 1976; USACE, 1997, 1999; BLM, 1976; BLM and MMS, 1998; MMS, 1987a, b, 1990,

1991, 1996a, 1998).

Other reasonably foreseeable petroleum-related activities that could interact with the alternatives to produce cumulative effects are discussed briefly in Section 4.5.2. These included two main categories: first, expansion and further development of existing and other ANS oil fields (Appendix A), and second, the commercial development of Alaska's substantial natural gas reserves. These and other potential future actions are considered in greater detail in the context of the individual impact discussions that follow.

It is assumed that either a GTL project using the existing TAPS pipeline or a new natural gas pipeline will be implemented in the event that the proposed action is selected; conversely, it is assumed that if the no-action alternative is selected, natural gas commercialization will not be economically feasible. This cumulative effects analysis assumes, for the sake of completeness, that the decision will be made to proceed with the NMDS installation at Ft. Greely, whether or not the proposed action is implemented.

4.5.3.1 Proposed Action: Physical Resources

By R.G.B. Senner, J.M. Colonell, J.D. Norton, and B. Trimm

After almost 25 years of operation, physical resource impacts of TAPS are fairly predictable. This section addresses several areas of potential cumulative effects for reasonably foreseeable future projects and continued operation of TAPS. These effects will likely occur even assuming that TAPS will continue to operate in compliance with permits and stipulations. Table 4.5-8 presents the criteria for ranking potential cumulative effects on physical resources. None of the potential cumulative effects met the intensity and probability criteria for significance.

Direct/indirect effects of TAPS operations and maintenance and of the no-action alternative are described in Sections 4.3 and 4.4, respectively. Because the pipeline system has been in continuous operation since 1977 under stringent regulatory controls, its effects on the physical environment — soils and land forms, air quality, and water quality — are familiar and can reasonably be expected to continue without significant change under the proposed action. Gas commercialization would add to the existing physical effects of TAPS depending on which alternative is implemented. The NMDS installation at Ft. Greely could produce cumulative effects in a small portion of the Central TAPS study area, and growing tourism and recreational activities would provide additional synergies although these impacts are expected to be insignificant.

The following discussion addresses only impacts to physical resources and not impacts on biological and social/cultural resources resulting from impacts to physical resources. For example, impacts of oil spills on the physical environment are discussed in this section, but impacts, if any, to biological resources or social/cultural resources are discussed in Sections 4.5.3.2 and 4.5.3.3, respectively.

The potential cumulative effects of the proposed action described below and are summarized and ranked with respect to intensity and probability in Table 4.5-9. Figure 4.5-6 presents the impact assessment matrix illustrating the significance rankings for the physical cumulative impacts.

Phy1. Changes to terrestrial environment (land forms).

Activities such as ANS development and/or gas disposition projects can change the terrestrial environment and affect visual/recreational resources, as well as the integrity of the terrestrial environment. The latter effects are discussed below. Potential impacts to visual/recreational resources are discussed in Section 4.5.3.3.

The network of gravel roads and pads that support TAPS and the North Slope oil-field infrastructure has unavoidably changed the landscape and will remain throughout the lifetime of the proposed action. Material-site use is consolidated at a few individual, regulated locations and contributes only a very local impact. For many years the petroleum industry has conducted systematic research on the rehabilitation of decommissioned roads and pads in the North Slope oil fields by creating controlled conditions that encourage revegetation by native plants. Experimental test sites have been shown to respond well to this approach, and many inactive gravel structures have become difficult to locate visually after 10 to 15 years (McKendrick, 2000b, pers. comm.).

As a cumulative effect, the network of roads and pads on the North Slope will increase in scope as new fields are brought into production. Roads and facility pads required for gas commercialization could add to the cumulative effect, and there is a potential for recreational facilities to make a further cumulative contribution. The annual increment of oil-field growth effects, however, would continue to decline because of mitigative strategies and technical advances, such as directional drilling, used successfully by the petroleum industry to consolidate production sites and reduce facility footprints. The oil-field infrastructure would remain until DR&R at some unknown future time. Following DR&R, restoration efforts will occur, and it is likely that the tundra will reclaim former oil-field sites and that signs of construction will greatly diminish within 25 years after the sites have been decommissioned.

Actively used gravel roads and pads associated with TAPS will remain throughout the life of the proposed ac-

PHYSICAL CUMULATIVE EFFECTS SUMMARY: PROPOSED ACTION

Potential Effect	PROPOSED ACTION	GAS COMMERCIALIZATION (GTL, LNG, Gas Pipeline)	NORTH SLOPE OIL FIELDS AND ANS TANKER TRADE (Past, Present, Future Development)	PUBLIC ACCESS	MILITARY (NMDS)	OTHER INDUSTRY	Intensity Factors			Ranking	
							Mag	Geo	Freq/ Dur	Int	Prob
Phy1 **Changes to terrestrial environment (land forms).**	Actively used gravel roads and pads and material sites associated with TAPS would remain throughout the life of the proposed action with their existing changes to the land forms. Significant restoration of the TAPS ROW will not occur until 2034 or later.	Roads and facility pads required for gas commercialization would add to the cumulative impact. For a buried gas pipeline, there would be a requirement for material sites, gravel access roads, gravel pads to support compressor stations, and limited portions of gravel workpad in locations where winter construction techniques would not be feasible.	The network of gravel roads and pads in the North Slope oil fields would remain throughout the proposed action. The annual increment of oil field growth would decline because of mitigative strategies and technical advances. Oil-field infrastructure would be remain until DR&R at some unknown future time. After DR&R, the tundra will reclaim former oil-field sites, and visible signs of construction will greatly diminish within 25 years.	A potential exists for recreational facilities and use to add to the cumulative impact.	Possible, unidentified landform impact from development of facilities.	Possible, unidentified landform impact from infrastructure development.	L	M-H	H	M	L
Phy2 **Changes to soil from dust deposition from gravel roads and pads.**	The dust-shadow effect will continue as at present, producing localized changes in microsite conditions such as moisture, albedo, and soil pH.	Increased traffic during project construction could have a minor, transitory impact.	The dust shadow effect has been well-documented along more heavily used gravel roads in the Prudhoe Bay oil field.	A potential exists for recreational facilities and use to add to the cumulative impact.	Negligible impact.	Negligible impact.	L	L	H	L	M
Phy3A **Changes to soils or water from large spills.**	A climatic or geological event or a mechanical failure could damage the structural integrity of the Trans Alaska Pipeline, resulting in a major spill.	Impact only if GTL liquids spill.	On the ANS, structural integrity of facilities belonging to TAPS, to one or more production units, or to oil-field support services and structures could result in a large spill, leading to a cumulative impact. A tanker spill is possible.	Unlikely that major spill will result.	Negligible impact.	Negligible impact.	H	M	L	H	L
Phy3B **Changes to soils or water from small spills.**	Small spills will continue as a result of leaks at valves and fittings and during fuel and product handling. Most small spills will be on the work pad and contained.	If gas commercialization employs GTL technology, there is a further potential that GTL products would be added to the inventory of fluids transported and total liquids transported will increase.	There will continue to be small spills associated with valve leaks and fuel and product handling.	A potential exists for recreational facilities and use to add to the cumulative impact.	Negligible impact.	Negligible impact.	L	L	M	L	H
Phy4 **Changes in air quality from air emissions.**	Emissions from pump stations and terminal will remain within regulatory standards mandated by regulations. Minor permit excursions might occur, but air quality will remain high.	An LNG terminal at Anderson Bay would be operated under its own air permit, with additional stringent state and federal requirements for potential natural gas releases to the atmosphere. Pump stations for a gas pipeline would operate under the same rules.	Emissions from oil field facilities will remain within regulatory standards mandated by the regulations. Minor permit excursions might occur, but air quality will remain high.	A potential exists for recreational facilities to add minimally to the cumulative impact.	Negligible impact.	Possible, unidentified but relatively small regulated discharge.	L	H	H	M	L
Phy5 **Changes to water quality from wastewater discharges.**	Discharges of domestic and non-domestic wastewater from TAPS facilities may cause minor changes in local water quality, but these changes are within regulatory standards. Minor permit excursions might occur.	Gas commercialization will have the potential to add new point-source discharge sites, but regulated discharges will avoid creating densities of wastewater discharges high enough to exceed state water quality standards for receiving waters. A possible LNG terminal at Anderson Bay near the VMT will produce waste water, but there should be no oily ballast water to treat.	Because individual oil-field, oil-field-support-service, and tourist facilities on the North Slope must operate under strict regulatory controls, releases of processed effluent from individual wastewater treatment systems should not be an issue. There is a potential, however, for an adverse cumulative impact resulting from many individual and separate permitted discharges to land and water.	Growing tourism will have the potential to add new point-source discharge sites, and these will have to be regulated to avoid creating densities of wastewater discharges high enough to exceed state water quality standards for receiving waters.	Relatively small regulated discharges could add to existing discharges.	Possible, unidentified but relatively small regulated discharge.	L	M	H	M	M

Table 4.5-9.
Physical cumulative effects summary: Proposed action.

Table 4.5-8. *Criteria for ranking potential cumulative effects on physical resources.*

	High	Moderate	Low
Magnitude	The effect would alter a physical resource in a way that would degrade its value to the point that it could not be used for subsistence, recreational, or commercial purposes, or would endanger human health. For example, both a series of large-volume marine oil spills *and* the destruction of a single fish stream by silt-laden runoff from multiple project sites could be in this category, although they might differ in geographic scope	The effect would indisputably alter a physical resource, but still allow the resource to be used for subsistence, recreational, or commercial purposes without endangering human health. For example, the construction of multiple access roads into a formerly roadless area would alter it physically, but would still allow the area to be used safely for subsistence, recreational, or commercial purposes, although some of these uses might be diminished and others enhanced. With moderate effects, users with different purposes typically tend to disagree about the extent of resource degradation.	The effect would visibly or measurably alter a physical resource without removing its value for subsistence, recreational, or commercial purposes, and without endangering human health. For example, ponding alongside gravel roads and pads built to support a variety of projects would alter the physical characteristics of an area without diminishing its overall value for subsistence, recreational, or commercial purposes, and without endangering human health.
Geographic Scope	The effect would occur on a statewide basis, or throughout a defined region such as the ANS, central TAPS study area, or PWS. For example, construction of a natural gas pipeline in the BLM Utility Corridor, aligned roughly parallel to the existing TAPS pipeline, would qualify as *high* in geographic scope.	The effect would occur at the borough or community level, or on a limited portion of the ANS, Central TAPS study area, or VMT/PWS. For example, establishment of a new production unit in the Prudhoe Bay oil fields would be considered *moderate* in geographic scope.	The effect would be site-specific or occur at a few isolated locations. For example, expansion of the Williams refinery at North Pole, with associated facility modifications at the North Pole Metering Station, would be rated as *low* in geographic scope.
Frequency and Duration	The effect would be continue indefinitely. For example, construction and operation of compressor stations for a natural gas pipeline would be in this category.	The effect would occur intermittently. For example, the recurring but infrequent release of black smoke from flare stacks would be ranked as *moderat*e.	The effect would most likely occur only once, if at all. For example, a 500-year flood event on the Yukon River could occur more than once during the project life, but this is unlikely.
Intensity	*Evaluated based on magnitude, geographic scope, and frequency/duration, using the criteria defined above.*		
Probability	Probability greater than 0.6.	Probability in the 0.3 to 0.6 range.	Probability of less than 0.3.

tion, and significant restoration of the TAPS ROW will not occur until 2034 or later. It can be assumed that restoration techniques and mitigation measures used after 2034 could be more advanced than today and could reduce enduring terrestrial impacts. From 2004 to 2034, impacts to the terrestrial environment would be mitigated to allow continued use of the land, with focus on erosion control, stabilization, and revegetation.

As described in Section 4.3.1, the terrestrial environment affected by TAPS has generally stabilized, and major long-term changes to the terrestrial environment are not anticipated. Future impacts would be influenced most by construction of a new gas pipeline. Although the proposed TAGS or ANGTS would consist of a buried pipeline, there would still be a need for material sites, gravel access roads, gravel pads to support compressor stations, and gravel workpads in locations where winter construction techniques would not be feasible (BLM and USACE, 1988). Based on over 20 years of operating history of the ANS fields and TAPS, integrity of the terrestrial environment would be only temporarily disrupted by a new project and would quickly stabilize.

The magnitude of this potential cumulative effect is low when judged against the criteria on Table 4.5-8 since future activities related to North Slope development or to gas commercialization will visibly or measurably alter the terrestrial environment but will not remove their resource value. Geographic scope will be high if a gas commercialization project other than GTL goes forward but moderate if future effects are caused only by ANS development or a GTL project. Frequency and duration would be high because effects will remain at least until 2034. The overall intensity ranking is moderate based on the low magnitude of the effect and the uncertainty of a gas disposition project. The probability of continued activity on the North Slope or a gas disposition project affecting integrity of the terrestrial

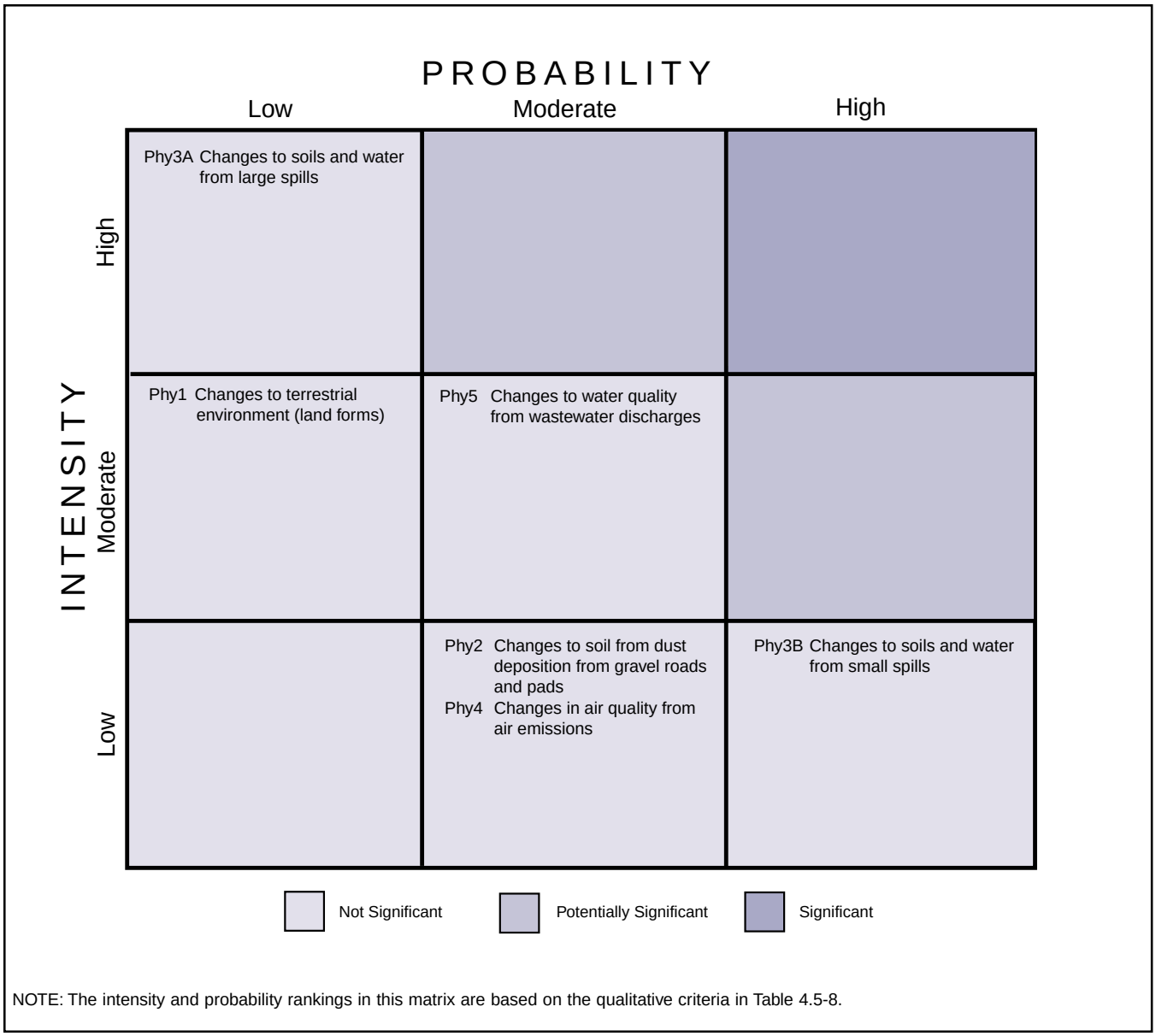


Figure 4.5-6. *Ranking matrix of potential cumulative impacts on physical environment (proposed action).*

environment is low based on the current status of land forms affected by TAPS and the ANS oil fields after over 20 years of operating experience.

Phy2. Changes to soil from dust deposition from gravel roads and pads.

The dust-shadow effect has been well documented along more heavily used gravel roads in the Prudhoe Bay oil field (see review by Auerbach et al., 1997; also Walker and Everett, 1987; and Walker, Cate, et al., 1987). Dust shadows also occur in places along the Dalton Highway (Montgomery, 1999, pers. comm.; Schmidt, 1999, pers. comm.; Shoulders, 1999, pers. comm.), although it has been well documented only for roads with heavy traffic on the North Slope (Walker, 1999, pers. comm.). In the proposed action, the dust-shadow effect will continue as at present, producing localized changes in microsite conditions such as moisture, albedo, and soil pH. Such changes will be confined largely to the locations where they presently occur, unless a major new development leads to one or more new roads that support traffic loads comparable to the Prudhoe Bay Spine Road or the Dalton Highway (Walker, 1999, pers. comm.). The establishment of new production units on the North Slope could lead to such an outcome if traffic on the connecting roads is frequent enough to produce heavy dust deposition, but thermokarsting, if it occurs at all, would be

limited to the heaviest dust zones (Walker, 1999, pers. comm.). A gas disposition project could result in increased traffic along the Dalton Highway to support construction but would not result in a large increase in traffic beyond the construction period.

This potential cumulative effect is ranked as low in magnitude, because any local thermokarsting would not affect current or traditional activities on the North Slope or endanger health. Geographic scope is also low, because thermokarsting would be site-specific, occurring in only a few isolated locations where roadside dusting was particularly heavy. Frequency/duration is high, because the effect would continue for as long as heavy vehicle and equipment traffic was sustained. Intensity is low, because existing thermokarsting along roads on the North Slope has not been shown to have an adverse effect on any resource or function. Probability is moderate, because although the effect has been documented, major increases in vehicle and equipment traffic on the North Slope are not foreseen.

Phy3. Contamination of soils or water from spills (Phy3A, large spills; Phy3B, small spills).

Spills can be caused by natural events, integrity failures of a system, or accidents. The impact of spills on soils and water depends on the size of the spill, product spilled, location, and effectiveness of the cleanup and remediation. A spill on undisturbed soils will have a significantly different environmental impact than a spill contained on a gravel pad. Spills can occur where contact with water is unlikely or where the spill can contact both land and water or water alone. Cleanup of spills is required by state and federal regulations, along with remediation actions as appropriate. Impacts can result from cleanup itself. Spill cleanup and disruption of normal use can vary from a day or less to several years depending on severity. Spill impacts are generally not long-lasting or of environmental consequence after cleanup and remediation.

It is possible that a climatic or geological event could damage the structural integrity of TAPS, resulting in a major spill (**Phy3A**). Earthquakes, flooding, wildfires, lightening strikes, and glacial changes have all occurred more than once in the vicinity of the TAPS ROW without adverse effects on the pipeline. Of these events, only flooding has threatened the pipeline because of the danger of washouts to VSMs, buried sections of pipeline, and valve housings. Risk from flood damage is mitigated through river training structures and, increasingly, through management of stream-channel configurations near pipeline crossings. Along the entire 800-mile route, gate and check valves are built into the pipeline to limit the volume of crude oil that would be released in the event of a leak. In addition, containment dikes or structures are located at critical locations along the pipeline. Nevertheless, a major spill is possible, and response equipment is maintained in a constant state of readiness at all pump stations and at strategic locations along the route. Residents of local communities such as Rampart and Stevens Village are an integral part of the program and, along with Alyeska personnel, receive repeated training in oil spill response. Thus, a combination of mitigative engineering design and response preparedness minimizes the effect of any spill that might occur.

The seismic history of the PWS region and the southern portion of TAPS demonstrates the potential for a high-magnitude earthquake. Special design features for the pipeline mitigate the risk of a pipeline failure. The VMT was designed to meet this contingency, specifically through secondary containment of the large-volume crude oil storage tanks on the terminal site and emergency shutoff valves, among other measures. Nevertheless, a large earthquake or other type of event could result in the loss of stored crude oil and fuel products to the waters of Port Valdez. A cumulative effect would result in the event of similar losses from the Petro Star refinery, other industrial and commercial facilities and, potentially, a future LNG terminal constructed at Anderson Bay.

On the North Slope, loss of structural integrity of facilities belonging to TAPS, to one or more production units, or to oil-field support services and structures could cause a major spill leading to a cumulative effect. Although TAPS facilities and oil-field production units, and other industrial and commercial operators function under strict regulatory and proprietary controls, a major spill of crude oil, fuels or — in the case of GTL-based gas commercialization — GTL products will be possible. Other gas commercialization alternatives are unlikely to create a major oil spill risk.

Besides concerns about natural events, maintaining structural integrity to avoid pipeline failure receives a major expenditure of effort, time, and funding by Alyeska. Thousands of preventive maintenance procedures are conducted and documented every year in this regard. The potential for pipeline corrosion is regularly monitored by automated and manual procedures. These include using instrumented “pigs” that travel through the pipeline and monitor wall thickness and condition, and annual corrosion inspections of above-ground and buried portions of the pipeline scheduled to ensure that the entire pipeline is examined on a recurring basis. Other preventive maintenance includes the regularly scheduled installation of cathodic protection devices. Similar controls are in place to mitigate the effect on pipeline structural integrity of damage caused

by metal fatigue from pressure cycles and vibrations. A significant security and surveillance program protects the system from terrorist threat. Section 4.2 provides more detailed discussion of methods used to mitigate these threats.

The magnitude ranking of a major spill is high, because human health could be endangered, resource values could be reduced, and the commercial viability of areas impacted by a spill would be reduced until completion of cleanup and site rehabilitation. Geographic scope is moderate, because a large spill or series of spills could affect site-specific but moderately large onshore areas or potentially a portion of the nearshore marine environment if the spill is on water. Because the VMT/Valdez area has a very large oil-spill response capability, a large spill at the VMT or in PWS would likely be contained and would not disperse widely in a manner similar to the *Exxon Valdez* spill.

Frequency/duration is ranked as low, because such an event would occur at a very low frequency, if at all, and duration of impact would be relatively short. Based on the high magnitude ranking and moderate geographic scope, the intensity of this potential effect is high. Probability is low, because large oil spills have not occurred in the North Slope oil fields and have been infrequent along TAPS and the tanker routes.

Small spills (**Phy3B**) can be caused in several ways. Some valves on North Slope pipelines and TAPS have been found to leak small amounts of crude oil into their secondary containment structures. Valve leaks occur on any pipeline. The risk is minimized through mitigation measures such as ensuring that pipeline valves are placed in secondary containment structures and conducting regular and comprehensive valve monitoring. See Section 4.2 for a discussion of management controls that reduce and control the risk of minor leaks from operations and maintenance activities.

Because of the continuous monitoring of TAPS and production unit pipelines, such leaks seldom enter the surrounding environment, and they involve very small quantities of oil and are corrected. Still, there is a potential cumulative effect associated with TAPS and oil-field production pipelines. If gas commercialization employs GTL technology, GTL products would be added to the inventory of fluids carried by TAPS, and the total volume of liquids transported by TAPS would increase. Some TAPS valves have released small quantities of crude oil into their secondary containment structures. In a few isolated cases — e.g., Check Valve 92 — larger quantities have been released to the surrounding environment, but the areal extent of effects have been relatively small.

The great majority of spills associated with TAPS and with the North Slope oil fields involve small releases of fuels or lubricants. Most of these spills are to gravel pads, but some occasionally contact soil and/or water. There is a cumulative effect when spills from TAPS, North Slope production units, oil field services, tourism and potentially, future gas commercialization are factored together, although each spill is site-specific and separately reported and cleaned up.

In general, spills at the VMT consist of fuel products and are contained and removed before contacting soil or water. In some cases, soils in the VMT industrial complex have been contaminated by fuel spills, and these sites have been remediated. The potential for a cumulative effect of VMT spills with spills from the Petro Star refinery, other industrial and commercial facilities along Port Valdez, and a future LNG marine terminal at Anderson Bay is small but present. Furthermore, occasional crude oil and fuel spills occur during tanker berthing at the VMT, and LNG tanker operations at Anderson Bay could add to this effect. In both cases, however, released hydrocarbons would be immediately contained by the preventive booming placed around all berthed tankers at either terminal.

The magnitude of this potential cumulative effect is ranked low because the small quantities involved would not alter the physical environment to the extent that it would degrade its resource value in terms of subsistence, recreation, or commercial use, or endanger human health. Geographic scope would also be low, because the site-specific small spills would not interact with one another to create a wider effect. Frequency/duration would be moderate, because the effect would occur intermittently, at different locations, during the lifetime of the proposed action. Therefore, the intensity of this potential cumulative effect is low. There is a high probability that individual small spills will continue to occur.

Phy4. Changes in air quality from air emissions.

Air emissions from Alyeska pump stations and North Slope oil-field facilities are regulated by ADEC under State of Alaska Air Quality Regulations (18 AAC 50), with overview authority retained by the EPA under the Clean Air Act. Individual facilities are regulated by ADEC air quality operating permits that prescribe types and quantities of stationary emission sources; place limits on air pollutant emissions; require that any modifications to or replacements of existing sources, or startup of new sources, receive advance approval from ADEC; require regular reporting of facility emissions to ADEC; and establish monitoring, record keeping, and reporting requirements. Certain mobile or portable emissions sources are also regu-

lated by permit.

The construction of new facilities that would create new emission sources requires additional permitting by ADEC under Prevention of Significant Deterioration (PSD) provisions of the Clean Air Act. This is a complex and lengthy process requiring emission-control technology evaluations and ambient-air impact-modeling. New Source Performance Standards (NSPS) also apply to major new stationary sources of air emissions. As new oil and gas production units are developed on the North Slope, their facilities will be subject to these requirements. PSD permitting, in particular, takes into account the emissions that will be added by a facility to permitted air emissions already in effect. Gas commercialization and other future oil field developments will be subject to these controls, and the cumulative volume and mix of emissions will be regulated by ADEC to minimize air pollution.

Atmospheric emissions from the VMT consist primarily of steam, hydrocarbon, and particulate output from the powerhouse. A tanker vapor recovery system designed to collect hydrocarbon vapors associated with tanker loading and divert them to the powerhouse fuel stream has recently been installed to reduce emissions. Powerhouse stack emissions are controlled by an ADEC operating permit and must meet federal and state air quality standards. An LNG terminal at Anderson Bay would be operated under its own ADEC permit, with additional stringent state and federal requirements for potential natural gas releases to the atmosphere. Moreover, the new terminal would have to meet PSD and NSPS increment provisions of the Clean Air Act that would be based on pre-existing VMT emissions. The volume and constituents of the emissions from a new terminal would be permitted only after extensive analysis and modeling to assure that the cumulative total would meet National Ambient Air Quality Standards.

If gas commercialization proceeds using GTL technology, the TAPS pipeline would be operated as a batch line carrying North Slope crude oil and GTL products in alternating batches. This mode of operation might require more frequent use of large breakout tanks for the temporary storage of crude oil or GTL products to allow the alternating transport of these materials to be precisely scheduled and coordinated, and to minimize pressure fluctuations in the pipeline. Opacity exceedances are sometimes associated with the diversion of crude oil to the breakout tanks. These unavoidable transient events are permitted, provided they are reported to the ADEC within 24 hours of the incident, and they are mitigated through careful nomination and regulation of crude oil flow through the pipeline and through improved flare nozzle design. If the pipeline is operated as a batch line, there may be a potential for a cumulative effect involving opacity incidents if flow diversions to breakout tanks become more frequent. Because most TAPS opacity incidents not involving tankers occur at Pump Station 1, this effect is discussed here in the context of the North Slope. It should be noted that opacity events occasionally occur at other pump stations.

Based on the existing regulatory structure, the magnitude of this potential cumulative effect is ranked low, because the new permitted facilities will not reduce air quality to the point where human health or subsistence, recreational, or commercial activities are endangered. Geographic scope is high because airborne emissions are involved. Frequency/duration is also high because emissions would continue for the life of the proposed action. Overall intensity is moderate on the basis of low magnitude but high geographic scope and frequency/duration. The probability that planned and regulated air emissions will adversely affect human, wildlife, and plant populations is considered low.

Phy5. Changes to water quality from wastewater discharge impact

Domestic and non-domestic wastewater discharges from Alyeska and oil-field facilities are regulated by State of Alaska water quality standards (18 AAC 70), ADEC wastewater disposal permits (18 AAC 72), and federal permits issued by the EPA under the National Pollutant Discharge Elimination System (NPDES) (40 CFR 122). Because individual oil-field, oil-field-support-service, and tourist facilities on the North Slope and the TAPS pump stations must operate under these regulatory controls, releases of processed effluent from individual wastewater treatment systems is not at issue. There is a potential, however, for an adverse cumulative effect resulting from many individual and separate permitted discharges to land and water from future compressor stations associated with a natural gas pipeline, along with tourist facilities or other industrial, commercial, or military activities. Because all individual releases of domestic (pathogen-containing) and non-domestic (industrial and construction-related) wastewater from facilities and construction sites must meet permit conditions and state water quality standards, it is unlikely that such a cumulative effect — involving multiple effluents — would occur. Furthermore, the density of facilities and their point-source effluent releases on the North Slope and along TAPS is presently too low to allow a synergistic effect that exceeds state water quality standards, and it is unlikely that the number and density of facilities will increase in the foreseeable future. Gas commercialization and growing tourism will have the potential to add new point-source

discharge sites, and these will have to be regulated to avoid creating densities of wastewater discharges high enough to exceed state water quality standards for receiving waters.

Biologically processed ballast water is released to a permitted and monitored Port Valdez mixing zone from the VMT Ballast Water Treatment Facility (BWTF). As with other wastewater discharges, the BWTF effluent is prescriptively regulated, and permit excursions in the past have been minor in terms of levels and duration. It is appropriate to assume that associated future projects will be similarly regulated. With gas commercialization, there is a potential for a new marine terminal to be built at Anderson Bay, near the existing VMT. Because the vessels involved with the second terminal would be LNG tankers, oily ballast water will not be an issue, and domestic wastewater would presumably be held in storage tanks for periodic removal to the City of Valdez wastewater treatment system.

Since state and federal water quality regulations will continue to be effective for controlling wastewater discharges, the magnitude of this potential cumulative effect is low. Geographic scope is moderate, because individual wastewater treatment systems and isolated, low-density point-source discharge points will continue to be dispersed within developed areas of the North Slope and along TAPS. Frequency/duration is high, because wastewater discharges will occur throughout the life of the proposed action and other actions not related to TAPS. On the basis of these rankings, the overall intensity is ranked as moderate. It is expected that this issue will increase in importance with continuing North Slope development. At the same time, existing regulatory controls will mitigate the potential for cumulative wastewater discharges to degrade surface water and groundwater resources of the North Slope. Thus, the probability of an adverse cumulative effect is moderate.

Proposed Action: Physical, Cumulative Effects Summary

In summary, none of the potential physical cumulative effects is considered significant by this analysis because:

- TAPS pipeline and related facilities already exist;
- Major changes to the pipeline system or to the affected physical environment are not expected during the ROW renewal period;
- New surface disturbance areas associated with TAPS will be small and isolated;
- Future North Slope development and potential gas commercialization projects would not cause significant disturbance to the physical environment, with the exception of the transitory construction disturbance.
- Pump stations, potential compressor stations, and marine terminals (VMT and LNG) would be widely separated, and their emissions would be relatively small and strictly regulated; and
- There would be no unavoidable adverse effect on the physical environment that would not be mitigated to the fullest extent technically feasible.

With continued regulatory compliance by TAPS and any associated future project, potential cumulative effects on physical resources are not expected to become significant issues during the life of the proposed action.

4.5.3.2 Proposed Action: Biological Resources

By M.A. Cronin, R.G.B. Senner, S.R. Johnson, L.L. Moulton, H. Whitlaw, W. Ballard, D.W. Funk, staff of LGL Alaska Research Associates, Inc., and staff of Alaska Biological Research, Inc.

This section follows the procedure described in Section 4.5.1 to analyze potential cumulative effects of the proposed action on biological resources. Section 4.5.2 discusses past, present, and reasonably foreseeable future actions, in addition to the continued operation of TAPS, that could affect the environment. These actions include two main categories: (1) expansion and further development of existing and other ANS oil fields and (2) commercial development of Alaska's substantial natural gas reserves. It is assumed that ANS oil-field developments will expand and that either a GTL project using the existing TAPS pipeline or a new natural gas pipeline will be implemented if the proposed action is selected.

Other past, present, and reasonably foreseeable future actions not directly related to the petroleum industry were also examined. Other industries, such as mining, may increase operations and affect the environments of concern. It is assumed that the NMDS installation will be built at Ft. Greely. Because tourism and outdoor recreation are increasing in Alaska, the potential effects of increased public access to areas under discussion were also considered.

The extent and nature of effects from future actions are necessarily speculative. For the future ANS developments and natural gas projects, information from the past operation of the ANS oil fields and TAPS was used to infer future effects. Past impacts from public access were also used to infer future effects. The assessment of potential impacts from activities of other industry in the future is constrained because the nature, location, or extent of operations are unknown, and this category is described in general terms.

The analysis also considered information on past, present, and future regulation and mitigation measures that influence effects. For example, tanker operations in Prince

William Sound presently include the SERVS tanker escort system, and will include double-hull tankers in the future. These measures greatly reduce the probability of a large oil spill from a tanker.

The impacts of the proposed action in the TAPS ROW, presented in Section 4.3.2, were consolidated into general impacts for the assessment of cumulative effects. We maintained the categories of vegetation and wetlands, fish, birds, terrestrial mammals, marine mammals, and threatened and endangered species, used in the assessment of impacts of the proposed action (Section 4.3). For vegetation the impacts fall under the following categories:

- Revegetation;
- Drainage and water flow issues;
- Thermokarst;
- Air pollution;
- Oil, fuel, and chemical spills;
- Fire and fire management;

For fish, birds, and mammals, the general categories of impacts are:

- Obstructions to movement;
- Disturbance and displacement;
- Habitat loss/alteration/enhancement;
- Mortality;
- Hunting, trapping, fishing, and recreational effects.

For the effects of oil, fuel, and chemical spills on birds and marine mammals, large spills and small spills are ranked separately because of the different magnitude of impact from each. Criteria for ranking potential cumulative effects on biological resources are shown in Table 4.5-10. Rankings were done for the intensity and probability of an impact, considering the proposed action and the other actions identified above. The intensity ranking was composed of sub-rankings for magnitude, geographic scope, and frequency/duration of an impact. The probability ranking was based on the probability that an impact would occur. For each category, rankings of high, moderate, or low were given.

The basic question in developing the ranking criteria was about the unit of impact. Impacts could be considered at the level of individual organisms, populations, species, or communities, and it is important to clearly state the unit that an action will impact. Because fish and wildlife are generally managed as populations and plants as communities, effects at these levels were emphasized in the criteria for magnitude. Impacts that change a population size, geographic range, or carrying capacity were deemed important and were ranked high or moderate. Impacts that do not change the size of a population, range, or carrying capacity were ranked low in magnitude. Because there are few examples in the study areas of direct cause-effect relationships between human activity and fish or wildlife population sizes, subjective terms and professional judgement were used in ranking magnitude. Thus, an impact's magnitude was ranked high if it changed the population size, range, or carrying capacity "substantially," and as moderate if changes were "measurable." The judgement of whether a population has changed according to these terms will vary among people. However, for most populations and communities, a consensus on impacts can be reached, and appropriate mitigation and regulation implemented.

Geographic scope was ranked according to the extent of impact. Impacts occurring throughout the entire range (ANS, TAPS ROW, and Valdez/PWS) were ranked high, those occurring primarily in one of the three major regions were ranked moderate, and those occurring at a limited number of sites were ranked low in geographic scope. The frequency/duration rankings considered how often, and for how long an effect would occur. An effect's frequency/duration was ranked high if it is continuous, moderate if it occurs intermittently, and low if it is infrequent. The magnitude, geographic scope, and frequency/duration were considered together for a single intensity ranking for each effect. The probability ranking reflects whether an effect is likely to occur. The rankings and their justifications are described in the text below, and summarized in a table identifying the contribution of each action to each cumulative effect and showing the rankings for each effect (Table 4.5-11). Figure 4.5-7 provides a graphical representation of the distribution of the rankings of the cumulative biological effects associated with the proposed action.

Proposed Action: Vegetation and Wetlands

By D.W. Funk and R.G.B. Senner

With the exception of the Beaufort Sea and Prince William Sound marine environments, the area under consideration is covered by indigenous terrestrial and wetland vegetation interrupted by gravel pads and roads, pipelines and other facilities. New construction or maintenance activity that is not on existing gravel pads and roads, or on ice pads and roads, will therefore require site-specific removal of vegetation or additional fill placement in wetlands. Because the North Slope is almost entirely covered by tundra wetlands and because wetlands occur abundantly along the TAPS ROW, wetland removal or alteration is an important issue in considering the cumulative effects of petroleum operations in both study areas (Senner, 1989). The following potential effects on vegetation and wetlands would be associated with continuing oil-field development on the

Table 4.5-10. *Criteria for ranking potential cumulative effects on biological resources.*

		High	Moderate	Low
INTENSITY		*Evaluated in the context of magnitude, geographic scope, and frequency/duration, using the criteria defined below.*		
	Magnitude	The effect would change substantially the size or geographic range of a fish or wildlife population or the distribution of a plant community, or the habitat carrying capacity.	The effect would change measurably the size or geographic range of a fish or wildlife population or the distribution of a plant community, or the habitat carrying capacity	The effect would be limited to a small number of individuals and would not measurably change the size or geographic range of a fish or wildlife population or the distribution of a plant community or the habitat carrying capacity.
	Geographic Scope	The effect would occur throughout the entire terrestrial or aquatic environments of concern.	The effect would occur primarily within one of the major study areas, the Alaska North Slope study area, or the central Trans Alaska Pipeline System study area, or the Valdez Marine Terminal/Prince William Sound study area.	The effect would be site specific at a few locations.
	Frequency & Duration	The effect would be continuous and of indefinite duration.	The effect would occur intermittently.	The effect would occur infrequently or only once.
PROBABILITY		*Evaluated in the context of professional judgment and past occurrence of impacts.*		

North Slope and with maintenance along the TAPS ROW, in combination with other construction projects such as a natural gas pipeline, installation of an NMDS site at Ft. Greely, or new campgrounds, visitor centers, service facilities, or other recreational amenities along the Richardson and Dalton Highways.

Bio1. Wetland and vegetation loss from gravel placement and mining, and dust fallout at roads, pads, and facilities.

The proposed action, with other future actions, will destroy vegetation under gravel pads and roads, and at material sites. The proposed action by itself would produce little further loss of vegetation from gravel mining or placement, unless a major pipeline reroute was required. All required facility pads and access roads are already in place, and there are no plans to add or expand pipeline facilities to the extent that new pads or roads would be needed. Oil-field development on the North Slope has similarly affected vegetation through the placement of gravel fill and the development of gravel mines. Development of new North Slope oil fields will add incrementally to the effects of gravel placement on vegetation. Most new developments have a substantially reduced footprint and are often roadless (or nearly so), markedly reducing the effects of gravel placement on vegetation, and reducing the number of gravel mines required. Construction of a natural gas pipeline would require extensive gravel mining and fill placement for burial of the new pipeline and for construction of compressor station pads and access roads. Routing of the pipeline will largely determine the contribution of such a project to the cumulative impact of gravel mining and placement. Use of existing pads, access roads, stream crossings, and material sites where feasible would help reduce the cumulative increase in impacts. Construction of a GTL facility, the NMDS site at Ft. Greely, other industrial developments such as mines, and campground and recreational facilities along the Dalton and Richardson Highways all could contribute incrementally to the cumulative effect of gravel placement on vegetation. These developments would probably be limited to a relatively small area and would have only site-specific effects.

Within 30 feet of roads and pads, dust and gravel may smother vegetation, resulting in a shift to weedy species and reduced plant photosynthesis; decreases in some common moss, lichen, and shrub species; and development of barren areas. The “dust-shadow” effect has been well-documented along more heavily used gravel roads in the Prudhoe Bay oil field and along the Dalton Highway (Auerbach et al., 1997; Walker and Everett, 1987; Walker, Webber, et al., 1987). For the proposed action, the dust-shadow effect will continue as at present, causing localized changes in plant species composition by changing microsite conditions such as moisture, albedo, and soil pH. Such

BIOLOGICAL CUMULATIVE EFFECTS SUMMARY: PROPOSED ACTION

Potential Effect	PROPOSED ACTION	GAS COMMERCIALIZATION (GTL, LNG, Gas Pipeline)	NORTH SLOPE OIL FIELDS AND ANS TANKER TRADE (Past, Present, Future Development)	PUBLIC ACCESS	MILITARY (NMDS)	OTHER INDUSTRY	Intensity Factors			Ranking	
							Mag	Geo	Freq/ Dur	Int	Prob
VEGETATION AND WETLANDS											
Bio1 **Wetland and vegetation loss from gravel mining and placement, and dust fallout at roads, pads, and facilities.**	Little or no additional gravel placement will occur, and similar levels of traffic are expected on roads and pads causing only limited impacts from dust.	Gravel placement at facility sites and road dust from construction and facility use are likely. Substantial quantity of gravel fill will be required for a buried gas pipeline. Dust will increase from road traffic for construction and operation.	Well-documented dust shadow effect along heavily traveled roads. Substantial placement of gravel fill for roads, pads and facilities has occurred. Placement of gravel fill for new roads, pads and facilities, but newer fields have a substantially reduced footprint and are often roadless.	Will contribute to dust shadow along the Dalton Highway.	Gravel placement at facility sites and road dust from construction and facility use are likely.	Gravel placement at facility sites and road dust from construction and facility use are likely.	M	M	H	M	H
Bio2 **Changes to natural drainage patterns causing changes to wetlands and vegetation.**	Few new changes to drainage patterns will be required. Maintenance activities for culverts and low water crossings may have some localized effects.	Potential for localized drainage issues depending on GTL facility siting. Pipeline construction will have potential for numerous site-specific changes in natural drainage that may cause localized habitat change and loss of wetlands.	Numerous site-specific changes in natural drainage patterns have occurred, resulting in localized habitat change and loss of wetlands. New facilities with a smaller footprint are carefully sited along natural drainage lines. Some site-specific changes in drainage patterns that result in altered habitat.	No impact.	Potential localized drainage issues depending on facility siting.	Potential localized drainage issues depending on facility siting.	L	M	H	M	H
Bio3 **Changes in plant community structure resulting from thermokarst.**	Small amounts of additional subsidence along the TAPS ROW may occur, but impacts to new areas will be negligible.	Minor localized thermokarst may occur depending on GTL facility siting. For pipeline, potential for thermokarst from impoundments and cross-drainage problems and clearing of vegetation to cause localized habitat loss and changes in plant communities. Minor localized thermokarst may occur depending on facility siting.	In heavily developed areas, about 3% of the total area may be affected resulting in habitat loss and alteration. In heavily developed areas, thermokarst is probably increasing, resulting in habitat loss and alteration. Future developments will have localized thermokarst impacts resulting in small amounts of habitat loss and changes, depending on the size and location of the development.	No impact.	Minor localized thermokarst.	Minor localized thermokarst depending on the size and location of the development.	L	M	H	M	H
Bio4 **Detrimental effects on plants from air pollution.**	Little or no impact on plants from air pollution will occur.	Project should have little or no impact on plants from air pollution.	Future developments are unlikely to have detrimental impacts on plants from air pollution.	Increased public access is unlikely to impact air pollution levels.	Project will probably have little or no impact on plants from air pollution.	Potential for some impacts on local plant communities depending on the type of industry.	L	L	M	L	L
Bio5 **Alteration of the natural fire regime.**	No additional impact on fire or fire suppression will occur, and the natural fire regime will not be affected.	GTL project is unlikely to have any impact on the natural fire regime. Potential increase in fire suppression during construction and operation of pipeline, but unlikely to affect the natural fire regime.	Development is unlikely to have any impact on the natural fire regime.	May increase number of human caused wildfires but is unlikely to have any effect on the natural fire regime.	Potential increase in fire suppression during construction and operation but is unlikely to affect the natural fire regime.	Potential increase in fire suppression during construction and operation.	L	L	L	L	L
Bio6 **Vegetation destruction and alteration from oil, fuel, and chemical spills.**	Minor fuel and oil spills likely, but most contained on workpads, some potential for a major spill.	Minor fuel and oil spills likely, but most will be contained on workpads. For pipeline, minor fuel and oil spills likely but most will be contained on workpads. Major spill possible but unlikely for GTL and LNG.	Most spills have been and will be contained on workpads, localized areas of tundra have been killed requiring remediation. No major spills on tundra have occurred, but major spill possible but unlikely.	Minor fuel and oil spills mostly confined to roadways.	Localized fuel, oil and chemical spills mostly confined to work areas.	Localized fuel, oil and chemical spills mostly confined to work areas.	L	L	M	M	L
Bio7 **Introduction of exotic vegetation from revegetation of disturbed areas.**	Minor revegetation along the TAPS ROW is possible in localized areas and may introduce some exotic species.	Possible minor revegetation following GTL facility construction on the North Slope and at Valdez. Revegetation of some construction sites along the pipeline route are likely following construction.	Some revegetation of construction and spill impacted sites will likely occur in the future.	Low level introduction of weedy species.	Revegetation of construction impacts at missile defense site is likely to occur.	Revegetation of mined sites and construction impacts are likely to occur.	L	L	M	L	H
FISH											
Bio8 **Obstruction of fish movements in freshwater rivers and streams.**	Some obstruction to movement of freshwater fish will occur at low water crossings and culverts. This is a chronic impact along the TAPS ROW.	No impact from GTL. For pipeline, new areas will be affected, depending on the route chosen. Construction and increased vehicle traffic for maintenance will add to this impact. Inspection and monitoring will keep impacts of short duration.	Some impacts have occurred and may occur, but design and mitigation minimize them. Newer developments have a smaller footprint and fewer roads decreasing impacts.	No impact.	Some impacts possible depending on siting of facility and the road corridors required for the development.	Some impacts possible depending on siting of facility and the road corridors required for the development.	M	M	H	M	H
Bio9 **Obstruction of fish movements in the marine environment due to causeways and docks.**	No impact on marine fish movements will occur.	No impact.	Some impacts have occurred at West Dock, but populations have not been affected. Present development at Northstar will have no impact. Future developments should have minimal impacts because of limited use of structures, careful siting, and mitigation.	No impact.	No impact.	No impact.	L	L	M	L	L
Bio10 **Alteration of marine habitats.**	No impacts on marine habitats will occur.	No impact.	Minor impacts may have occurred, but have been within discharge and regulatory standards. Minor impacts may occur at Northstar and future developments, but will be within discharge and regulatory standards because of strict regulations.	No impact.	No impact.	No impact.	L	L	M	L	M
Bio11 **Alteration of freshwater fish habitats.**	Maintenance activities along the TAPS ROW may alter freshwater fish habitats in localized areas.	No impact from GTL. New areas may be impacted by pipeline construction and increased vehicle traffic for maintenance, depending on pipeline route chosen. Inspection and monitoring will keep impacts limited.	Some impacts may have occurred, but populations have not been affected. Some impacts may occur, but mitigation will limit impacts.	There may be minor impacts from erosion from off-road vehicles.	Potential for small impact from gravel placement for construction of facilities depending on siting of facility.	Potential for small impact from gravel placement for construction of facilities depending on siting of facility.	M	H	M	M	H

Table 4.5-11.
Biological cumulative effects summary: Proposed action.

BIOLOGICAL CUMULATIVE EFFECTS SUMMARY: PROPOSED ACTION

Potential Effect	PROPOSED ACTION	GAS COMMERCIALIZATION (GTL, LNG, Gas Pipeline)	NORTH SLOPE OIL FIELDS AND ANS TANKER TRADE (Past, Present, Future Development)	PUBLIC ACCESS	MILITARY (NMDS)	OTHER INDUSTRY	Intensity Factors			Ranking	
							Mag	Geo	Freq/ Dur	Int	Prob
FISH (CONT'D)											
Bio12 **Effects of oil, fuel, and chemical spills on fish.**	Most spills are contained on the work pads. There is potential for some spills to reach freshwater habitats and impact local fish populations. There is also potential for a large spill into fresh water that would have major impacts on fish, but this has not occurred in the past and is unlikely to occur.	Most spills will be small and contained on gravel, but there is the potential for a major spill that could impact fish.	Most spills will be small and contained on gravel. A large marine spill could occur from subsea pipeline and impact fish.	Possible small spills from vehicles that could impact fish in small areas.	Most spills will be small and contained, but there is the potential for a large fuel spill.	There is the potential for fuel spills, the size, and impact on fish depending on the extent and location of operations.	H	H	L	M	L
Bio13 **Effects on fish populations from increased recreational fishing.**	TAPS ROW renewal will be accompanied by continued public access from roads and workpad.	No impact from GTL, beyond future operation of TAPS. New access from pipeline route will increase fishing pressure on local populations.	No impact.	Increased fishing pressure from existing and new access points may impact local stocks.	No impact.	Increased fishing pressure from new access to remote areas may result.	M	H	H	H	H
BIRDS											
Bio14 **Obstruction of bird movements by roads, causeways, pipelines, and other structures.**	Continued TAPS operation will not block movements of birds.	No impact from GTL. As the gas pipeline will be buried, no impact will occur, except during construction.	Limited impacts have occurred on geese, but habituation has removed the impact. Limited impacts may occur, but mitigation and habituation will make them minor.	No impact.	No impact.	No impact.	L	L	L	L	L
Bio15 **Disturbance and displacement of birds by traffic, aircraft, and other activities.**	Continued TAPS operation will not appreciably disturb or displace birds.	Small impacts may result from new facilities on the ANS and at VMT for GTL. As the gas pipeline will be buried, little impact will occur, except during construction.	Some disturbance and displacement has occurred in the ANS oil fields but there have been no population level impacts. Impacts will be minor because of the small footprint of new developments and other mitigation.	Increased public access may have small impacts near the road system.	Local disturbances may occur at the NMDS site during construction.	Local impacts may occur at specific sites.	L	L	M	L	H
Bio16 **Birds use of man-made habitats including gravel pads, causeways, artificial islands, and pipelines.**	Birds will continue to use TAPS structures for nesting, perching, and foraging.	No impact.	Birds use oil field structures for nesting, perching, and foraging and may use new developments on and offshore.	No impact.	Birds may use new developments at the NMDS site for nesting, perching, and foraging.	Birds may use new developments for nesting, perching, and foraging.	L	M	H	M	H
Bio17 **Loss of bird habitat from roads, pipelines, and other facilities.**	Continued TAPS operation will not appreciably alter bird habitat.	Small impacts may occur from new facilities on the ANS and at VMT for GTL or along the pipeline corridor, particularly during construction.	Habitat has been altered by gravel and facilities, but there are no population-level impacts. Small amounts of habitat will be altered, but impacts to bird populations will be minor.	No impact.	Small amounts of habitat will be altered, but impacts to bird populations will be minor.	Small amounts of habitat will be altered, but impacts to bird populations will be minor.	L	M	H	M	H
Bio18 **Early vegetation green-up and habitat use by birds due to deposition of dust from roads.**	Birds will continue to use habitats with early green-up along TAPS. Positive impacts have occurred where birds use areas of early green-up to feed in the spring	No impact from GTL. New roads for gas pipeline may expand this impact to new areas.	Positive impacts. Birds aggregate in areas of early green-up to feed and replenish fat reserves before nesting. Positive impacts may occur near new roads.	Increased traffic on unpaved roads may increase this impact.	No impact.	Positive impacts may occur near new roads.	M	M	M	M	H
Bio19 **Bird habitat changes caused by water impoundments.**	Some impoundments have affected bird habitats along the north end of the Dalton Highway.	Small impacts may occur from new facilities on the ANS. No impact from gas pipeline.	Some impoundments have affected and may affect bird habitats and have resulted in changes in species using habitats.	No impacts.	Some impacts may occur depending on facility location and design.	Some impacts may occur depending on facility location and design.	M	M	M	M	H
Bio20 **Mortality of birds from highway vehicle roadkills.**	Small numbers of birds may be killed by continued operation of TAPS.	No impact. Some mortality may be associated with increased road traffic for gas pipeline.	No impact.	Road kills of birds will increase with increased traffic, particularly in early green-up areas.	No impact.	Some mortality may be associated with increased road traffic, depending on the extent and location of developments	L	M	L	L	M
Bio21 **Incidental bird mortality at facilities.**	Small numbers of birds may be killed during continued operation of TAPS.	Bird mortality could result at facilities.	Bird mortality could result at facilities.	No impacts.	Bird mortality could result at facilities.	Bird mortality could result at facilities.	L	M	L	L	M
Bio22 **Increased predation on birds.**	Continued TAPS operation will not increase numbers of predators with good garbage management.	No impact from GTL. Impacts possible, particularly during pipeline construction. Good garbage and food management can mitigate this impact.	Impacts have occurred in the past, particularly predation on waterfowl and shorebird eggs. Some predators still abundant and the impact continues, but improvements to garbage management are mitigating the impact.	Potential impacts could occur, depending on garbage management by the public.	Potential impacts could occur, depending on garbage management.	Potential impacts could occur, depending on garbage management by the public.	M	H	H	H	M

Table 4.5-11 (Cont'd).
Biological cumulative effects summary: Proposed action.

BIOLOGICAL CUMULATIVE EFFECTS SUMMARY: PROPOSED ACTION

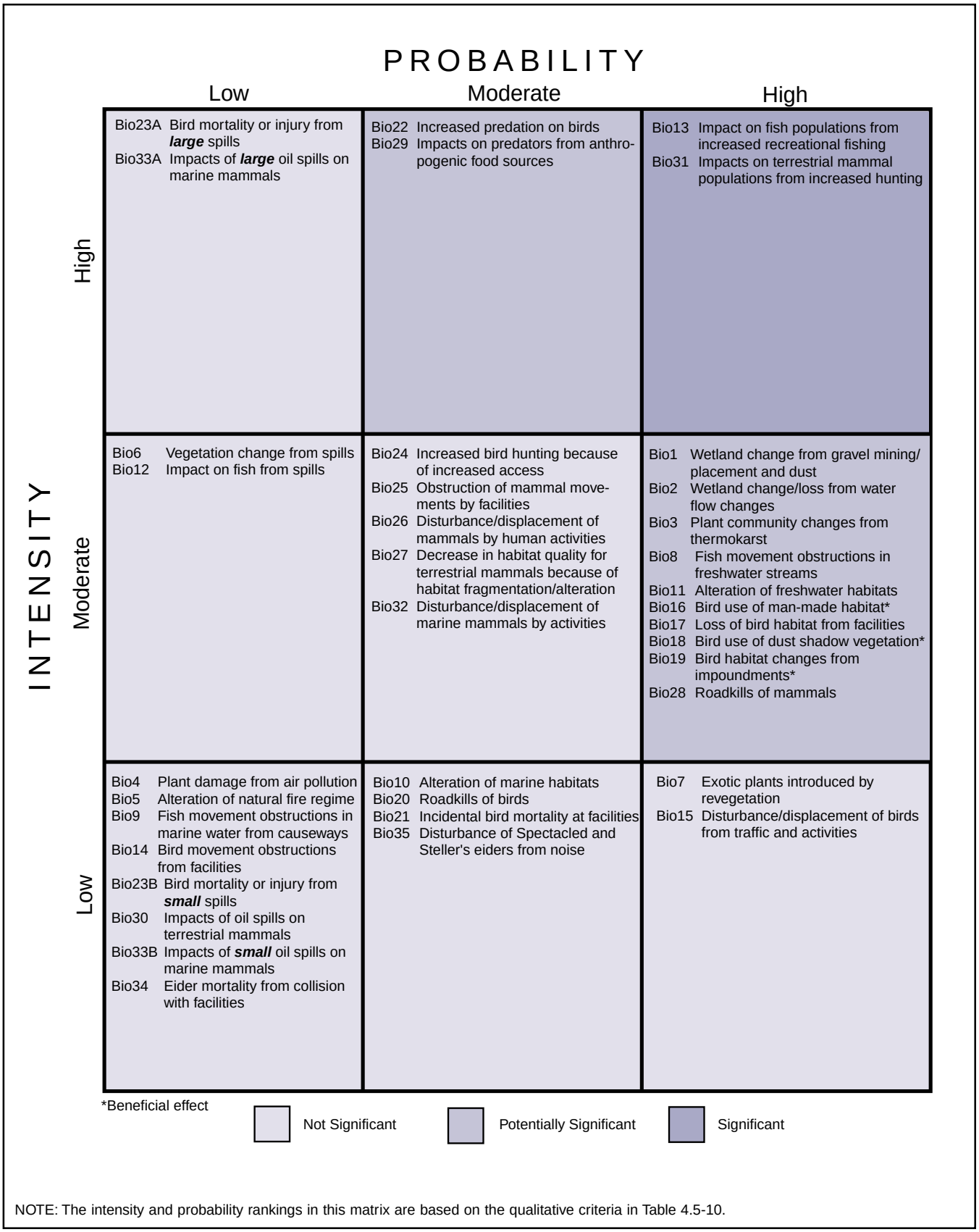
Potential Effect	PROPOSED ACTION	GAS COMMERCIALIZATION (GTL, LNG, Gas Pipeline)	NORTH SLOPE OIL FIELDS AND ANS TANKER TRADE (Past, Present, Future Development)	PUBLIC ACCESS	MILITARY (NMDS)	OTHER INDUSTRY	Intensity Factors			Ranking	
							Mag	Geo	Freq/ Dur	Int	Prob
BIRDS (CONT'D)											
Bio23A (large spills) Bio23B (small spills) **Injury or death of birds from oil, fuel, or chemical spills.**	Spills from TAPS are small and infrequent but may kill birds on land or in rivers and lakes.	GTL or fuel spills from tankers could impact birds.	Generally, no impact. Offshore pipeline or fuel spill could impact birds.	Small fuel spills could impact small numbers of birds.	Fuel spills could impact birds.	Fuel spills could impact birds, depending on the extent and location of developments.	H	H	L	H	L
							Bio 23A (Large Spills)				
							L	L	M	L	L
							Bio 23B (Small Spills)				
Bio24 **Increase in bird hunting from increased access.**	Bird hunting is expected to continue with TAPS operation.	No impacts for GTL, since no hunting allowed in North Slope oil fields. With a pipeline, bird hunting may increase with new access, depending on restrictions.	Access via Deadhorse airport may have increased hunting pressure on ANS outside oil fields where hunting is allowed. No hunting allowed in North Slope oil fields.	Impacts will increase with increased public access.	Possibly increased hunting will result from new military personnel.	Impacts will increase with increased public access, depending on the location and extent of development.	L	M	M	M	M
TERRESTRIAL MAMMALS											
Bio25 **Obstructions of mammal movements by roads, pipelines, and facilities.**	Continued operation of TAPS will not obstruct mammals' movements.	No impact from GTL. As the gas pipeline will be buried, little impact will occur, except during construction.	Some wildlife movements may have been impeded, but no population-level impacts have occurred. Some wildlife movement deflection may occur, but crossing of roads and pipelines occurs with proper design and no population level impacts are expected.	No major changes from past operation of TAPS, but increased vehicle traffic that deflects wildlife movements may occur on highways.	No impacts are expected except possibly during the construction phase.	Depending on the extent and location of activity, vehicle traffic or new roads may deflect wildlife movements.	L	M	M	M	M
Bio26 **Disturbance and displacement of large mammals by human activities.**	Continued operation of TAPS will have minimal disturbance or displacement of mammals.	No impact from GTL. As the gas pipeline will be buried, little impact will occur, except during construction, and at pumping facilities.	Some disturbance and displacement of calving caribou on the ANS have occurred, but no population-level impacts. Some disturbance and displacement of calving caribou may occur with new developments, but timing of activity and mitigation will prevent population-level impacts.	Increased public access in PWS, the TAPS ROW, and the ANS may result in increased disturbance of terrestrial mammals. The level of this impact is not expected to be very high.	No impacts are expected except possibly during the construction phase.	Depending on the extent and location of activity, vehicles, aircraft, or other human activity may disturb and displace terrestrial mammals.	L	H	M	M	M
Bio27 **Reduced habitat quality for terrestrial mammals caused by fragmentation and alteration of habitat.**	Continued operation of TAPS will not destroy or alter habitats for caribou or other ungulates.	No major changes will occur, although new facilities and pipelines on the ANS and VMT may add to this impact. With a buried gas pipeline, little impact will occur, except during construction, and at pumping facilities.	Mammalian habitats have been altered by TAPS and ANS oil fields, but no population-level effects have occurred. New developments incorporate measures to minimize habitat alteration and footprint of development.	No impacts.	Minor impacts may occur at the development site.	Impacts may occur at development sites, depending on the location and extent of projects.	L	H	M	M	M
Bio28 **Mortality of terrestrial mammals from highway vehicle roadkills.**	Some roadkills may result from continued operation of TAPS, but this impact has not been large in the past.	No impact from GTL. Increased traffic on existing roads or new roads associated with a gas pipeline could result in increases in roadkills.	Occasional roadkills have occurred in the ANS oil fields. Present developments at Badami, Alpine, and offshore have few roads, and no main road connections to the major oil field areas so roadkills will be rare or none. Future developments at NPRA and offshore will have few roads, and no main road connections to the major oil- field areas so roadkills will be rare or none.	Increased public access will result in increased numbers of roadkills on public highways.	Traffic associated with new military developments could result in increased roadkills.	This impact depends on the amounts of traffic associated with new industry activity.	L	H	L	M	H
Bio29 **Effects on predators from anthropogenic food sources and habitat enhancement.**	TAPS operations have not allowed access to anthropogenic food sources in the recent past and will not in the future.	No impact from GTL. Potential impacts during pipeline construction phase, and at pipeline pump stations could include improved nutrition, but mortality of nuisance animals and hunter kills. Mitigation measures and proper management will minimize impacts.	Predator populations have probably been enhanced by anthropogenic food in the ANS oil fields. However, mortality from hunters also has occurred. Recent mitigation and management actions may have reduced this impact. Present and future developments have strict control of anthropogenic food sources and minimum impact.	Increased public access could provide anthropogenic food for predators and increase mortality.	This impact could occur and depends on the control of anthropogenic food by the NMDS.	This impact could occur and depends on the control of anthropogenic food by other industries and regulators.	M	H	H	H	M
Bio30 **Mortality, injury, or disturbance of terrestrial mammals from oil, fuel, or chemical spills.**	It is very unlikely that spills from TAPS operations will impact terrestrial mammals.	No impact.	No impact has occurred, but there is the potential for land spills to impact small numbers of terrestrial mammals.	No impact.	No impact.	No impact.	L	H	L	L	L
Bio31 **Increased hunting of terrestrial wildlife from increased access**.	Continued TAPS operations will not increase hunting and trapping.	No impact from GTL. New access on pipeline route could increase hunting pressure.	Access provided from Deadhorse airport has increased hunting pressure on ANS. No impact from future development.	Increased access from TAPS roads, Dalton highway, and facilities has increased hunting pressure. Regulatory changes maintain populations to meet objectives.	Increased military personnel could add to hunting pressure.	New human presence in rural areas could increase hunting pressure.	M	H	H	H	H

Table 4.5-11 (Cont'd).
Biological cumulative effects summary: Proposed action.

BIOLOGICAL CUMULATIVE EFFECTS SUMMARY: PROPOSED ACTION

Potential Effect	PROPOSED ACTION	GAS COMMERCIALIZATION (GTL, LNG, Gas Pipeline)	NORTH SLOPE OIL FIELDS AND ANS TANKER TRADE (Past, Present, Future Development)	PUBLIC ACCESS	MILITARY (NMDS)	OTHER INDUSTRY	Intensity Factors			Ranking	
							Mag	Geo	Freq/ Dur	Int	Prob
MARINE MAMMALS											
Bio32 **Disturbance and displacement of marine mammals by petroleum-related operations.**	TAPS operations will not disturb marine mammals. Tanker traffic in Prince William Sound could have a small impact.	No impact from GTL. Offshore Beaufort Sea route for gas pipeline could disturb marine mammals during construction and maintenance operations. Increased LNG tanker traffic in PWS could disturb marine mammals.	Offshore exploration has disturbed some marine mammals. Development at Northstar may disturb marine mammals, although mitigation and monitoring have been instituted. Seismic exploration will disturb limited numbers of marine mammals and development at Liberty and other offshore locations could disturb marine mammals, although mitigation will reduce impacts.	Increased public access in PWS may disturb marine mammals.	No impact.	No impact.	L	H	M	M	M
Bio33A (large spills) **Bio33B (small spills)** **Mortality, injury, disturbance, or alteration of habitats for marine mammals from oil, fuel, or chemical spills.**	Spills from TAPS will not impact marine mammals. Past spills have had an impact in Prince William Sound, but populations have recovered.	GTL spills in PWS could impact marine mammals. No impact from pipeline, but LNG spills could impact marine mammals.	Past spill of ANS oil into PWS from the *Exxon Valdez* resulted in mortality of sea otters and seals and potential impacts on whales. Spills from Northstar could impact marine mammals. Spills from Liberty and other offshore developments could impact marine mammals.	No impact.	No impact.	Spills near the coast could impact marine mammals.	H	H	L	H	L
							Bio33A (Large Spills)				
							L	L	L	L	L
							Bio33B (Small Spills)				
THREATENED / ENDANGERED SPECIES											
Bio34 **Collisions of eiders with onshore or offshore structures.**	No impact from TAPS	No impact.	Possibly few instances where this impact occurred or will occur.	No impact.	No impact.	No impact.	L	L	L	L	L
Bio35 **Disturbance of Spectacled and Steller's eiders on the North Slope from noise and activities from oil-field operations.**	Operations at Pump Station 1 and TAPS on the ANS may disturb some eiders.	No impact.	Some disturbances of eiders probably have occurred but no effect on the population. Some disturbances of eiders may occur but will be minimized by regulation.	No impact.	No impact.	No impact.	L	L	M	L	M

Table 4.5-11 (Cont'd).
Biological cumulative effects summary: Proposed action.



NOTE: The intensity and probability rankings in this matrix are based on the qualitative criteria in Table 4.5-10.

***Figure 4.5-7**. Ranking matrix of cumulative impacts on the biological environment (proposed action).*

changes will be confined largely to the locations in which they presently occur, unless a major new development leads to one or more new roads that support traffic loads comparable to the Prudhoe Bay Spine Road or the Dalton Highway (Walker, 1999, pers. comm.). Dust shadows may be increased by the addition of roads, facility pads, and greater traffic loads associated with gas commercialization on the North Slope. Construction of a natural gas pipeline would increase traffic loads on the Dalton Highway, contributing to the effect in the Central TAPS study area. Other industry, an NMDS site at Ft. Greely, and recreational use would contribute modestly to dust effects in the areas of concern. The dust shadow affects a limited amount of habitat, but will continue as long as heavy traffic occurs on gravel roads.

The magnitude of this effect is moderate, the geographic scope is ranked moderate, and the frequency/duration is ranked high, for an overall intensity of moderate. The probability of these impacts occurring is high. Magnitude is moderate because careful siting of facilities and the smaller footprints of new developments limit the amount of vegetation affected by gravel placement and dust. Proper siting restricts the potential to substantially alter the distribution of a plant community. Geographic scope is ranked moderate because impacts occur on the ANS and along the TAPS route. Frequency and duration are high since gravel placement destroys vegetation directly under the road or pad, and dust effects will continue as long as traffic volumes remain the same or increase. The probability of at least some gravel placement being required for the proposed action and potential future actions is high.

Bio2. Changes to natural drainage patterns causing changes to wetlands and vegetation.

The effects of roads, pads, and other facilities will include the drying up of some areas due to restriction of sheet-drainage flow volume or duration, and also to the flooding of some wetlands. In localized areas along the TAPS ROW, road and pad construction has influenced flow patterns during spring runoff — which has in turn resulted in flooding and the loss of some habitats, including wetlands. These effects are site-specific and typically affect a small area for a small part of the year, although some impoundments may last throughout the life of the project. Further wetland losses or alterations from TAPS maintenance projects are likely to be minor and site-specific, and will be managed routinely through the Army Corps of Engineers Section 404 nationwide permitting process. Future oil development, gas commercialization, other industry, tourism/recreation, and military activities, along with current TAPS-related activities, may result in cumulative effects.

Similar effects to natural drainage patterns have occurred with development in the North Slope oil fields. A major new North Slope oil field requiring permanent gravel roads and pads for production facilities would incrementally increase the area affected by changes in drainage patterns. The construction of a natural gas pipeline would also contribute to these types of effects on wetlands, because trenching for, and burial of, the pipeline and gravel placement for compressor stations and access roads would cover wetland sites and affect natural drainage patterns. Although these effects would be directly attributable to the gas pipeline, they would add cumulatively to wetland disturbances related to the proposed action. If a natural gas pipeline is routed approximately parallel to the TAPS alignment, impacts can be minimized by using the existing TAPS workpad, access roads, stream crossings, and material sites when feasible. In locations where this is not an option, winter construction with temporary ice roads and pads will be an important additional mitigative measure to ensure that new gravel mining and fill sites are minimized. Other activities near the TAPS ROW that may alter natural drainage patterns include the NMDS installation at Ft. Greely and the establishment of campgrounds and visitor service facilities along the Richardson, Steese, Elliot, and/or Dalton highways. These developments would probably have only small-scale, site-specific impacts on drainage patterns but would contribute incrementally to habitat disturbance from changes in drainage patterns.

Residual ice (late melting) along ice roads or ice pads also influences drainage and affects tundra vegetation. Winter construction employs temporary ice roads and pads to avoid fill placement on vegetation and wetlands underlain by permafrost soils. The slower melting of the ice relative to adjacent tundra decreases the growing season for plants beneath the ice road or pad. Additionally, when the ice used for these structures melts during spring, water temporarily accumulates along the melting edges. In general, these effects have not been identified as a significant drawback to winter construction, because of the mitigative advantages afforded by this construction technique. The North Slope producers use winter construction to build exploratory roads and well pads, to expand existing oil fields, and to develop new satellite fields. This technique is also used occasionally by Alyeska when cross-country access from the workpad to repair sites is required, although existing access roads usually suffice. If a natural gas pipeline is built, it is likely that winter construction will be used extensively. However, any temporary adverse effects of late melt-

out or meltwater on vegetation would be greatly offset by the advantage of avoiding gravel fill. Effects of a shorter growing season would typically last only for that year and would have no long-term impacts. Because most of the affected microsites would be perennially wet environments, the additional meltwater would not have a significantly adverse effect and would not persist beyond a single season.

For this impact magnitude is ranked low, geographic scope moderate and frequency/duration high giving an overall intensity ranking of moderate. The probability of this impact occurring is ranked high. Magnitude was ranked low because impacts from changes in drainage patterns do not appreciably change the distribution of a plant community. Geographic scope was ranked moderate because localized problems associated with drainage have occurred in both the ANS and along the TAPS ROW. Frequency/duration was ranked high because drainage problems and impoundments tend to persist from year to year. These impacts have been a reoccurring site-specific problem along TAPS and in the ANS, making the probability of the impact high.

Bio3. Changes in plant community structure resulting from thermokarst.

Permafrost is sensitive to changes in surface conditions that alter the energy balance and increase heat flow into the ground. Even small disturbances to the plant cover and soil moisture regime can increase the depth of the active layer and melt ice-rich permafrost, causing thermokarst or settlement of the ground after thawing (MacKay, 1970; Webber and Ives, 1978; Brown and Grave, 1979; Lawson, 1986; Jorgenson, 1986; Walker, Webber, et al. 1987). Thermokarst has resulted from a variety of disturbances along the TAPS ROW, but primarily from the formation of impoundments and cross-drainage problems. A limited amount has also been associated with terrain adjacent to buried sections of the pipeline at MP 19, 574, and 734. Thermokarst was mitigated in these areas by filling sinkholes with gravel (Thomas and Ferrel, 1983). VSMs on slopes at MP 687 and 717 have also been exposed to limited thermokarst confined to the workpad. Thermokarst from impoundments, icings, and dust are likely to persist and cause small amounts of additional settlement. However, few new thermokarst areas will be created by the proposed action. Maintenance work may cause some minor impacts associated with clearing of vegetation along the ROW.

In heavily developed portions of the Prudhoe Bay oil field, thermokarst has resulted from impoundments and construction-related disturbances. Walker et al. (1986) indicated that 3 percent of the total area was affected and that the area of impact was increasing with time. Walker, Webber, et al. (1987) suggested that a cumulative loss of habitat was occurring from thermokarst-related impacts. However, Noel et al. (1996) suggested that at least a portion of the area being impacted was from thermokarst occurring because of natural processes associated with the thaw-lake cycle (Billings and Peterson, 1980).

Thermokarst in the heavily developed portions of the ANS oil fields will continue to increase in area. New developments are designed with minimal footprints, are often roadless, and carefully consider drainage patterns in facility siting. These design improvements have generally been successful at limiting the area affected by thermokarst. However, additional developments on the North Slope will contribute incrementally to the area affected by thermokarst, but the impacts will be substantially less than in the early development of the Prudhoe Bay oil field.

Construction of a GTL facility on the North Slope would have minimal localized effects on thermokarst that would depend on the site chosen. Increased thermokarst impacts from construction of a natural gas pipeline would depend greatly on the route chosen. A route using existing workpads, access roads, stream crossings, and material sites to the greatest extent possible would limit additional thermokarst. Development of other industry and the NMDS site at Ft. Greely may also have some localized thermokarst impacts depending on the size and the location of the facilities and would cause some incremental increase in thermokarst impacts.

The magnitude of thermokarst impacts is ranked low, geographic scope is ranked moderate, and frequency/duration is ranked high, for an overall intensity of moderate. The probability of thermokarst impacts occurring is high. The magnitude of thermokarst impacts is ranked low because impacts will occur in limited areas and will not appreciably alter plant community distribution. The geographic scope is ranked moderate since effects are site-specific but occur in the ANS oil fields and the along the TAPS ROW. However, the frequency/duration is ranked high since thermokarst impacts will remain and probably progress once they occur. The probability of these impacts is high, since current thermokarst areas will remain and probably increase in size even with no new development.

Bio4. Detrimental effects on plants from air pollution.

The TAPS pump stations, facilities on the ANS, and the VMT currently produce emissions to the atmosphere. Studies of plant response to emissions have not been conducted along TAPS, but studies at ANS facilities, which have

larger permitted discharges, show no adverse impacts to vegetation at pollutant concentrations at or above those likely to be experienced near TAPS facilities (Kohut et al., 1994). The proposed action would not increase the number of pump stations or facilities along the TAPS route. Construction of a gas pipeline or an NMDS site at Ft. Greely, and other industry along the TAPS route would produce some incremental increase on pollutant emissions. Any impacts from these pollutants would in most cases be very localized and unlikely to result in detectable changes in the vegetation.

Magnitude and geographic scope are ranked low and frequency/duration is ranked moderate, giving an overall intensity rank of low. The probability of impacts from air pollutants on plants occurring is ranked low. Magnitude and geographic scope are ranked low because potential impacts are limited to a few small areas. Emissions do occur from pump stations and the VMT and would occur intermittently from other developments along the TAPS route making frequency/duration moderate.

Bio5. Alteration of the natural fire regime.

The Alaska Interagency Fire Management Plan provides for a full range of suppression responses that vary from aggressive control that extinguishes the fire to surveillance (ADNR, 1999b). Decisions on fire suppression are at the discretion of the federal or state agency involved. Suppression action is based on the fire's threat to human life, inhabited property, designated physical developments, and structural resources such as National Historic Landmarks, high-value natural resource areas, and other high-value areas such as identified cultural and historical sites. The current operation and maintenance of TAPS do not directly affect fire-suppression decisions. The proposed action would not increase human habitation or infrastructure along the pipeline route and would not increase the likelihood of suppression action occurring.

Construction of a gas pipeline along the TAPS route would increase the likelihood of suppression action during construction phases and may increase the number of personnel at facilities along the pipeline. Future developments on the North Slope would also potentially increase fire suppression actions, but the likelihood of a wildfire in tundra is low. Construction of an NMDS site at Ft. Greely would also potentially increase fire suppression, as would other industry developments such as mines. These actions would increase infrastructure and human habitation and therefore could increase the likelihood of fire suppression actions being taken.

Fire is a natural force in the Alaskan Interior, and most forest communities have been extensively influenced by recurring fire (Dyrness et al., 1986). There has been considerable debate on the effect of fire suppression on the natural fire cycle. In general, Alaska is thought to still be in a "wilderness fire" stage in which fire suppression has had no pronounced effect on the natural fire cycle. The proposed action and the anticipated future developments are unlikely to alter wildfire patterns or responses except on a very localized scale.

Increasing the number of people and facilities in an area increases the potential for human-caused wildfires. The proposed action would not increase the likelihood of human-caused fires, because there would be no increase in facilities or personnel. However, construction and operation of a natural gas pipeline, a missile defense site, other industrial developments, and increased usage for recreation and tourism could potentially increase the number of human-caused fires.

Magnitude, geographic scope, and frequency/duration are all ranked low, for an overall intensity ranking of low. The probability of the impact occurring is also low. Magnitude, geographic scope, and frequency are ranked low because wildfires and wildfire suppression decisions would occur on a site-specific basis and would occur infrequently if at all. The probability of impacts to the natural fire regime is extremely low.

Bio6. Vegetation destruction and alteration from oil, fuel, and chemical spills.

Oil, fuel, and chemical spills reported along the TAPS ROW have generally been confined to the workpad and have been small leaks of refined product. Only a few of these spills significantly impacted vegetation. Oil, fuel and chemical spills will probably occur along the TAPS ROW during the 30-year period of the proposed action. As in the past, most of these spills will occur on the workpad with no impacts to adjacent vegetation. In accordance with spill response plans, any spills contacting vegetation will be quickly contained, cleaned and remediated. Spills reaching vegetation are expected to be rare. However, there is some inherent risk of a large-scale spill occurring during transportation of large volumes of oil. Continued operation of TAPS would result in the continued likelihood of spills and would contribute to cumulative effects of spilled oil in the Alaskan environment.

Future ANS development would also contribute to the cumulative effects of oil and fuel spills. Tundra vegetation may be exposed to oil in the event of a pipeline leak, or a leak or blowout at the production pads or facilities. In addition, coastal wetlands or salt marsh habitats could be af-

fected by an offshore spill that reaches the shoreline. For pipelines, small spills will most likely be contained on the gravel pads. Leaks in the elevated portion of a pipeline could expose the tundra to oil. During winter these will be on top of snow and will be cleaned with minimal impact to tundra vegetation. Spills occurring during summer will penetrate the tundra mat, killing the vegetation, but oil will not penetrate beyond the active layer. The contaminated area would be cleaned and revegetated. Few oil spills have occurred on tundra during the development and operation of the Prudhoe, Kuparuk, and Milne Point oil fields, and there is no reason to expect that this will change with future developments. However, future development on the North Slope could cause an incremental increase in the effects of spilled oil on vegetation.

Other future developments, including construction of a gas pipeline, GTL facility, an NMDS site at Ft. Greely, and mine construction, could also contribute to spills of fuel, oil, and chemicals. Most of these impacts would occur during construction phases and would primarily involve spilled fuel, although in some mining operations, chemical spills could also occur. These impacts could also incrementally increase the cumulative impacts of spills.

Spill impacts are ranked as low magnitude, low geographic scope, and moderate frequency/duration for an overall intensity rank of moderate. The probability of spills impacting vegetation is ranked low. Spills are given a low magnitude and low geographic scope ranking because they occur at specific locations and would impact vegetation in a localized area. Spills will probably occur intermittently over the period of the project and are therefore ranked as moderate for frequency/duration. Intensity is considered moderate despite the low rankings of magnitude and geographic scope because there is the potential for a large spill. The probability of spill impacts on vegetation occurring was ranked low, because while the probability of some spills occurring is high, few of the spills that do occur will contact vegetation.

Bio7. Introduction of exotic vegetation from revegetation of disturbed areas.

Seed mixes used for revegetation of construction sites, roads, pads, and other areas could include nonindigenous species of grasses and other plants. However, the introduction of exotic plants with seed application has been reduced as greater quality-control measures have been developed for producing seed mixtures for construction sites in arctic and subarctic environments. The result of introducing exotics on the North Slope and along the TAPS ROW has usually been benign and has not led to large-scale replacement of indigenous plant species. However, in some cases these introduced plants have slowed the reformation of natural plant communities and successional patterns on revegetated sites. Site-specific revegetation will continue on the North Slope and in the Central TAPS study area in conjunction with limited excavations for pipeline inspection and maintenance. New construction of oil fields, a natural gas pipeline, GTL facility, the Ft. Greely NMDS installation, or public use facilities such as campgrounds will create greater potential for introduction of exotic plant species, since all these actions will involve some site-specific revegetation.

The magnitude and geographic scope of this impact are low, and frequency/duration is moderate, giving an overall intensity ranking of low. The probability of this impact occurring is high. Magnitude and geographic scope were ranked low because revegetation would be site-specific and occur at a few locations. The frequency/duration of the impact is moderate because it is intermittent, because construction of projects will have different schedules.

Proposed Action: Fish

By L.L. Moulton and R. Fechhelm

Bio8. Obstruction of fish movements in freshwater rivers and streams.

Drainage structures, such as culverts and low water crossings of the TAPS workpad, may impede fish migration (BLM and USACE, 1988) and obstruct fish passage (Brna, 1999, pers. comm.). This impact was addressed for the TAPS ROW in Section 4.3.2.3. The impacts occur intermittently at some, but not all, stream crossings, and they are generally mitigated through regulation, monitoring, and corrective action.

This impact may occur in ANS oil fields, although proper design and maintenance of road and pipeline river crossings at most locations have resulted in little or no impact there. This will also be the case for present and future ANS oil fields. The GTL project will have no impact. A gas pipeline will likely have impacts similar to those for TAPS. New roads, workpad, and buried pipeline crossings for a gas project will impact new areas outside the TAPS ROW. Increased public access could result in more vehicles crossing streams along TAPS and increase this impact. The NMDS will have no impact. Other industry may increase this impact depending on location, extent, and level of mitigation.

The magnitude of this impact is moderate because impeding fish migration can lead to reduced spawning upstream from the impact site and affect a population. The

geographic scope is moderate because it occurs along the TAPS ROW. The frequency/duration is high because it has been a continuous impact for TAPS. The overall intensity is moderate. The probability is high, because it is a continuing maintenance issue throughout the TAPS route.

Bio9. Obstruction to fish movements in the marine environment due to causeways and docks.

This impact does not occur along TAPS, but may occur in the marine environment of the Beaufort Sea. There has been little or no impact on fish movements from docks or causeways at the VMT or in Prince William Sound. Relative to the extensive distributions and coastal movements of marine and anadromous species, any additional VMT structures would likely impact an insignificant number of individuals and a small geographic area.

On the ANS, this impact was a concern at West Dock and the Endicott Causeway, although impacts were only realized at West Dock. In general, breaching and other design features have minimized impacts. Under certain meteorological conditions, structures along the Beaufort Sea mainland coast can block the movements of diadromous fishes, particularly juveniles (Fechhelm, 1999). Diadromous species are freshwater fish that overwinter in North Slope rivers but disperse into low-salinity coastal waters during the summer to feed. Because many of these species avoid high-salinity, marine conditions, they tend to remain nearshore where they forage up and down the coast within a narrow band of warm, low-salinity water (Craig, 1984). Causeways can impede coastal movement either by directly blocking fish or by modifying nearshore water conditions to the point where they might become too cold and saline for these species. However, current construction practices and mitigation efforts have shown that breaching can alleviate blockage (Fechhelm, 1999).

The location of causeways relative to coastal topography, local bathymetry, and freshwater drainages also is critical in determining their impact to the nearshore migration corridor (Niedoroda and Colonell, 1990). For example, West Dock was constructed at the eastern end of an extensive brackish-water lagoon system (Simpson Lagoon) through which fish disperse and migrate. The causeway extends seaward enough into the marine environment beyond the 2-meter (m) isobath to exacerbate coastal mixing processes that sometimes block the movements of those fish. In contrast, the entire Endicott Causeway was constructed inside the 2-m isobath and does not protrude into deeper marine waters. The onshore encroachment of marine water is further impeded by the freshwater discharge of the Sagavanirktok River (Niedoroda and Colonell, 1990). As a result, cells of upwelled marine water that develop at the Endicott Causeway are restricted to the seaward tip of the causeway's western leg and do not reach the mainland shore, where it might otherwise disrupt fish migrations (Hachmeister et al., 1991; Gallaway et al., 1991).

The impact of causeways obstructing the movements of marine fishes (i.e., fish with their entire life history in marine waters) would be small. The marine species that dominate the nearshore zone are found throughout the Arctic and are abundant and widely distributed along the Beaufort Sea coast (Morrow, 1980; Griffiths et al., 1998). Relative to the extensive and continuous distribution of these marine species, even a worst-case causeway effect would be of limited geographic scope, affecting only a small fraction of the population. Further, the most abundant marine species found in nearshore coastal waters during summer are benthic Arctic flounder and fourhorn sculpin (Griffiths et al., 1998). Given their sedentary nature, it is doubtful that they undergo extensive alongshore migrations.

Proper siting for any future causeway construction along the ANS Beaufort Sea coast is the most important consideration regarding fish movements. In addition, breaching may be appropriate relative to site location and hydrography. Other structures constructed at offshore facilities and artificial islands would not affect diadromous fish habitat and would have a limited influence on marine species. A GTL project, a gas pipeline, increased public access, an NMDS and other industry activity will not have an impact.

The magnitude of this impact is low, the geographic scope is low, and the frequency/duration is moderate, for an overall intensity of low. The probability that the impact will occur is low. The magnitude is low, assuming that future causeway construction includes proper siting and adequate design. Documented instances of causeway blockage (Fechhelm et al., 1999) suggest that causeways have had no detectable effect on stocks after nearly 20 years of study (Moulton, 1997). The geographic scope is low because the impact occurs at only a few sites in the Beaufort Sea and only in the immediate vicinity of the structure (Niedoroda and Colonell, 1990). The frequency/duration is moderate because of the intermittent nature of the impact.

Bio10. Alteration of marine habitats.

This impact does not occur along the TAPS ROW, but may occur in the marine environments of the Beaufort Sea and Prince William Sound. In the ANS oil fields, offshore construction discharges and offshore trenching may alter marine habitat and influence planktonic and benthic marine invertebrates and fishes (USACE, 1984, 1999). This impact could also occur at the VMT in Prince William Sound. Af-

fected areas would likely be more turbid than normal, and this turbidity could affect faunal respiration and vision. Because ANS construction is in the winter with darkness and thick ice cover, phytoplankton photosynthesis is not likely to be affected. Heavy downstream sedimentation could smother the benthos. In general, species occupying these areas are adapted to dynamic conditions and react to short-term fluctuations in water quality and habitat either by enduring and functioning under those conditions or moving out of the impact zone. This has been the case with past ANS offshore developments. An exception is the Boulder Patch community that lies several kilometers seaward of the Sagavanirktok River delta. The Boulder Patch is a community of epilithic flora and fauna that inhabit an isolated area of rock substrate in Stefansson Sound (Dunton and Schonberg, 2000). Organisms occupying the Boulder Patch are at risk from localized impacts because they are immobile, occupy a relatively small geographic area, and are an isolated community that cannot easily be repopulated from surrounding stocks. Offshore construction and trenching in this area would require special consideration.

A GTL development, a gas pipeline, public access, and an NMDS would have no impact. Other industry could have an impact only if it included offshore operations.

The magnitude of this impact is low, the geographic scope low, and the frequency/duration moderate, for an overall intensity of low. The probability of this impact is moderate. The magnitude is low because even under a worst-case scenario in which benthos (excluding the Boulder Patch community) were covered and destroyed, the numbers of individuals would be small relative to the population, and they would likely be quickly replaced from nearby stocks. The geographic scope is low because offshore construction and trenching discharges would be restricted to few specific sites in the Beaufort Sea. The frequency/duration of this impact is moderate because of the intermittent nature of offshore construction projects. The probability of this impact is moderate because offshore construction is likely to continue.

Bio11. Alteration of freshwater fish habitats.

The impacts associated with freshwater habitat alteration were addressed for the TAPS ROW in Section 4.3.2.3. These impacts include sedimentation and loss of spawning beds and overwintering areas near pipeline and road crossings and during pipeline construction and maintenance (BLM and USACE, 1988). TAPS operations include erosion control, restoration, and monitoring that minimize this impact.

These impacts could occur on the ANS, although they have not been a large problem and have been adequately mitigated. An additional impact on the ANS has been removal of fresh water from lakes for construction of ice roads and pads and other operations. Design and mitigation are included in these operations to minimize impacts on fish. Present and future ANS oil-field developments will also have these impacts, but regulation minimizes them.

A GTL development would have no impact. A gas pipeline would have impacts similar to those of TAPS, including construction and maintenance operations. Inspection and monitoring will limit impacts. Public access will have little impact unless there is increased erosion of stream banks from off-road vehicles. An NMDS will have no impact unless facilities are constructed near lakes or rivers. Other industry could have impacts depending on their location and extent.

The magnitude of this impact is moderate, the geographic scope high, and the frequency/duration moderate, for an overall intensity of moderate. The probability of this impact is high, because it is a continuing maintenance issue throughout the route. The magnitude is moderate because the impact can change a population size or spawning or wintering range. The geographic scope is high because the impact can occur along the TAPS ROW or across the ANS. The frequency/duration is moderate because the impact occurs intermittently.

Bio12. Effects of oil, fuel, and chemical spills on fish.

Oil, fuel, or chemical spills are a primary concern for TAPS and related operations. The impact of freshwater spills was addressed for TAPS in Section 4.2.3.3. Most spills along TAPS have been small and restricted to gravel pads at facilities or roads. Large spills into fresh water have not occurred, but if one occurs in the future, it could impact fish.

Large marine spills, such as EVOS, can potentially have large, but short-term, impacts on fish. Such spills can cause mortality and injury to plankton, marine invertebrates, and fish (USACE, 1999). Direct mortality of fish due to oil is seldom seen outside of the laboratory, and impacts on fish in natural environments have been largely inferred (Neff and Stubblefield, 1995). The EVOS probably had some impacts on fish, including pink salmon and herring, but there is not a consensus on the extent and duration of impacts on these species (Wells et al., 1995; Rice et al., 1996). However, populations and habitats had largely recovered as of 1995. Even during the *Exxon Valdez* oil spill, the concentration of oil in water was not sufficiently high to cause fish mortalities (Neff and Stubblefield, 1995).

Past oil spills along TAPS and in the ANS oil fields have

been mainly confined to land but could leak into watersheds and impact fish. Future operation of TAPS and construction of a gas pipeline, NMDS, or other industrial activity carry the risk of small-scale spills of oil, fuel and chemicals from vehicles and machinery. However, industry and agencies have established rigorous criteria for the environmentally safe operation of machinery. These include such measures as regular inspection of facilities and equipment and deployment of containers to catch oil drips from parked vehicles.

Present and future ANS oil-field developments may have an impact, particularly in the marine environment. The potential for spills from subsea pipelines and other sources on offshore developments in the Beaufort Sea has been assessed previously (USACE, 1999). Impacts of spills in solid ice or broken ice in this region may be particularly difficult to clean up.

A GTL development could increase the risk of impacts related to the increased volume of liquids transported through TAPS and in tankers. A gas pipeline, an NMDS, and other industry activities have potential impacts from fuel spills that may enter fresh water, depending on facility locations. Increased public access could result in some small spills from highway vehicles, off-road vehicles, and boats.

The magnitude of this impact is high, the geographic scope high, and the frequency/duration low for an overall intensity of moderate. The probability of this impact is low. Spills will occur, but they will not necessarily impact fish. The magnitude is high because large spills can impact a population or range. The geographic scope is high because spills may occur on the ANS, TAPS ROW, or in Prince William Sound. The frequency/duration is low because spills that reach water occur infrequently, and impacts are of limited duration.

Bio13. Effects on fish populations from increased recreational fishing.

The impact of sport fishing along the TAPS ROW is addressed in Section 4.3.2.3. Increased access has resulted in decreases in some fish populations. Overharvest can occur when regulations and enforcement are inadequate. Developments in remote areas, such as the TAPS ROW, can allow access to previously unavailable harvest opportunities (BLM, 1972). The problem is magnified in northern areas because productivity is low and populations are more susceptible to excessive harvest.

This impact has not occurred in the ANS oil fields or Beaufort Sea, although some sport fishing occurs there. There is increasing public access into Prince William Sound, where sport fishing could impact populations. Sport fishing and commercial fishing are managed by the Alaska Department of Fish and Game and the U.S. Fish and Wildlife Service.

Present and future ANS development and a GTL development will have limited impacts because there is no public access to the oil-field operating areas. However, expansion of oil development on the ANS and in the Beaufort Sea could result in increased access for recreation (BLM, 1976). An NMDS will have little to no impact. Increased public access from existing roads and airfields, along with access to new areas with a gas pipeline and other industry activity, will add to this impact. Depending on the level of regulation and enforcement of sport fishing harvest, some areas could have reductions in fish populations. This impact is regulated by the state and federal agencies, and is not under the control of industry.

The magnitude of this impact is moderate, the geographic scope high, and the frequency/duration high, for an overall intensity of high. The probability of this impact is high. The magnitude is moderate because sport fishing can lead to reductions in a local stock, but not widespread populations. The geographic scope is high because this impact can occur along the TAPS ROW, in Prince William Sound, and potentially on the ANS. The frequency/duration is high because the impact will occur regularly in accessible areas.

Proposed Action: Birds

By S.R. Johnson and M.A. Cronin

Bio14. Obstruction of bird movements by roads, causeways, pipelines, and other structures.

There has been concern that roads, causeways, pipelines, and other facilities could obstruct movements of birds (USACE, 1984). This impact was discussed for the TAPS ROW in Section 4.3.2, and impacts were negligible.

A major concern expressed before construction of the Endicott Development Project was that the road and causeway would obstruct traditional movements of flightless molting and brood-rearing geese nesting in the Sagavanirktok River delta. Some of the geese were initially reluctant to cross the new road, but they eventually habituated to the road and traffic and moved across the road to brood-rearing habitats (Johnson, 2000a). Although long-term monitoring studies indicated that some individual birds and family groups may avoid heavily used roads (Bur-

gess et al., 1992), most evidence indicates that geese and most other waterfowl have habituated to roads and traffic in the North Slope oil fields.

Present and future ANS oil-field developments may include new roads that may obstruct bird movements to some extent. However, after years of research, there has been no evidence of population-level impacts on birds due to blockages by roads and causeways. Concerns were also expressed that proposed near-the-ground flexible pipelines (i.e., not elevated pipelines) on the North Slope could obstruct movements of molting and brood-rearing waterbirds. Recent research showed that geese initially avoided a simulated near-the-ground pipeline, but they eventually became habituated to the pipe and moved around and under it (Olson and MacLean, 1999).

A GTL development would likely have small impact because there will be only a few new facilities on the ANS and the VMT. A gas pipeline could result in more impacts during the construction phase over a wider geographic area. Because the gas pipeline will be buried, impacts will be restricted to the construction corridor during the construction period. Continued or increased public access, military activities, and other industry activities likely would have no impact.

The magnitude of this impact is low, the geographic scope low, and the frequency/duration low, for an overall intensity of low. There is a low probability that this impact will occur for birds. The low magnitude is because the impact will be on small numbers of birds. The geographic scope is low because the impacts are site-specific. The frequency/duration is low because the impact is infrequent.

Bio15. Disturbance and displacement of birds by traffic, aircraft, and other activities.

Breeding, postbreeding, molting or brood-rearing birds exposed to oil-field or pipeline operations, aircraft or vehicle traffic, and other human activity could be disturbed and displaced from local habitats and/or subject to increased energy demands. Such disturbances and displacements in the TAPS ROW have been site-specific and intermittent, have affected small numbers of birds, and have not limited populations (See Section 4.3.2).

Operations in the ANS oil fields have caused some disturbance and displacement, but no population-level impacts have been documented (reviewed in Truett and Johnson, 2000). Noise, activity, bright lights, and constant human presence associated with construction and operations at the VMT may disturb and displace some birds. However, the number of birds displaced is likely small, the impact is only at the VMT, and most birds have probably habituated to the facilities.

Present and future ANS developments may have limited impacts, but the smaller size of new facilities will result in less impact than in the past. GTL development will have localized impacts at the new ANS and VMT facilities. A natural gas pipeline could disturb and displace birds during the construction phase. Increased public access may have local and minor impacts. The NMDS will have local impacts during the construction phase. Other industry activity will have impacts depending on the location and extent of development.

The magnitude of this impact is low, the geographic scope low, and the frequency/duration moderate, for an overall intensity of low. The probability of this impact was judged high. The magnitude is low because of the small number of birds affected, because no population-level effects have been documented previously, and because none are anticipated in the future. The geographic scope is low because of the localized impacts. The frequency/duration is moderate because of the intermittent nature of the impacts. A high probability exists that birds will be disturbed and displaced to some extent.

Bio16. Bird use of man-made habitats including gravel pads, causeways, artificial islands, and pipelines.

Habitat alteration can result in both beneficial and negative impacts on birds. The negative impacts are discussed in the next subsection (Bio17). Several studies have documented positive impacts of TAPS on birds (see Section 4.3.2). Raptors perch and nest on oil-field and pipeline structures (Schmidt, 1999, pers. comm.; Ritchie, 1991), and swallows and other birds nest on structures at several TAPS pump stations (Shoulders, 1999, pers. comm.). Similarly, Pollard et al. (1990) and Rodrigues (1992) documented extensive bird use of gravel pads and adjacent disturbed sites in the North Slope oil fields. Another beneficial impact is that offshore artificial drilling islands provide new habitat that will attract birds (USACE, 1999). This positive effect was documented on the Endicott Causeway, which was colonized by Common Eiders. In addition, molting Oldsquaws aggregate on the leeward side of the causeway. This occurred during the first summer after completion of the causeway despite construction and operational activities.

Present and future oil and gas development on the ANS, particularly offshore in the Beaufort Sea, may involve the construction of more offshore islands, which would likely provide more nesting and molting habitat for birds. This could enhance local bird productivity and increase local bird populations. A GTL project would likely have no im-

pact. A gas pipeline would likely have no impacts, unless offshore gas production included island habitat. Public access would have no impact. An NMDS and other industry activity might create habitats attractive to birds.

This impact is beneficial. The magnitude is low, the geographic scope is moderate, and the frequency/duration is high, for an overall intensity of moderate. The probability of birds using man-made habitats is high. The magnitude is low because few individuals are impacted. The geographic scope is moderate because the impact occurs at specific sites along TAPS and across the ANS. The frequency/duration is high because the impact is continuous.

Bio17. Loss of bird habitat from roads, pipelines, and other facilities.

There is concern that pipeline and oil-field development — including roads, pads, and other structures — removes vegetation and decreases available habitat (BLM, 1972; USACE, 1984). This impact was discussed for the TAPS ROW in Section 4.3.2, and both beneficial and negative impacts have occurred. The beneficial impacts were discussed in the previous subsection (Bio16).

In the ANS oil fields, about 8,800 hectares (ha) of tundra habitats have been covered with gravel (Gilders and Cronin, 2000). However, there is no evidence this has had population-level impacts. Studies suggest that birds displaced by gravel fill move to adjacent tundra habitats (TERA, 1990). Other studies in the Sagavanirktok River delta indicated that Snow Geese continued to use adjacent habitats after construction of the Endicott road and causeway (Johnson, 1991, 1998, 2000a; Wilkinson et al., 1993). Some birds preferentially use gravel habitats for nesting or other activities (Johnson, 2000b).

Present and future oil and gas development on the North Slope will result in continued habitat alteration, although new developments have smaller footprints, and relatively smaller impact than in the past. A GTL development will have small impacts at a few facilities. A gas pipeline will have some impacts during the construction phase, but revegetation of the buried pipeline should make the impact short-term. Public access will have no impact. An NMDS will have local, site-specific impacts. Other industry impacts will depend on the location and extent of activities.

The magnitude of this impact is low, the geographic scope moderate, the frequency/duration high, for an overall intensity of moderate. The probability of this impact is high. The low magnitude is because a small number of birds and small areas are impacted. The geographic scope is moderate because the impact is primarily on the ANS. The frequency/duration is high because the habitat alteration is generally long-term.

Bio18. Early vegetation green-up and habitat use by birds due to deposition of dust from roads.

Road dust and associated early spring green-up may cause local redistributions of waterfowl and shorebirds (BLM, 1989). This impact was discussed for the TAPS ROW in Section 4.3.2. Impacts are generally beneficial by providing birds more forage early in the spring. This impact occurs along unpaved roads, but it also occurs naturally along river floodplains. The impact is annual in early spring and many birds are affected. The positive effects on the energy balance of local bird populations has not been studied, but they are likely beneficial.

Road dust from vehicle traffic on the Dalton Highway drifts downwind onto adjacent snowfields and the dark-colored dust decreases albedo, increases heat absorption, and stimulates early snowmelt and green-up. Areas of early green-up are attractive feeding places for migrating waterfowl and shorebirds in early spring when most tundra habitats are still snow-covered. Most waterbirds are food-stressed in spring after long migrations, and areas of early green-up provide good feeding areas. As long as roads remain unpaved, road traffic associated with future North Slope oil development, potential gas commercialization, other industry activities, and tourism and recreation will likely maintain dust shadows along the Dalton Highway and side roads. The GTL project will have no impact because no new roads will be built. A gas pipeline with new gravel roads will expand this impact to new areas. Present and future ANS oil-field development will expand this impact to new areas, although new roads will be limited compared to past operations. Increased public access on unpaved roads will increase this impact, while an NMDS will have no impact. Other industry activities may have impacts depending on their extent and location.

The magnitude of this impact is moderate, the geographic scope is moderate, and the frequency/duration is moderate, for an overall intensity of moderate. The probability of this impact occurring is high because it has been extensively documented and is likely to occur in the future. The magnitude is moderate because it affects many birds over the ANS oil fields and along the Dalton Highway and may enhance carrying capacity and population sizes. The geographic scope is moderate because it occurs primarily over the northern part of the TAPS ROW and in the ANS oil fields. The duration/frequency is moderate because it occurs intermittently in the spring.

Bio19. Bird habitat changes caused by water impoundments.

Construction of roads and gravel pads sometimes results in blockage or rerouting of water flow, particularly during spring snowmelt. Since culverts sometimes do not thaw before spring runoff or are not effective, temporary or permanent water impoundments can occur in areas where there was previously no standing water. In other cases, wetlands may dry up because they do not receive enough water. This issue was addressed for the TAPS ROW in Section 4.3.2.4., and impacts may occur along the north end of the Dalton Highway. The impacts of most impoundments are site-specific, are usually temporary, and have not affected population sizes.

The impacts of impoundments on birds and their invertebrate prey have been studied extensively in the ANS oil fields over the several past decades (Noel et al., 1996). Most man-made impoundments are site-specific and temporary, and most are mitigated by replacing culverts and reestablishing traditional drainage patterns. In the few instances where impoundments have become permanent, the diversity of bird species using them for feeding and nesting was similar to that in natural wetlands. Although some birds, such as tundra-nesting passerines and shorebirds, may be displaced by impoundments, other species, such as loons, waterfowl, and some shorebirds (mainly phalaropes) frequently use impoundments. Overall, the numbers of birds using impoundments is similar to or higher than the numbers using natural wetlands. This impact could be beneficial or negative, depending on the species considered. Mitigation and remediation can reverse the effects of impoundments.

Present and future ANS oil-field development could create new impoundments, although the extent of new roads will be substantially less than in previous developments. A GTL project may create some impoundments depending on where facilities are sited on the ANS. A gas pipeline could create impoundments if roads or workpads accompany the buried pipeline. Public access should have no impact as long as culverts are not blocked. The NMDS may have some site-specific impoundments depending on design. Other industry activities may cause impoundments depending on their extent and location.

The magnitude of this impact is moderate, the geographic scope moderate, and the frequency/duration moderate, for an overall intensity of moderate. The probability of the impact is high. The magnitude is moderate because the impact could measurably alter the population sizes of some birds — either a beneficial increase or a negative decrease in population. The geographic scope is moderate since the impact occurs in the ANS oil fields and northern TAPS ROW. The frequency/duration is moderate because it occurs intermittently, mainly in spring and summer.

Bio20. Mortality of birds from highway vehicle roadkills.

Birds may be killed by vehicles. This impact is more likely for birds using early green-up areas in dust shadows along the TAPS ROW (Shoulders, 1999, pers. comm.; Schmidt, 1999, pers. comm.). This impact was addressed in Section 4.3.2.4 and may affect small numbers of birds.

This impact could occur in ANS oil fields, although it has not been reported as a problem there. It is unlikely to be a problem with present or future ANS oil fields or a GTL project. A gas pipeline could include more roads and traffic that could result in some roadkills. Increased public access could also cause some roadkills of birds, while an NMDS is unlikely to cause an impact. Other industry activities could cause roadkills depending on their location and extent.

The magnitude of this impact is low, the geographic scope moderate, and the frequency/duration low, for an overall intensity of low. The probability this impact will occur is moderate. The magnitude is low because small numbers of birds are affected, while the geographic scope is moderate because it can occur along the length of the TAPS ROW. The frequency/duration of the impact is low because it is occurs infrequently and seasonally.

Bio21. Incidental bird mortality at facilities.

Birds may be accidentally killed at industrial facilities — for example, some birds (e.g., cliff swallows) may nest at TAPS pump stations, may fly into pump station structures, or may be sucked into compressor intakes. Structures and bright lights at the VMT may attract birds during inclement weather (Senner, 1999, pers. comm.). The number of birds killed is small, and the impacts are restricted to the immediate vicinity of the VMT. Collisions normally occur during spring and fall when birds are migrating through the area. This minor impact was addressed for the TAPS ROW in Section 4.3.2.4.

In the ANS oil fields, there is some anecdotal evidence for bird mortality at nearshore structures such as Endicott and at the seawater treatment plant at the end of the West Dock causeway. Bird mortality at such structures, however, has been intermittent and local, and has involved only a few individuals. Present and future ANS oil-field development could cause this sort of bird mortality. It has been postulated that lights at offshore facilities such as Northstar may attract migrating birds that could then collide with struc-

tures (USACE, 1999).

A GTL development will involve a few structures that could add to this impact, and a gas pipeline would have compressor stations that could add to this impact. Public access would not add to this impact, while the NMDS may have structures that could add to this impact locally. Other industry activity could cause this impact depending on the types of facilities used.

The magnitude of this impact is low, the geographic scope moderate, and the frequency/duration low, for an overall intensity of low. The probability this impact will occur is moderate. The magnitude is low because a small number of birds are affected, while the geographic scope is moderate because the impact can occur at specific sites on the ANS, along TAPS, or at the VMT. The frequency/duration is low because it occurs infrequently.

Bio22. Increased predation on birds.

Predators such as gulls, ravens, foxes, and bears may be attracted to human activity because of access to garbage and other food. This could increase predation on birds (BLM and MMS, 1998). This impact was addressed for TAPS in Section 4.3.2.4, and was thought to be minor because of good garbage and food management at Alyeska facilities.

Increased predator populations due to access to human food has been a problem in the ANS oil fields. High predator populations in the ANS oil fields could also be due to natural factors such as high prey availability and natural den sites. Because of the availability of supplemental food at the North Slope Borough Landfill and in dumpsters throughout the ANS oil fields, populations of predators such as bears, foxes, gulls, and ravens have increased over the past three decades. Although there is no definite cause-effect relationship between human food and predator numbers, predators have adversely affected nesting success of ground-nesting birds, especially colonial nesting Snow Geese, and possibly some ducks and shorebirds. Recent improvements in garbage management and cessation of intentional feeding of predators should result in mitigation of this impact in present and future ANS oil fields.

A GTL project will likely have stringent garbage management at its few facilities and little to no impact. A gas pipeline could have an impact, especially if garbage and feeding at construction camps are not managed properly. Increased public access could increase this impact, although hunting and trapping of the predators could balance increases due to supplemental feeding. An NMDS and other industry could have an impact if anthropogenic foods are not managed properly.

The magnitude of this impact is moderate, the geographic scope is high, and the frequency/duration is high, for an overall intensity of high. The probability is moderate. The magnitude is moderate because increased predator numbers have affected bird populations in the ANS oil fields. The geographic scope is high because it may occur over the ANS and could occur with new gas development and increased public access. The frequency/duration is high because it has occurred over several years on the ANS.

Bio23. Injury or death of birds from oil, fuel, or chemical spills (Bio23A, large spills; Bio23B, small spills).

Oil spills have a potentially large impact on birds, particularly in marine environments, because spills may kill or injure birds or reduce forage species and contaminate habitat. This issue was addressed for the TAPS ROW in Section 4.3.2.4, and impacts were infrequent and of low magnitude. Likewise, for past ANS oil-field operations, oil spills have been small and site-specific, with little or no impact on birds. This includes the offshore developments at Endicott and numerous offshore exploration sites.

Present and future ANS oil-field development will include more offshore development with the potential for marine oil spills (USACE, 1999). Oil pipelines will be used for both the Northstar and Liberty developments in the Alaskan Beaufort Sea, and fuel barges are used for supply. Depending on the time of year and volume of an oil spill, either no birds or several thousand birds could be affected by a spill in the Beaufort Sea (USACE, 1999). Small, infrequent spills are more likely than large catastrophic spills. Small spills that are not contained on the facility pad could have site-specific impacts, and in such cases, few birds would likely be affected. Since most marine birds are absent for over half the year, the duration of impacts from a spill in the Beaufort Sea would be considerably less than in more southern latitudes where birds are present all year. However, oil may persist in the cold arctic environment longer than at warmer latitudes.

The *Exxon Valdez* oil spill in Prince William Sound in 1989 impacted many birds. Marine birds were killed and habitat was contaminated. Birds may die by ingesting oil from the water or from their feathers when they preen. They may also drown after losing buoyancy when their feathers become oil-soaked (reviewed in Rice et al., 1996; Wells et al., 1995). The experience with EVOS indicates that although many thousands of birds were killed and extensive bird habitat was contaminated, fewer long-term population-level impacts were detected than originally thought (Day, Murphy, et al., 1995; Wiens, 1996; Wiens et al., 1996). Today, several bird species have either recovered or are in the

process of recovering, and most habitats are recovered. According to EVOS Trustees, of the 10 bird species thought to have been affected by the EVOS, one has completely recovered (Bald Eagle), three are nearly recovered (Black Oystercatcher, Common Murre, Marbled Murrelet), and six are considered to have not yet recovered (Common Loon; Pelagic, Red-faced, and Double-crested cormorants; Harlequin Duck; and Pigeon Guillemot). For at least some species, such as Common Murres, factors other than EVOS — e.g., a wide-scale oceanographic regime shift — may be affecting recovery (Agler et al., 1999). For one species, the Kittlitz's Murrelet, not enough information is available to determine its present status.

Wiens et al. (1996) and others (Day et al., 1995; Wiens, 1995, 1996) who studied habitat use by seabirds documented that within two years of EVOS, the marine bird community showed few effects related to the spill. Initially, bird species that were most significantly affected by oiling were those that feed near or on shore, that either breed on the beach, or that winter or are full-year residents in the area. However, even those species showed little evidence of continuing impacts after mid-summer 1990 (Wiens et al., 1996, p. 838). The findings of Wiens et al. (1996), Wiens (1995, 1996), and Day, Murphy, et al. (1995) corroborate research by others (Harrison and Buck, 1967; Chabreck, 1973) which shows that avian communities often make rapid recoveries following oil spills.

Present and future oil transport through Prince William Sound is now safer than before EVOS because of the implementation of the SERVS vessel escort system. In addition, the use of double-hull tankers in the future will add further protection against spills.

A GTL project will add more volume of liquids through TAPS and more tanker trips through Prince William Sound, although the product is lighter and probably less persistent than crude oil. A gas pipeline will not add to this impact, with the exception of potential of LNG spills or accidents and fuel spills from tankers. Public access will not add to this impact unless small spills into rivers and lakes impact small numbers of birds. The NMDS has the potential for site-specific land spills of fuels, while other industry activity could result in fuel spills the extent of which is dependent on location and volume.

For a large spill (**Bio23A**), the magnitude of this impact is high, the geographic scope is high, and the frequency/duration is low, for an overall intensity of high. The probability of large oil spills impacting birds is low. The magnitude is high because population-level impacts may occur from large spills, although populations may recover. The geographic scope is high because of the potential for spills from the Beaufort Sea to Prince William Sound. The frequency/duration of large spills is low because they have been infrequent, and the implementation of the SERVS escort vessels and double-hull tankers will further reduce the probability of marine spills.

For small, operational spills (**Bio23B**) , the magnitude of impact is low, the geographic scope is low, and the frequency/duration is moderate, for an overall intensity of low. The probability of small oil spills impacting birds is low. The magnitude is low because of the small volumes involved, and the scope is low because such spills usually affect only a small area. The frequency/duration of small spills is moderate because they happen more frequently but are usually quickly cleaned up.

Bio24. Increase in bird hunting from increased access.

Increased access along the Dalton Highway in recent years may have resulted in increased harvests of some bird species. This impact was addressed in Section 4.3.2.4 for the TAPS ROW, and impacts are minor.

In the ANS oil fields, this impact does not occur because of the prohibition on hunting there. This will continue to be the case with present and future ANS oil fields and a GTL project. A gas pipeline and other industry activity may bring more workers to remote areas and could increase hunting pressure depending on location and extent of development. However, it is likely that firearms will be prohibited from gas-pipeline construction sites and facilities (as with Alyeska facilities today) and that hunting will be prohibited from the ROW of a gas pipeline, as with the TAPS ROW. Increased public access will result in the greatest impact through sport hunting, while an NMDS may bring more military personnel who hunt, although hunting may be prohibited on the military site. Industry does not control this impact, which is regulated by state and federal agencies.

The magnitude of this impact is low, the geographic scope is moderate, and the frequency/duration is moderate, for an overall intensity of moderate. There is a moderate probability this impact will occur. The magnitude is moderate because small numbers of birds are affected. The geographic scope is moderate because it is primarily along the TAPS ROW. The frequency/duration is moderate because of the intermittent nature of the impact.

Proposed Action: Terrestrial Mammals

By W. Ballard, M.A. Cronin, H. Whitlaw

Bio25. Obstruction of mammal movements by roads, pipelines, and facilities.

There have been concerns that road and pipeline construction, operation, and maintenance could interfere with the movement of caribou and other wildlife in the North Slope oil fields and along the TAPS ROW (FWS, 1970; BLM, 1972; USACE, 1999). As discussed in Section 4.3.2.5, TAPS has not seriously obstructed wildlife movements, although individual animals are sometimes deflected.

In the ANS oil fields, elevated pipelines and adjacent roads may impede caribou movements to some extent (Cronin et al., 1994). Single pipelines elevated >1.5 m adjacent to roads with low levels of vehicular traffic (<5 vehicles per hour) generally do not impede caribou movements (Cronin et al., 1994; Lawhead et al., 1993; Curatolo and Murphy, 1986; Smith and Cameron, 1985). Elevated pipelines and adjacent roads with moderate to heavy levels of vehicle traffic (>15 vehicles per hour) may impede caribou movements, although this depends on several factors (Lawhead, 1997; Johnson and Lawhead, 1989; Cronin et al., 1994). For example, caribou crossing success tends to increase with insect abundance and decrease with caribou group size (Pollard et al., 1996a; Cameron et al., 1995; Cronin et al., 1994; Johnson and Lawhead, 1989; Curatolo and Murphy, 1986; Smith and Cameron, 1985). Studies indicate that gravel ramps are not necessary to allow caribou movement through the oil fields (Cronin et al., 1994; Johnson and Lawhead, 1989). Cronin et al. (1994) concluded that neither elevated pipelines (<10 parallel pipes) nor roads alone posed significant barriers to the movements of caribou. New oil fields have lower road and pipeline densities than older oil fields, and nearly all pipelines are elevated >1.5 m (Cameron et al., 1995; Cronin et al., 1994). Therefore, although the early unelevated pipelines may block some caribou movements, recent mitigation measures (primarily elevating pipelines) have been effective in allowing movements of caribou (Lawhead, 1997; Cameron et al., 1995; Cronin et al., 1994).

Wildlife movements are not obstructed in the Prince William Sound area, except for possible interference of local movements of black bears by the VMT.

Present and future ANS oil-field development could cause some obstruction of movements, as in the existing oil fields. However, elevated pipelines and limited roads will limit this impact. A GTL development would have little or no impact because only a few new facilities would be built on the ANS and VMT. A natural gas pipeline would be buried and have no impact, except during construction. A new marine terminal and LNG plant at Anderson Bay on the south side of Port Valdez could create an additional obstruction to movements of terrestrial mammals in the vicinity. The NMDS would have very localized impacts in the area of development. Increased public access could result in more highway traffic and increased obstruction of wildlife movements. The impact from other industry activity depends on extent and locations.

The magnitude of this impact is low, the geographic scope moderate, and the frequency/duration moderate, for an overall intensity of moderate. The probability is moderate that roads and pipelines will obstruct wildlife movements. The magnitude is low because this impact has not affected population sizes or ranges, and mitigation measures limit the impact. The geographic scope is moderate because the impact is primarily in older oil fields of the ANS, and the frequency/duration is moderate because the impact occurs intermittently.

Bio26. Disturbance and displacement of large mammals by human activities.

There has been concern that operations in the ANS oil fields, along TAPS, and at the VMT could disturb and displace terrestrial mammals. This could include impacts from aircraft, ground vehicles, and other human activities (BLM and MMS, 1998; BLM, 1972, 1976; USACE, 1999; FWS, 1970; BLM and USACE, 1988). Disturbance by humans can elicit short-term impacts on individuals (Colescott and Gillingham, 1998; Andersen et al., 1996; Tyler, 1991; Horejsi, 1981), although there is evidence for habituation (Reynolds, 1998; Harting, 1987; Miller and Gunn, 1984). As discussed in Section 4.3.2.5, TAPS construction and operation have generally not caused any appreciable disturbance or displacement of wildlife.

Extensive assessments have been conducted on the impacts of the ANS oil fields on caribou (Ballard et al., 2000). Disturbance of other terrestrial mammal species in the oil fields has not been investigated as intensively, but is probably minor compared to that postulated for caribou. Most work has been on the distribution and behavior of caribou relative to infrastructure and human activity. Pre- and post-development data in the Milne Point and Kuparuk oil fields suggest that cow caribou with calves are sometimes displaced 1 to 6 kilometers (km) from oil-field roads with traffic during the calving period (Dau and Cameron, 1986b; Cameron et al., 1992; Cronin et al., 1994; Lawhead, 1988; Nellemann and Cameron, 1998, 1996). In addition, surveys in the 1990s found that the area of most concentrated calving (in both density and absolute numbers) by the western segment of the CAH has shifted south of the Kuparuk field since the late 1980s (Lawhead and Cameron, 1988; Lawhead and Johnson, 2000; Murphy and Lawhead, 2000). Some researchers have interpreted this shift as progressive

abandonment of the Milne Point and Kuparuk calving area (Nellemann and Cameron 1996, 1998). Displacement of caribou from the oil fields during the post-calving (July-August) period has also been suggested (Cameron et al., 1995). It also has been suggested that these impacts result in declines in nutritional status and productivity of caribou (Cameron 1995, Wolfe et al. 2000).

Despite this potential displacement, there is no evidence of impacts on the herd. Although there may be displacement of some calving caribou from roads with traffic, not all animals are so affected. Some cows with calves occur within 1 km of the roads, and many caribou return to the calving areas within the oil fields each year. In addition, calving-period surveys of the Milne Point oil field during the 1990s show displacement from roads in only some years (Olson and Noel, 2000). The combined data from all sources indicate that displacement of calving caribou from roads with traffic is not absolute in either space or time. During the post-calving season, caribou regularly occur in, and move through, the North Slope oil fields, and no displacement from infrastructure occurs (Pollard et al., 1996a; Cronin, Ballard, et al., 1998). In fact, oil-field infrastructure, including roads, gravel pads and buildings, are regularly used as insect-relief habitat (Pollard et al., 1996b; Noel et al., 1998). Most importantly, there is no evidence of adverse population-level effects, as the herd has grown during the period of oil-field development. There are no consistent differences in herd numbers or productivity indices in developed and undeveloped areas, and the ADF&G management objectives for the herd are being met (Cronin, Amstrup, et al., 1998; Cronin et al., 1997; Cronin et al., in press).

Besides ground facilities and operations, aircraft may disturb wildlife. The effects of aircraft overflights on wildlife vary among species, populations, environmental variables, and habitat types, and are dependent on flight altitude and aircraft type. Helicopters and low-flying jet aircraft are generally more disturbing to individuals than light fixed-wing aircraft (Maier et al., 1998; Côte, 1996; Bleich et al., 1994; McKechnie and Gladwin, 1993; Murphy et al., 1993; Harting, 1987; Davis et al., 1984; Miller and Gunn, 1984; Valkenburg and Davis, 1984; Fancy, 1982; also see Section 4.3.2.5). Some terrestrial mammals on the North Slope and along TAPS may be habituated to aircraft disturbance (McLaren and Green, 1985; Davis et al., 1984; Miller and Gunn, 1984; Valkenburg and Davis, 1984). Some individuals of most terrestrial mammal species on the North Slope are likely to have short-term responses to aircraft disturbance, but mitigation in the form of flight altitude-limits reduces impacts. Avoidance of seasonally sensitive areas (e.g., muskoxen calving areas on the Arctic Coastal Plain during April to mid-June) also reduces adverse effects (Reynolds, 1998).

Present and future North Slope oil-field development may add a degree of disturbance and displacement during the calving period, as in the existing oil fields. However, mitigation such as restricting timing of activity and locating facilities away from calving areas can minimize the impacts. A GTL development would have little impact because only a few new facilities would be built on the ANS and VMT. A natural gas pipeline would be buried and would have no impact, except during the construction phase. The NMDS would have very localized impacts in the area of development. Increased public access could result in more highway traffic and increased disturbance of wildlife. Year-round human presence (recreational vehicles, ATVs, and snowmachines) along the TAPS ROW will cause noise which could disturb wildlife. However, wildlife observations collected during Alyeska Security flights indicate the year-round presence of terrestrial mammals in the vicinity of the ROW. The future impacts from public use of the ROW and nearby areas depend on the nature and extent of use. The impact from other industry activity depends on the extent and location of development.

The magnitude of this impact is low, the geographic scope high, and duration/frequency moderate, giving an overall intensity of moderate. The probability of this impact is moderate. The magnitude is low because the only change to a population has been a possible shift of a portion of the calving range of the Central Arctic caribou herd (the majority of the original range is still used by numerous caribou). No population-level changes are anticipated from future impacts. The geographic scope is high because impacts may occur along the TAPS ROW from public access, with gas pipeline construction, and in new ANS oil fields, although mitigation should minimize the extent. The frequency/duration is moderate because the impact in the ANS oil fields is for only a few weeks during calving and in other areas will be intermittent.

Bio27. Reduced habitat quality for terrestrial mammals caused by fragmentation and alteration of habitat.

There has been concern that pipeline and oil-field development may alter and fragment wildlife habitats (USACE, 1984). This was discussed for the TAPS ROW in Section 4.3.2.5, and no substantive impacts are expected.

Regarding past oil-field operations on the ANS, this impact is related to those of obstructions to movement, and disturbance and displacement (Bio25 and Bio26). It has been suggested that oil-field development has fragmented

calving habitat in the ANS oil fields, resulting in the loss of some areas and overuse in others (Nellemann and Cameron, 1996; Cameron et al., 1992). Nellemann and Cameron (1996) concluded that this resulted in the overuse of forage. Nellemann and Cameron (1998) further concluded that reductions in foraging habitats during calving might explain a southwesterly shift in calving activity. Reduced availability of forage could reduce productivity and energetically stress female caribou entering the winter (Whitten and Cameron, 1985; Cameron et al., 1992; Nellemann and Cameron, 1998).

As described previously, there is no evidence of adverse population-level effects, as the Central Arctic Herd has grown during the period of oil-field development and there are no consistent differences in herd numbers or productivity indices in developed and undeveloped areas (Cronin, Ballard, et al., 1998; Cronin et al., 1997; Cronin et al., in press). The scientific literature on ungulates suggests that population density and animal movements are more likely to affect a caribou herd than oil-field infrastructure and operations (Cronin et al., 1997; Cronin et al., in press).

It is also apparent that caribou use the ANS oil-field infrastructure (including gravel pads, roads, and buildings) as insect-relief habitat (Noel et al., 1998; Pollard et al., 1996a, b; Lawhead et al., 1993). In this case, habitats have been enhanced.

Other terrestrial wildlife populations such as grizzly bears, muskoxen, and foxes have also increased during oil-field development. This is not due to habitat alteration, but probably due to protection from hunting and access to anthropogenic food sources.

Present and future North Slope oil-field development may add a degree of habitat alteration for caribou, as in the existing oil fields. However, the decreasing size of developments' footprint will result in small amounts of affected habitats. A GTL development would have little impact because only a few new facilities would be built on the ANS and at the VMT. A natural gas pipeline would be buried and would have no impact, except during construction. A new marine terminal and LNG plant at Anderson Bay on the south side of Port Valdez would change some habitats locally. The NMDS would have localized impacts as well. Increased public access would not alter habitats appreciably. The impact from other industry activity depends on extent and locations.

The magnitude of this impact is low, the geographic scope high, and duration/frequency moderate, for an overall intensity of moderate. The probability of this impact is moderate. The magnitude is low because there have been no population-level changes. The geographic scope is high because habitats could be altered along TAPS and across the ANS. The frequency/duration is moderate because the impact occurs seasonally and infrequently.

Bio28. Mortality of terrestrial mammals from highway vehicle roadkills.

Improved access and increased traffic via the Dalton Highway and other roads may result in increased road kills. This impact was addressed for the TAPS ROW in Section 4.3.2.5. There are some roadkills associated with TAPS, but they are infrequent compared to those in other parts of Alaska. In 1996, the Alaska Department of Transportation (ADOT) reported that highway segments with the most moose/vehicle accidents were near cities and towns. No highway segments with high vehicle/moose accidents were on the Richardson or Dalton Highways (ADOT, 1996).

Roadkills have not been a problem in the ANS oil fields, although there may be occasional mortalities of caribou or bears. The same trend is likely with present and future ANS oil-field developments and a GTL project. A gas pipeline may increase traffic on highways, particularly during construction. This is unlikely to impact large numbers of animals. Increased public access may increase the numbers of roadkills from Valdez to the ANS, while the NMDS is unlikely to have an impact. Other industry activity may cause roadkills, depending on the location and extent of developments.

The magnitude of this impact is low, the geographic scope high, and the frequency/duration low, for an overall intensity of moderate. There is a high probability that this impact will occur to some extent. The magnitude is low because of the small numbers of animals affected. The geographic scope is high because it occurs from Valdez to the ANS. The frequency/duration is low because of the infrequent occurrence of roadkills.

Bio29. Effects on predators from anthropogenic food sources and habitat enhancement.

Improper garbage disposal and food availability may attract wildlife, especially bears and foxes, and could result in mortality of the animals. The intentional feeding of wildlife, and the use of anthropogenic food sources (i.e., garbage) was a problem during TAPS construction, and some bears were killed in the vicinity of the TAPS ROW between 1971 and 1979 (Follmann and Hechtel, 1990). As discussed in Section 4.3.2.5 the general consensus among biologists is that animal feeding and garbage management by Alyeska personnel are no longer problems within the TAPS ROW. However, increasing recreational use of remote areas along the TAPS ROW and the ANS may cause an impact

(McCarthy and Seavoy, 1994; Follmann and Hechtel, 1990; Miller and Chihuly, 1987; Milke, 1977; see Section 4.3.2.5). Bears may occur around the VMT and access anthropogenic food from public sources in Valdez.

In the ANS oil fields, use of anthropogenic food by bears is problematic (Shideler and Hechtel, 2000). Bears with access to anthropogenic food in oil fields (primarily garbage in dumpsters and the landfill) have high cub survival in relation to other Arctic Coastal Plain bear populations. The anthropogenic food sources may be beneficial to the population in terms of increasing productivity. However, these benefits are offset by relatively high subadult and adult mortality (Shideler and Hechtel, 2000). Of 10 deaths reported from the ANS, only one was killed by a vehicle collision in the oil fields (Shideler and Hechtel, 2000). Two bears died of apparent natural causes, and the remaining 7 were legally harvested or killed in defense of life and property outside the oil fields. Shideler and Hechtel (2000) suggest that bears which had become habituated to the presence of humans in the oil fields were more vulnerable to being killed by humans when they moved out of the oil fields.

Arctic foxes also access garbage, use facilities for den sites, and may have increased in numbers in the ANS oil fields. Disease outbreaks, including rabies, may occur as the population density of foxes increases. Ninety-nine arctic foxes were killed for scientific purposes (i.e., disease testing) during winter 1994 as a result of an attack on two oil-field workers by a rabid arctic fox (Ballard et al., 2000). Rabies was detected in one fox, and exposure to rabies without active infection in four others.

In addition to affecting the predators themselves, the increased predator populations resulting from access to anthropogenic foods may negatively affect bird and mammal prey populations. As discussed in **Bio22**, fox and bear predation on Snow Geese on the ANS occurred several times in the 1990s. It is also possible that bears may prey on caribou calves in the oil fields.

It is important to note that management practices, including fencing the landfill, use of bear-proof dumpsters, strict prohibition of wildlife feeding, and worker education have reduced this impact on the ANS over the last few years. This impact will decline in the future because present and future ANS oil-field operations will have strict prohibitions of feeding wildlife and will have procedures to limit wildlife access to garbage. A GTL project will be managed according to ANS oil field or VMT regulations with minimal impact. A gas pipeline could have impacts during construction and operations, but will also be managed to minimize wildlife access to anthropogenic foods. Increased public access in the TAPS ROW may allow predators access to anthropogenic foods, with associated increases in populations and increases in hunting mortality. This may be mitigated by public information programs. The NMDS could have an impact, although garbage and feeding management, as with the oil-industry projects, should be enacted. The impact from other industry activity depends on extent, locations and extent of regulation.

The magnitude of this impact is moderate, the geographic scope high, and the frequency/duration high, for an overall intensity of high. The moderate magnitude is due to potential changes in numbers of animals. The high geographic scope is because it may occur on the ANS, TAPS ROW, and at the VMT. The high frequency/duration is because it has occurred regularly. There is a moderate probability that this impact will occur to some extent.

Bio30. Mortality, injury, or disturbance of terrestrial mammals from oil, fuel, or chemical spills.

It is thought that oil and fuel spills from onshore and offshore activities and marine transportation could result in mortality of small numbers of terrestrial animals (USACE, 1999). Cleanup activity could also disturb and displace animals, and change habitats.

There are no data to suggest that oil spills have killed or otherwise impacted terrestrial mammals on the ANS or TAPS ROW. Cleanup of land spills could cause some disturbance and destroy vegetation in the affected area, but this has not occurred to any extent in the past.

The large oil spill from the *Exxon Valdez* in Prince William Sound may have affected some terrestrial mammals. The major cleanup effort for EVOS undoubtedly disturbed terrestrial mammals to some extent. There is no evidence that cleanup activities and the associated human presence for EVOS or other cleanups have adversely affected terrestrial mammal populations. The only terrestrial mammal species of concern during the restoration effort was the river otter, which uses coastal habitats that may have been oiled. There is some evidence of exposure to oil (Duffy et al. 1996), but river otters are now considered recovered from the spill. No other evidence exists that EVOS or other spills in Alaska have adversely affected terrestrial mammal populations.

A GTL project could increase the risk of a spill by virtue of the additional volume of liquids being transported by TAPS and in tankers. However, the GTL product is more volatile and less persistent than crude oil. A gas pipeline will have minimal impact, largely confined to small spills of refined products during construction and operation of the pipeline and facilities. Present and future ANS oil-field

development could include land spills from ANS pipelines, but impacts on terrestrial mammals will be minimal. Increased public access, the NMDS, and other industry activity should have little or no impact.

The magnitude of this impact is low, the geographic scope high, and the frequency/duration low, for an overall intensity of low. The probability of this impact is low. The magnitude is low because of the small numbers of animals that would be affected. The geographic scope is high because spills may occur in the ANS, TAPS ROW, or Prince William Sound. Based on the impact of past spills on terrestrial mammals, the frequency and duration are low. Based on the low frequency of past oil spills and the prevention measures implemented since EVOS, the probability is low that future spills will impact terrestrial mammals.

Bio31. Increased hunting of terrestrial wildlife from increased access.

Increased access to, and human presence in, remote areas will increase hunting and trapping pressure that may impact wildlife populations (BLM, 1976). This impact was discussed for the TAPS ROW in Section 4.3.2.5. In general, adaptive management in response to increased hunting and trapping has minimized the population-level impacts along the TAPS ROW.

Hunting is not allowed in the ANS oil fields, although access to adjacent areas from the Dalton Highway and the Deadhorse airport has increased pressure on wildlife populations. Game harvests have increased in Game Management Unit 26 (Arctic Coastal Plain); however, ADF&G management objectives are being met for most populations, and bag limits and seasons have been adjusted to allow for maximum sport-harvest opportunities without adversely affecting populations. This impact is regulated by the state and federal agencies, and is not under the control of industry. Smith (1999) concluded that although use of the Dalton Highway Corridor Management Area has increased since 1991, populations of moose, caribou, brown bears, and wolves have not been adversely affected. Hunting has not reduced populations below management objectives.

Present and future ANS oil-field development and a GTL project will not increase this impact. A gas pipeline may increase access to remote areas and increase harvests, particularly during construction. The NMDS and other industry activity may also increase the numbers of hunters in remote areas.

The magnitude of this impact is moderate, the geographic scope high, and the frequency/duration high, for an overall intensity of high. The probability that this impact will occur is high. The magnitude is moderate because hunting pressure can change a population size. The geographic scope is high because the impact occurs from the ANS to Prince William Sound. The frequency/duration is high because the impact occurs every year.

Proposed Action: Marine Mammals

By R.G.B. Senner and J. Burns

The potential for cumulative effects on marine mammals is a concern in both the Beaufort Sea and Prince William Sound. There are no marine mammals along the TAPS ROW itself, but the ANS oil-field developments and tanker traffic in Prince William Sound could affect these species. Marine mammals in these areas are described in Section 3.2.7.5.

The central Alaskan Beaufort Sea supports the bowhead whale, the belukha whale, and several species of seals, all of which are important subsistence resources for the Iñupiat people. In addition, polar bears range widely on the drifting ice pack, and pregnant females den on sea ice or sometimes along snow-laden coastal river terraces or stream banks from late October or November until late March or early April. Marine mammal populations in Prince William Sound include a diversity of cetaceans (whales, porpoises, dolphins), pinnipeds (seals and the Steller sea lion), and the sea otter. All marine mammals, including polar bears, are protected under the Marine Mammal Protection Act of 1972, and any activity that might disturb them requires a federal permit. The bowhead whale, humpback whale, and Steller sea lion are listed as endangered and federally protected under the Endangered Species Act of 1973.

There are two basic ways in which the proposed action could affect marine mammals: disturbance and displacement, and oil spills. In the Beaufort Sea, petroleum exploration and production activities have the potential to disturb migrating bowhead whales and belukhas in the spring and fall, and ringed seals that pup on shorefast ice near Prudhoe Bay. Female polar bears and cubs in maternity dens can be similarly disturbed. In Prince William Sound, the primary concern relates to potential oil or fuel spills, but noise produced by vessel traffic, including tankers and cruise ships, can also disturb marine mammals. Both types of disturbance have received increasing attention because of the *Exxon Valdez* oil spill and because some Alaskan marine-mammal populations (including the Steller sea lion and the harbor seal) have declined since the mid-1970s.

Bio32. Disturbance and displacement of marine mammals by petroleum-related operations.

Arctic oil and gas exploration and production, including

the outer continental shelf of the Beaufort Sea, have occurred and would continue with the proposed action. There is a potential for marine mammals — including endangered bowhead whales, seals, and polar bears — to be disturbed and/or displaced by noise and movement from seismic exploration, vessel traffic, low-flying aircraft, and construction of causeways, artificial islands, and undersea pipelines. All such activities are regulated by the U.S. Minerals Management Service, the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, and the Alaska Department of Fish and Game. Regulations require avoidance of sensitive periods such as the autumn bowhead-whale migration and sensitive locations such as known polar-bear maternity dens. Bowhead whales have not been present in nearshore waters of the Alaskan Beaufort Sea where petroleum exploration has been conducted during the winter, spring, and summer. Activities such as seismic exploration, module transport, and artificial-island construction are conducted in the nearshore Beaufort Sea when whales are not present. Long-term monitoring and research have allowed for design of mitigation of these impacts. On-ice seismic exploration has locally displaced individual ringed seals in winter and during the spring molting season (Frost and Lowry, 1988; Link et al., 1999; Lawson and Williams, 1999). Agencies and industry monitor the locations of ringed-seal breathing holes and subnivean lairs during activities conducted on sea ice so that these locations can be avoided. Information on potential noise effects on seals during open-water periods has not been systematically collected, but there is no evidence that seals have experienced population-level effects as a result of industrial activity in the Alaskan Beaufort Sea.

Noise from tanker traffic and other vessels could disturb and displace marine mammals in Prince William Sound. Marine mammals, including killer whales, seals, the Steller sea lion, and sea otters, are known to react in various ways to moving vessels. There is evidence that killer whales use calls, passive listening, and echolocation to communicate with one another and to locate prey (Ford, 1989; Saulitis, 1993). Vessel noise could interfere with normal sound transmission and reception, thus disrupting social communication and foraging (Ford et al., 1994). It has been suggested that noise and other disturbance from increased vessel activity associated with EVOS cleanup activities led to avoidance of some usual foraging areas by killer whales (Saulitis, 1993). In a review of reports on whale/vessel interactions, Richardson, Greene, et al. (1995) concluded that reactions to vessels vary among individual whales of the same species and that vessels in some cases caused temporary avoidance and displacement, but that long-term avoidance of specific areas was not indicated by evidence.

Anthony (1995) documented short-term behavioral reactions by sea otters to vessel traffic in Port Valdez. These responses, which variously included avoidance, attraction, flight, cessation of previous activity, and assumption of alert posture, lasted for a few minutes, after which otters typically resumed their previous activity. The frequency of otter responses to vessels increased with vessel size and proximity; most responses occurred less than 50 m from vessels and in reaction to vessels greater than 30 m in length. Only about one-third of the encounters of sea otters with vessels elicited a response, and otters did not avoid the tanker lane or VMT vicinity.

Vessel noise from crude oil tankers transiting Prince William Sound would continue under the proposed action, and GTL or LNG development would increase tanker traffic. Increased public access, including tour ships and recreational boats, would add to the traffic. Present and future offshore operations in the Beaufort Sea will include vessel traffic, open-water and on-ice seismic exploration, exploratory drilling, and construction of islands, facilities, and subsea pipelines. Regulation and mitigation can minimize impacts from these actions. The development of a gas (not LNG) pipeline and the NMDS would have no impact. Other industry could have impacts if it occurs in the offshore area or involves marine vessel traffic.

The magnitude of this impact is low, the geographic scope high, the frequency/duration moderate, for an overall intensity of moderate. The probability of this impact is moderate. The magnitude is low because available evidence suggests impacts would be limited to transient responses by individual animals and would not alter populations. The geographic scope is high, because the impact could occur throughout tanker lanes in Prince William Sound or in the Beaufort Sea. The frequency/duration is moderate because of the intermittent nature of the impacts. The probability this impact will occur is moderate.

Bio33. Mortality, injury, disturbance, or alteration of habitats for marine mammals from oil, fuel, or chemical spills (Bio33A, large spills; Bio33B, small spills).

Under the proposed action, the marine transport of crude oil from the VMT through Prince William Sound would continue. Offshore exploration and production will also continue in the Beaufort Sea. There is the potential for large or small crude oil or fuel spills in both regions.

Oil spills can kill or injure marine mammals through the inhalation and ingestion of hydrocarbons and through the fouling of fur and skin, resulting in acute toxicity, hypothermia, and loss of buoyancy. Chronic toxicity can result

from sublethal exposure to hydrocarbons from spills, ballast water releases, and contaminated prey animals in the food chain.

Oil spills have not impacted marine mammals in the Beaufort Sea. Small spills during exploration operations have occurred, but none have been of enough magnitude to be of concern. The large *Exxon Valdez* oil spill resulted in considerable mortality of sea otters, seals, and possibly other species in Prince William Sound (Wells et al. 1995; Rice et al. 1996). Estimates of the numbers of seals and sea otters killed by EVOS vary, but there is general agreement that many seals were exposed to oil (Lowry et al., 1994), and that a substantial portion of the sea otter population was killed. There is also agreement that seals and sea otters exhibited short-term avoidance of spill cleanup activities. The overall Prince William Sound sea otter population has recovered from the spill, although there may be local areas with lingering effects. The sea otters in Prince William Sound are also impacted by subsistence harvest and killer whale predation (see Table 4.3-12). There is speculation that killer whales died as a result of EVOS because 14 whales were missing from one pod after the spill. However, five other pods that were observed in heavily oiled water did not suffer losses (Dahlheim and Matkin, 1994).

Present and future ANS offshore operations may result in spills of crude or refined oil into the Beaufort Sea which could impact marine mammals. A large crude-oil spill could also occur from a tanker in Prince William Sound. However, preventive measures now in effect as a result of the Oil Pollution Act of 1990 (OPA 90) and independent actions by Alyeska have reduced the probability of a large marine spill. These measures include the SERVS vessel escort system, improved response capabilities, and future use of double-hull tankers. Spills of refined fuel from commercial shipping, gas commercialization, marine transportation of petroleum products, or tour ships could also occur.

The impact of a spill would depend on the quantity of fuel, location, and time of year. A GTL development would use tankers as in the current crude oil operations and increase the volumes of hydrocarbons transported by tankers. The GTL product is lighter and more volatile than crude oil and would likely have less impact on most organisms. A gas pipeline would not impact marine mammals if it stayed on land. For an LNG operation in Valdez, tanker traffic would increase, but only the ships' fuel would pose a spill threat. LNG poses potential danger from explosion, but not the physical oiling threat that crude or fuel oil poses. Increased public access into Prince William Sound could increase the numbers of small fuel spills, but impacts on marine mammals would be small. The NMDS would have no impact. Other industry activities could increase the potential for fuel spills if they were near the marine environment.

For large spills (**Bio33A**), the magnitude of this impact is high, the geographic scope is high, and the frequency/duration is low, for an overall intensity of high. The probability of this impact is low. This is particularly true with the new spill prevention measures in Prince William Sound, and the careful design and regulation in the Beaufort Sea. The magnitude is high because a large marine spill could substantially change a marine-mammal population size. The geographic scope is high because there is the potential for spills in the Beaufort Sea or Prince William Sound, while the frequency/duration is low because large spills occur infrequently.

For small, operational spills (**Bio33B**), the magnitude of impact is low, the geographic scope is low, and the frequency/duration is low, for an overall intensity of low. The probability of small oil spills impacting marine mammals is low. The magnitude is low because of the small volumes involved, and the scope is low because such spills usually affect only a small area. The frequency/duration of small marine spills is low because they happen infrequently and are usually quickly removed.

Proposed Action: Threatened and Endangered Species

By S.R. Johnson and M.A. Cronin

Bio34. Collisions of eiders with onshore or offshore structures.

After breeding, Spectacled Eiders move to the nearshore Beaufort Sea before starting migration during late summer (Petersen et al., 1999). Construction and operations both offshore and onshore could involve the use of cranes and other tall structures with which flying birds could collide at night or in fog. Bird collisions have been documented intermittently at other tall structures on the North Slope, such as the seawater treatment plant on West Dock. The placement of strobe lights on tall structures has been shown to reduce bird collisions. Typically, only a few birds are involved in collision incidents, mainly during spring and fall migration. As future oil and gas development occurs on the North Slope, more tall structures are likely to be constructed and some bird collisions may occur. The probability of future bird collisions with tall structures (buildings, equipment, powerlines) depends on whether mitigation measures (low profile of new structures, strobe lights) are effective. The impacts will be site-specific, infrequent in nature, and involve very few birds. Other future operations

in areas other than the ANS will not have an impact.

The magnitude of this impact is low, the geographic scope low, and frequency/duration low, for an overall intensity of low. The probability of this impact is low. The magnitude is low because only a few birds are impacted. The geographic scope is low because the impact is limited to a few sites in offshore ANS areas, and the frequency/duration is low because the impact occurs infrequently.

Bio35. Disturbance of Spectacled and Steller's eiders on the North Slope from noise and activities from oil-field operations.

Some oil-field facilities, such as gas compressor stations (e.g., GHX-1), produce loud noises that have disturbed and displaced a few non-breeding Spectacled Eiders (Anderson et al., 1995). Other activities in oil fields, especially those that involve humans in close proximity to nests or broods, may disturb and displace Spectacled and Steller's eiders. The few documented disturbances and displacements have been site-specific and intermittent (Anderson et al., 1995) and in some cases have resulted in positive impacts (Warnock and Troy, 1992). Future oil and gas development on the North Slope will result in more facilities producing loud noises and more human activity that could disturb and displace eiders. However, monitoring and mitigation for eiders accompany new developments and will minimize impacts.

The magnitude of this impact is low, the geographic scope is low, and the frequency/duration is moderate, for an overall intensity of low. The probability of this impact is moderate. The magnitude is low because a small number of birds will be impacted. The geographic scope is low because the impact is limited to specific sites on the ANS. The frequency/duration is moderate because the impact would occur intermittently.

Proposed Action: Biological Cumulative Effects Summary

In summary, two potential biological cumulative impacts met the significance criteria of high intensity and high probability: Bio13, Impacts on fish populations from recreational fishing, and Bio31, Impacts on terrestrial mammal populations from increased hunting. Both impacts can be mitigated by regulation and enforcement by the appropriate agencies. Note, however, that other impacts could be biologically significant, depending on chance events (e.g., oil spills) or mitigation (e.g., maintenance of low water crossings). This approach acknowledges that all of the impacts identified in this report could occur. In many cases, preventive or mitigation measures will minimize impact.

4.5.3.3 Proposed Action: Social Resources

By L.D. Maxim, O.S. Goldsmith, M. Galginaitis, C. Gerlach, P. Bowers, C. Wooley, R. Niebo

This section addresses the potential cumulative effects of the proposed action with respect to economics, sociocultural features, and subsistence. This analysis considers the effects of the renewal of the TAPS ROW along with the continued operation of the ANS oil fields, the VMT, and the associated marine transportation link. These facilities were treated as a group in the economic analysis, because the econometric models employed for prediction of these effects were linked, and it was not feasible to undertake this analysis on a facility-by-facility basis. Because the economic effects of the proposed and no-action alternatives were assessed using an integrated state economic model, the discussion contained in Sections 4.3 and 4.4 covers cumulative effects and only a summary of these findings is presented here.[7]

Other reasonably foreseeable petroleum-related activities that could interact with the alternatives to produce cumulative effects are discussed briefly in Section 4.5.2. The starting point for this analysis was an inventory of the potential direct and indirect effects presented in Sections 4.3.3 and 4.4.3, respectively. These issues were distilled from pertinent EISs, other published literature, and interviews. These were compared with the numerous impact issues predicted for other past, present, and reasonably foreseeable future actions tabulated from the EISs, EAs, environmental reports, and other relevant documents. Using the screening criteria shown in Table 4.5-12, the potential for cumulative effects was assessed in qualitative terms. Many issues were deleted, whereas others were retained for more detailed description and analysis. This section provides a summary of potentially important effects, with abbreviated discussions of others.

Potential cumulative effects were grouped into six broad effects categories (Table 4.5-13 and Figure 4.5-8):

- **Economic:** Many of the potential effects and issues are fundamentally economic. These include revenues derived from oil and gas operations in Alaska, direct and indirect employment, personal income, and other fiscal effects of oil and gas development and other actions. Consolidated economic issues are relevant in several contexts, including effects on the national as

[7]The economic analysis in Sections 4.3 and 4.4 does not consider the economic impacts of possible projects to commercialize natural gas produced on the North Slope (discussed in this section). Therefore, the incremental economic effects of these projects should be added to those estimated in Sections 4.3 and 4.4.

well as state and local economies.

- **Social Change:** Other issues are usefully grouped under the heading of *social change*. Industrial development, among other factors, helps to create and/or accelerate social changes, particularly in areas previously insulated from the modern industrial economy. For example, an influx of new workers, who may bring with them different lifestyles and customs, is one manifestation of social change. New entrants contribute to the demand for housing and various government services and may place strains on limited infrastructure. Also, large income changes resulting from oil and gas employment and/or revenues (an economic effect) may also hasten the process of social change — with both beneficial and adverse consequences. Wage and salary employment for Alaska Natives — an issue itself in terms of employment opportunities or lack thereof in the oil and gas industry — may contribute to social change and can have complex effects on subsistence. Social changes brought about by wage and salary employment, availability of advanced communications (e.g., telephones, television, radio, the Internet), and other elements of modern industrial society can make it more difficult for Alaska Native individuals and communities to retain their traditional culture and language.
- **Subsistence:** The choice of a traditional lifestyle based on the skillful harvesting and use of wildlife, fish, and plant resources is essential to many Alaskans. Subsistence harvesting is important in economic terms alone (Section 3.3). However, subsistence has even more important cultural and social dimensions. Adverse effects on subsistence may occur from oil spills, access limits resulting from oil and

Table 4.5-12. *Criteria for ranking potential cumulative effects on social resources.*

	High	Moderate	Low
INTENSITY	*Evaluated in the context of magnitude, geographic scope, and frequency/duration, using the criteria defined below.*		
Magnitude: *Visual/Recreational*	Visual/recreational effects are termed high if degraded to a point that resources could no longer be used for recreational purposes and/or the visible landscape(s) were altered for many years. One or more large-volume oil spills in the same geographic area could have this potential.	Visual/recreational effects are termed moderate if the affected areas could still be used for the intended purposes, albeit with some loss of value(s). Significant, but time-limited effects (e.g., those occurring from an isolated large oil spill) are included in this category.	Visual/recreational effects are termed low if these do not attain the threshold for moderate.
Magnitude: *Land-Use and Related*	Land-use effects would be high if widespread and significant effects on planned land use would occur, leading to an irretrievable (or at least very long-term) commitment of resources inconsistent with other possible uses. Land-use effects from creation of the TAPS pipeline route would be termed high. However, construction of a natural gas pipeline is moderate, even though the area affected is comparable, because of the pre-existence of TAPS. Potential destruction of many cultural sites would also be termed high.	Effects on land use are termed moderate if effects entail an irretrievable (or at least long-term) commitment of resources, but are not large in extent or not novel (e.g., construction of a pipeline in a pre-existing utility or transportation corridor).	Effects on land use are termed low if they do not reach the threshold for moderate.
Geographic Scope	The effect would occur at the national and/or state level.	The effect would occur primarily within one of the major study areas (Alaska North Slope, Central TAPS, or Valdez/PWS).	The effect would be site-specific at a few locations.
Frequency & Duration	The effect would be nearly continuous and last more than 10 years.	The effect would occur intermittently and/or last longer than 2 years but less than 10 years.	The effect would occur infrequently and last less than or equal to 2 years.
PROBABILITY	*Evaluated in the context of professional judgment and statistical or econometric analysis.*		

SOCIAL RESOURCES CUMULATIVE EFFECTS SUMMARY: PROPOSED ACTION

POTENTIAL EFFECT	PROPOSED ACTION	GAS COMMERCIALIZATION (GTL, LNG, Gas Pipeline)	NORTH SLOPE OIL FIELDS AND ANS TANKER TRADE (Past, Present, Future Development)	PUBLIC ACCESS	MILITARY (NMDS)	OTHER INDUSTRY	Intensity Factors			Ranking	
							Mag	Geo	Freq/ Dur	Int	Prob
ECONOMIC											
Soc 1 National economic effects.	The proposed action does not generate national-level economic benefits by itself but rather enables continued operation of the ANS fields.	All gas commercialization options will have beneficial economic effects at the national level. Revenues to the federal government include royalties, lease bonuses, and federal income taxes. Revenues depend on the scale of operations, gas transportation costs, wellhead prices, lease rates, royalty rates, tax rates, and before tax profits. All options increase domestic energy self-sufficiency and reduce the trade deficit in energy. The scale of either the LNG or gas export pipeline alternative is about twice that for the GTL option.	ANS oil and gas operations and the pipeline have contributed approximately $40 billion in revenues to the federal government. This production accounts for approximately 20% of domestically produced petroleum. Based on economic projections, ANS will contribute a further $10.8 billion (1998 $) in revenues during the renewal period.	No impact.	Deployment of limited ABM system believed to have national security benefits.	No impact.	H	H	H	H	H
Soc 2 State economic effects.	Economic effects associated with TAPS include contributions to gross state product (GSP), direct and indirect economic benefits associated with purchases, and certain taxes.*	All gas commercialization options will have beneficial economic effects at the state and local levels. Revenues to the state government include royalties, severance taxes, and state income taxes. Revenues depend on the scale of operations, gas transportation costs, wellhead prices, royalty rates, severance tax rates, and before tax profits. To various degrees, all options contribute to local property tax revenues. The scale of either the LNG or gas export pipeline alternative is about twice that for the GTL option.	ANS production has contributed approximately $51 billion in revenues to the state. Continued operation of the ANS oil fields, TAPS, and the marine transportation system is expected to generate $14.2 billion (1998 $) in state revenues during the renewal period. Revenues to state are used for a wide variety of beneficial purposes.	No impact.	Economic effects positive, but of much less significance than oil and gas development.	No impact.	H	H	H	H	H
Soc 3 Local government economic effects.	Continued operation of TAPS will generate income for local communities in Alaska in the form of property taxes.	To various degrees, all gas commercialization options contribute to local government revenues. For example, property taxes would be paid on permanent facilities. Property taxes for the export pipeline option depend on the specific route.	ANS production has contributed $4.4 billion in revenues to local governments and is projected to contribute another $2.2 billion during the renewal period.	No impact.	Economic benefits (e.g., construction activity and local payroll) could partially compensate for closure of other facilities at Fort Greely.	No impact.	H	M	H	H	H
Soc 4 Employment effects.	TAPS will continue to provide jobs in Alaska.	Both construction and operation and maintenance jobs would be created. Employment effects would be largest for the LNG option, because of facilities to be located in Valdez. Employment effects for the gas export pipeline depend on the route chosen. Employment effects for the GTL option are not likely to be substantial. The number of jobs created varies with the option.	Total employment, wage and salary employment, and real per-capita income will increase over the ROW renewal period as a result of continued operation of TAPS and associated ANS fields.	No impact.	Construction would require an average of 300 workers for 5 years. Operations would entail 360 direct and 108 indirect jobs.	No impact.	M	M	H	M	H
SOCIAL CHANGE											
Soc 5 Social change effects.	The proposed action will result in a modest decline in direct pipeline employment (operations and oversight) from approximately 2,600 at present to 1,800 in 2015.	All gas commercialization options entail some construction activity. The specific increment depends on the option selected and other factors (e.g., pipeline route). However, the influx of construction workers is likely to be smaller than for construction of TAPS. For example, the peak annual average construction employment for TAPS was 22,000, compared to a projected peak of 7,200 for TAGS.	The combined effects of the ANS fields, pipeline, VMT, and marine transportation segment on employment have been substantial. If the ROW is renewed, the continued operation of these facilities will result in only a very small increment in workforce. (There would be additional workers for one or more of the gas commercialization options were selected.) Cumulative effects associated with the proposed action are only one of many causes of social change.	No impact.	Construction of the NMDS facility will necessitate a small, temporary influx of workers.	No impact.	H	M	H	H	H
Soc 6 Job opportunities for Alaska Natives.	Alyeska's Native hire programs under the Alaska Native Utilization Agreement will continue under the proposed action.	Specific estimates of Alaska Native hire are not available for these options. However, all options will create additional jobs.	Operation of ANS fields past 2004 will ensure that employment opportunities for Alaska Natives in the oil and gas industry continue to exist.	No impact.	No impact.	No impact.	M	M	H	M	H
Soc 7 Income potentially affecting social problems.	The proposed action will have only modest effects on personal income.	Gas commercialization would have incremental effects on personal income. However, the linkage between income and social problems is not clear. Increased income provides resources for social programs.	Revenues to state and local governments from ANS developments have supported a variety of beneficial social programs. The North Slope Borough undertakes a variety of beneficial social programs.	No impact.	No impact.	No impact.	M	M	H	M	H

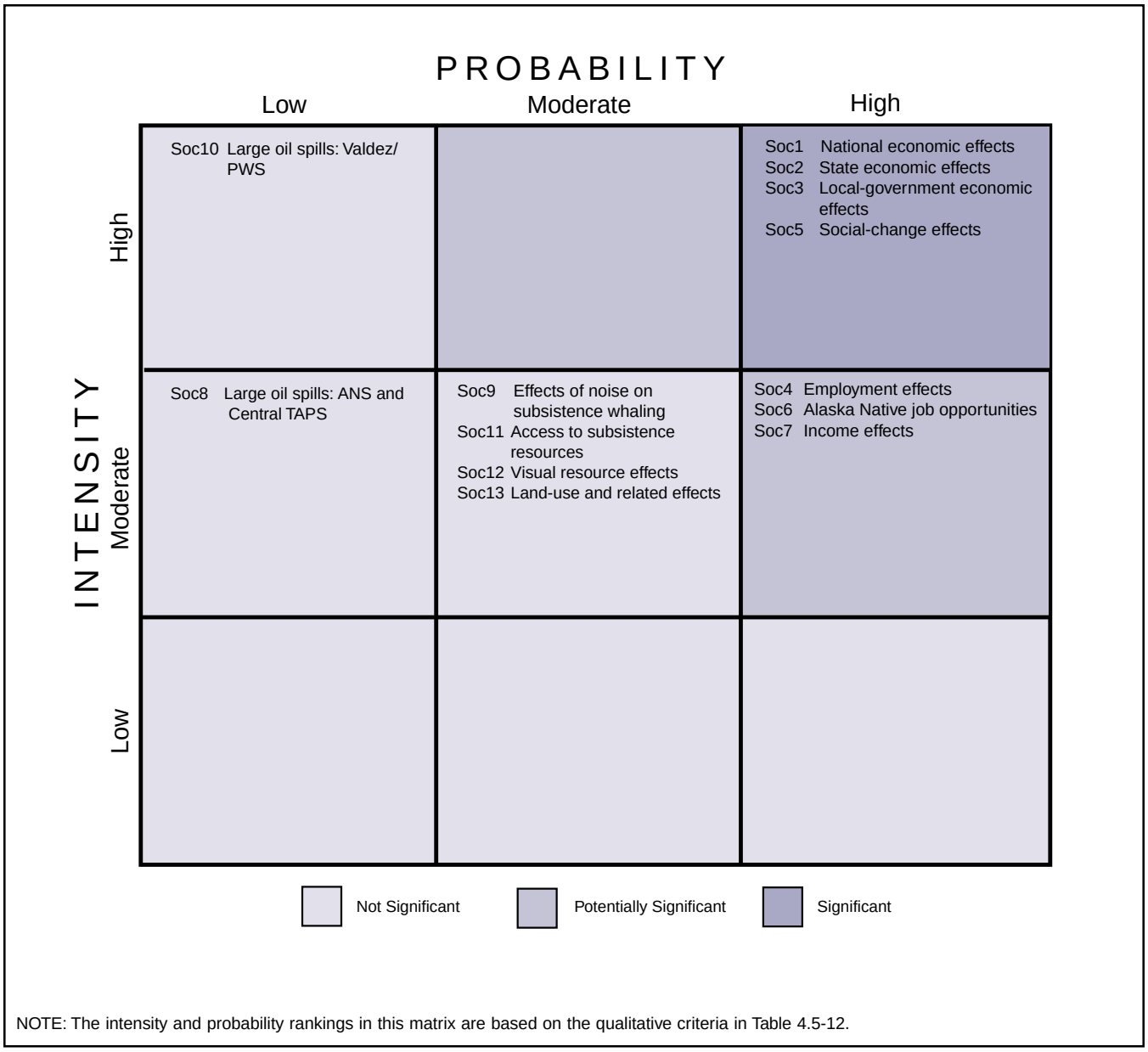
* The economic effects presented here include the effects of both the proposed action (pipeline alone) and other oil and gas production and development activities that are enabled by continued operation of TAPS. These are included in a linked economic model and presented in aggregate.

Table 4.5-13.
Social resource cumulative effects summary: Proposed action.

SOCIAL RESOURCES CUMULATIVE EFFECTS SUMMARY: PROPOSED ACTION

Potential Effect	PROPOSED ACTION	GAS COMMERCIALIZATION (GTL, LNG, Gas Pipeline)	NORTH SLOPE OIL FIELDS AND ANS TANKER TRADE (Past, Present, Future Development)	PUBLIC ACCESS	MILITARY (NMDS)	OTHER INDUSTRY	Intensity Factors			Ranking	
							Mag	Geo	Freq/ Dur	Int	Prob
SUBSISTENCE											
Soc 8 **Large oil spills affecting quality of subsistence resources: ANS and Central TAPS.**	The proposed action could result in pipeline-related oil spills in the ANS or Central TAPS study areas. The effects of these spills depend on the amount spilled, location, and season. Historically, these effects have been small. The five largest pipeline spills to date has resulted in localized and temporary effects.	Oil spills are not associated with either the LNG or the export pipeline options. Implementation of GTL could increase spill volumes because TAPS throughput would be increased. Gas leaks are not likely to create significant adverse environmental effects, although fires and explosions could result.	Historically, most ANS oil spills were small and have had little affect on subsistence resources. Possible spill estimates based upon other ANS EISs have concluded that the probability of one or more large (>1,000 bbl) oil spills is high and could adversely affect subsistence resources for 1 to 5 years. Actual ANS data suggest the probability of a large spill is low.	No impact.	No impact.	No impact.	H	M	M	M	L
Soc 9 **Effects of noise on subsistence whaling.**	Continued operation of TAPS will have no direct effect on whaling.	Existing wells and other infrastructure are sufficient to support gas commercialization. Thus, no new exploration activities are required.	Additional offshore oil exploration and development activities may adversely affect subsistence whaling, but effects can be mitigated.	No impact.	No impact.	No impact.	M	L	L	M	M
Soc 10 **Large oil spills affecting quality of subsistence resources: Valdez/PWS.**	Pipeline and VMT spills are not likely to be large or result in significant effects.	The GTL option increases tanker traffic in Valdez and could increase PWS oil spills marginally. Potential LNG tanker traffic is small in comparison to oil tanker traffic. However, LNG accidents could affect marine mammals.	Continued operation of the marine transportation link is required to support ANS production. Analyses presented in this study indicate that the probability of one or more large (>1,000 bbl) oil spills ranges from 50% (best estimate) to 90% (no improvement from historical experience). Large oil spills could result in a material adverse effect on subsistence harvests.	No impact.	No impact.	No impact.	H	L	M	H	L
Soc 11 **Access to subsistence resources.**	Access to subsistence resources is unlikely to be materially affected by the proposed action.	Subsistence harvests could be adversely, although temporarily affected, by construction activity and increased competition for subsistence resources with construction workers. During the operational phase of these projects, effects are likely to be small.	Development of ANS oil fields has restricted access to subsistence resources on the North Slope in the past. Current regulations make provisions for subsistence users to access certain areas. Access to subsistence areas on the North Slope will continue to decrease as more oil fields are developed.	The opening of the Dalton Highway to general use provides greater access for tourists, recreation seekers, and hunters and anglers.	No impact.	No impact.	M	M	H	M	M
VISUAL/RECREATIONAL											
Soc 12 **Effects on visual/recreational resources.**	The proposed action is unlikely to result in any material effects on visual/recreational resources. Ground-impacting activities, including corrosion digs, river training structure repairs, and below ground valve inspections, could result in minor visual effects, as could oil spills.	All options result in incremental North Slope construction. New facilities do not occupy a large area, particularly in proportion to the present area of ANS industrial activity. Construction of a gas pipeline would result in temporary impairment of visual resources. However, once completed, the buried pipeline will have a small visual effect. For the LNG alternative, there will be additional visual effects associated with the LNG plant and marine terminal.	Historically, ANS development has substantially altered the visual character of this area. Reasonably foreseeable future projects will result in the geographic expansion of these visual effects. Improvements have reduced the size of the visual footprint of exploration and production facilities.	No impact.	Construction of this facility would result in an added visual effect.	No impact.	M	M	H	M	M
LAND USE AND RELATED ISSUES											
Soc 13 **Land use and related issues.**	No material effects on land use, wilderness, and cultural sites are foreseen. Oil spills could result in temporary changes to land uses and adverse effects on cultural sites.	Commercialization of ANS gas could have land use effects, depending on the option and (in the case of the pipeline options) the route chosen. For the LNG option, new facilities would be constructed in Valdez, affecting approximately 390 acres of land.	Land use has changed over time as ANS oil and gas production expanded. This trend would continue for the proposed action. Expansion of the land area used for oil and gas production could affect cultural resources in the area.	No impact.	Localized effects possible.	No impact.	M	M	M	M	M

Table 4.5-13 (Cont'd).
Social resource cumulative effects summary: Proposed action.



NOTE: The intensity and probability rankings in this matrix are based on the qualitative criteria in Table 4.5-12.

***Figure 4.5-8**. Ranking matrix of potential cumulative impacts on the social environment (proposed action).*

gas development, and competition for subsistence resources resulting from population growth and increased access by nontraditional users of subsistence resources.

- **Visual/Recreational:** Several issues are grouped in this general category. Industrial development changes the general appearance of formerly nonindustrial areas and can alter patterns of recreational use. Not all such effects are adverse. On the positive side, the TAPS pipeline and VMT are tourist attractions. Visible changes associated with petroleum development on the North Slope are of concern to some members of the public, and oil spills and associated cleanup activities can have temporary adverse effects on scenic vistas.
- **Environmental Justice:** Some of the potential cumulative effects associated with the proposed action have implications for "environmental justice," because they may have disproportionate effects on particular demographic groups. Some of these effects are beneficial. For example, the Alaska Permanent Fund Dividend (PFD), which is funded by oil and gas revenues, is distributed to all Alaskans who satisfy residency and other minimal requirements. Although the

dividend (for any given year) is a fixed amount per person, the impact of the PFD on household income is proportionately greater for larger families and for low-income families. Other effects of oil and gas development may have disproportionately adverse consequences. For example, an oil spill could disrupt subsistence harvests, with the potential to have greater effects on low-income and/or minority families that, by circumstance or choice, are dependent upon these resources to a greater degree than other residents. Environmental justice effects are reviewed in this section (see also Section 4.10), but this is not treated as a separate set of effects to avoid double counting.

- **Land Issues:** Included in this classification are topics related to changing land uses, land use conflicts, coastal zone management, and effects on wilderness. Potential effects of the proposed action on cultural resources are included in this category.

In the summary exhibits, these categories are disaggregated into selected component issues, which are evaluated in terms of a common rating scheme. At the conclusion of the discussion of each category or issue cluster, an overall evaluation of the intensity and probability of component effects is presented. This overall rating is based upon a judgement of the significance of each of the topics and issues together with the individual ratings.

Proposed Action: Economics

The economic effects of ANS development and of the construction and operation of TAPS, the VMT, and the marine transportation link from 1974 to the present have been both beneficial and substantial. In Section 3.3.1, these effects are discussed in national, state, and local contexts. The proposed action will allow the economic benefits of ANS petroleum development to continue throughout the ROW renewal period. Section 4.3.3.1 provides estimates of direct, indirect, and cumulative economic effects of TAPS for the period from 2004 to 2034. As noted in Section 4.3.3.1, the analysis of the economic effects of the proposed and no-action alternatives was based upon a constant real price for North Slope of approximately $16 per barrel (1998 dollars). Prices presently prevailing are substantially greater. It is not feasible to replicate this analysis in response to every crude oil price movement. However, the effect of any upward shift in crude oil prices is to magnify the economic effects projected here. Increased prices directly affect revenues from royalties and severance taxes, but also (if these prices continue) increase the effectiveness of marginal fields, which may increase the quantity of oil produced. For these reasons, the economic effects of the proposed action alternative are understated.

Soc1. National economic effects.

On the national level, ANS output presently accounts for about 20 percent of domestic oil production. This percentage will decline as ANS production and TAPS throughput decline, but it will remain significant (the Prudhoe Bay oil field is the largest oil and natural gas discovery in the history of North American exploration) (Gilders and Cronin, 2000). Crude oil self-sufficiency is not an option for the U.S., but each barrel produced domestically reduces the amount of oil that needs to be imported and therefore, the trade deficit. The proposed action will reduce this deficit by approximately $150 billion in 1998 dollars (based on world crude oil prices forecast by USDOE) from 2004 to 2033. ANS production will contribute approximately $10.8 billion to the federal government in the form of income taxes, lease payments, royalties, and bonuses. Application of the criteria shown in Table 4.5-12 indicates that the intensity of this effect is high, as is the probability that this will occur.

Additionally, continued operation of TAPS will necessitate the construction of new “Jones Act” double-hull tankers (estimated nine) to replace tankers retired from service because of OPA 90. Collectively, this amounts to an expenditure of $1.5 billion at U.S. shipyards for construction, and still more for periodic repair/maintenance. Since each of the tankers will generate approximately 1,000 shipyard jobs for 18 months, the total fleet purchase is estimated to support a total of 162,000 worker-months. Operation of Jones Act tankers requires U.S. seafarers. At the beginning of the ROW renewal period, tankers serving the ANS trade are estimated to employ 1,330 U.S. seafarers, declining to 530 by the end of the period.

Implementation of one or more of the three potential gas commercialization options would also have economic benefits at the national level. The federal government would receive royalties, lease bonuses, and federal income taxes. Additional domestic natural gas production would increase the degree of self-sufficiency and reduce the net balance of payments deficit in natural gas.

Soc2. State economic effects.

At the state level, the economic benefits of the proposed action (direct, indirect, and cumulative) would also be large. Projected state revenues from ANS oil production and pipeline operations under the proposed action total $14.2 billion. At the beginning of the ROW renewal period, these payments will account for 65 percent of total state general fund revenues, declining progressively to 18 per-

cent by 2025. To cope with oil and gas revenue declines, it is projected that Alaska will reimpose an income tax and reduce PFDs (which would be eliminated under the no-action alternative). These measures will reduce disposable personal income and slow job growth rates compared to historical norms, but will help to maintain public services.

Continued ANS production will provide statewide employment and income opportunities. Direct employment is not large in proportion to total state employment, but oil and gas economic activity generates substantial indirect (multiplier effect) activity and employment.

The above projections do not include the contribution of various gas commercialization options or the proposed NMDS installation at Fort Greely. These effects will add to those discussed above, as follows.

All natural gas commercialization options will provide income to the state in the form of royalties and severance taxes. Implementation of any of these options will increase the overall level of economic activity in the state through direct and indirect (multiplier) effects. Independent estimates of economic effects are not made in this analysis because the projects are not sufficiently characterized, no option has been selected, and future energy prices are uncertain. (Where appropriate, other estimates are included.) Nonetheless, there is little doubt that the economic benefits to the state will be large if any of the gas commercialization options prove viable.

As noted above, the capital cost for the LNG option including the GCF, pipeline, LNG plant, and LNG tankers is estimated to be $12 billion to $14 billion. Construction would require from 8 to 10 years and employ a peak work force of 10,500 (7,200 direct jobs and 3,300 indirect jobs). Upon completion, TAGS was projected to generate revenues of $188 million annually in property taxes and $189 million annually in royalties and severance taxes (BLM and MMS, 1998). These estimates depend upon the scale of operations, royalty and severance tax rates, transportation costs, and LNG prices at destination ports. TAGS was projected to generate 550 direct and 1,250 indirect jobs throughout its 30-year life (BLM and MMS, 1998).

The economic effects of the ANGTS pipeline depend, to some degree, upon the specific route chosen. Because the scale of operations (2 bcf/day) is the same as that for the LNG option, royalties and severance taxes are likely to be similar.[8] Property tax receipts, availability of gas for Alaskan communities (e.g., Fairbanks), purchases in Alaska, and employment opportunities for Alaskans are likely to depend on the specific route chosen for the pipeline.

The GTL option also provides economic benefits in the form of royalties and severance taxes. Because GTL liquids will use the present TAPS pipeline, the unit pipeline costs will decrease as fixed costs are spread over a larger number of barrels of throughput. Tariffs will also decrease (for all barrels shipped over TAPS), which will increase the net wellhead value of the crude oil.

Implementation of GTL, LNG, or the ANGTS pipeline will increase domestic supply and U.S. self-sufficiency in natural gas. As noted above, 2 bcf/day is equivalent to about 20 percent of present net imports, so implementing both the LNG and ANGTS pipeline options would have a significant effect on US net imports and the balance of trade.

The proposed action will provide Alaska with the opportunity to effect a gradual transition away from heavy dependence on one industry to a more diversified economy. Such changes are never easy, but they can be particularly difficult if the transition is abrupt.

Construction of the NMDS facility at Fort Greely will cost $626 million and require an average of 300 construction workers over a 5-year period; operation of the system could employ as many as 360 workers (U.S. Army Space and Missile Defense Command, 1999). During operation, employment will generate at least $9.7 million of direct income per year. Some 108 indirect jobs would also be created. In aggregate, these jobs would partially compensate for closure of other facilities at Fort Greely, and the NMDS installation might alleviate some of the economic hardship of base downsizing.

Application of the criteria given in Table 4.5-12 indicates that the statewide economic effects of the proposed action alternative are of high intensity and high probability.

Soc3. Local government economic effects.

The proposed action will provide revenues to local governments totaling an estimated $2.2 billion over the ROW renewal period. Revenue projections are particularly large for the North Slope Borough ($1.9 billion), but the continuing revenues will also be important for Valdez/Cordova ($126 million), Fairbanks ($51 million), and Anchorage ($25 million). These estimates do not reflect any allowance for property taxes on natural gas facilities, which would add to these totals. Application of the criteria identified in Table 4.5-12 indicates that the economic effects on local governments are of high intensity and high probability.

Soc4. Employment effects.

Selection of the proposed action alternative would have

[8]These quantities are computed on the net wellhead value, which is the sales price minus the transportation cost. Net wellhead values could differ among the gas commercialization options.

employment effects. These vary by location and are discussed below.

Alaska North Slope. Renewal of the TAPS ROW will maintain the existing sociocultural dynamics of the North Slope. The principal effects will be continued state and local revenues (Section 4.3.3.1) and earnings derived from probable operation and maintenance (O&M) contracts with Alaska Native regional corporations and their subsidiaries that provide services to Alyeska and the oil companies. Efforts to sustain and expand Alaskan and Alaska Native employment on TAPS-related O&M work are likely to continue. Under the proposed action, aggregate employment in the petroleum industry will increase only modestly from 2000 to 2010 and will remain constant thereafter (Section 4.3.3.1). Nonetheless, employment opportunities will continue to exist, as some growth is expected in North Slope oil-field operations (Table 4.3-17 in Section 4.3.3.1). A continued but declining revenue stream supporting government, community services, and Alaska Native corporations will provide benefits.

The NSB has a young population relative to other parts of Alaska and continues to grow at a more rapid rate than the state average. In fact, the increasing demand for employment caused by NSB population growth may exceed local employment opportunities afforded by renewal of the TAPS ROW. This may result in a net migration out of the borough. Whatever adverse effects are associated with declining crude production, however, are much smaller than would result if crude production were to cease abruptly.

Central TAPS. These effects are discussed in Section 4.3.3.1. Selection of the TAGS option would result in temporary economic benefits associated with construction activities and long-term benefits from property taxes and increased employment. Similar benefits would result if the Alcan route were chosen for the ANGTS pipeline.

Valdez/PWS. The proposed action contributes to a continuing growth in the level of jobs, employed resident workers, and maintenance of personal income in this study area. Valdez will continue to serve as the residential base for VMT employees and contractors, but will have little, if any, impetus for growth resulting from ongoing TAPS and shipping operations.

If TAGS were constructed, the LNG plant at Anderson Bay near Valdez would increase employment, economic activity, and local government revenues from taxes. A major new source of local employment since the *Exxon Valdez* oil spill has been the incorporation of local boat owners (mainly in the commercial fishing fleet) and trained spill response personnel from Valdez, Cordova, Tatitlek, and Chenega Bay into the Alyeska SERVS. The projected decline in revenues derived from petroleum property tax receipts (from $9 million in 2004 to $2 million in 2033) may cause adverse socioeconomic effects in Valdez (these effects would be more intense in the no-action alternative). Revenues from the LNG plant and marine facilities could partially offset this decline if the TAGS option were selected.

Selection of the GTL option is unlikely to increase revenues or employment in the Valdez/PWS study area. However, the additional throughput associated with the GTL option may extend the economic life of the pipeline, because lower TAPS tariffs could increase the economic attractiveness of marginal oil fields.

The ANGTS pipeline is not expected to have any effect on the Valdez/PWS study area, because none of the candidate routes for this pipeline approach this area.

Continued operation of the pipeline and of North Slope oil activity generates a large and stable level of basic sector employment. Because jobs in this sector are among the highest paid in the state, each job makes a large contribution to the economy. Wage and salary employment is projected (see Table 4.3-18) to grow modestly if the proposed action alternative is selected, as is real per-capita income. Using the criteria identified in Table 4.5-12, the intensity of employment effects is evaluated as moderate and the probability as high.

Summary: Economics

For the economic effects as a group, the effects are clearly beneficial, very substantial (high intensity), and almost certain to occur (high probability).

Proposed Action: Social Change

Examples of social change issues include potential cumulative effects associated with population changes (influx of new workers), demand for increased housing, the effect of wage and salary employment (and lack of same) on Alaska Natives, and concern over loss of cultural identity.

Soc5. Social change effects.

Significant social changes have occurred in many Alaskan communities. Industrial development, including construction of the North Slope oil-field infrastructure and TAPS, has been one of the factors contributing to this change (Coates, 1993; Cole, 1997). As noted in Section 3.3.2.1, other factors have included early Alaska Native contact with Euroamericans, mining booms such as the Klondike, World War II, the construction of the Distant Early Warning (DEW) line, Federal government policies (e.g., the Bureau of Indian Affairs), and changes in the

structure of government associated with statehood. Legislation, including ANCSA and ANILCA, also contributed to major changes in social organization and cultural value systems (Section 3.3.2.1). The increased availability of new communications technology (e.g., telephones, radio, television, and the Internet) provides many benefits but also contributes to cultural change. The increased availability of higher education is clearly a benefit, but it also introduces new values that may cause cultural stresses. Actual or perceived economies of scale in mass merchandising have led to the growth of shopping malls and major chain stores in larger communities; while convenient, this may have reduced the regional diversity of available products. Wage and salary employment reduces the time available for other pursuits, but the resultant income provides the means to purchase a wide variety of goods and services.

The institutions, policies, events, and trends identified above have helped to bring about social change. It should also be noted that many institutions and programs increase stability and cohesion. For example, many villages have programs (e.g., storytelling, traditional dance, crafts, boatbuilding, and Native language instruction) designed to promote elements of a traditional lifestyle.

There have been significant social changes for both Alaska Natives and non-Natives alike. The scope and depth of these social changes fully justifies an intensity evaluation of high. The probability of these changes continuing in the future is also high. This assessment is reflected in the ranking matrix of potential cumulative effects presented in Figure 4.5-8. This said, the contribution of the proposed action alternative is less clear — indeed it is likely that social change would continue regardless of the alternative.

Thus, to some extent, these cultural changes are *unavoidable* and may be *irreversible.* Whether or not many of these social changes are *undesirable* is a matter of personal or group perception. Some social changes can generally be considered beneficial. For example, almost 76 percent of the adult population of the NSB has graduated from high school, earned a general equivalency diploma, and/or attended an institution of higher education — a considerable increase compared to 1993 (NSB, 1999). The number of Iñupiat men and women from 18 through 26 years of age who have taken some college or university classes increased from 13.1 percent to 19.6 percent in 1993-99. Education is one of the benefits provided by rising incomes and programs provided by the NSB, funded in part by revenues from oil and gas activities on the North Slope.

Potential social effects of TAPS were foreseen by the Federal Task Force on Alaskan Oil Development in drafting the original EIS for TAPS (BLM, 1972). The EIS noted that economic activity might spur social change and discusses both positive and negative effects.

Several of the consolidated issues relate to the influx of new workers and population increases in general. A disruptive source of long-term change depends on the relative weakening of traditional stabilizing institutions through prolonged stress and disruptive effects (USACE, 1999). These changes already are occurring to some degree on the North Slope as a result of the cumulative effects of onshore oil and gas development, more dependence on a wage economy, higher levels of education, improved technology, improved housing and community facilities, improved infrastructure, increased presence of non-Natives, increased travel outside of the North Slope, and the introduction of television and the Internet (BLM and MMS, 1998; USACE, 1999).

The economic analysis of the proposed action provides projections of wage and salary employment overall and in the oil and gas sector in particular. Table 4.3-17 in Section 4.3.3.1 indicates that direct full-time employment with TAPS and ANS oil field operations is projected to increase from 11,601 in 2000 to 11,812 in 2015, a modest rise. Estimated total wage and salary employment on the North Slope is projected to increase from 7.6 thousand in 2000 to 9.2 thousand in 2015, proportionately greater than that for oil and gas employment overall, but not large. Thus, the potential population influx in the future will be limited.

The NSB has chronic unemployment and underemployment (NSB, 1999) and has a stated policy objective of "seeking ways to diversify the economies of the North Slope communities to enable them to become less dependent upon the resources of the North Slope Borough government."

Commercialization of ANS natural gas could result in an influx of new workers. For example, if the LNG project is implemented, there will be a temporary influx of construction workers, chiefly to the Central TAPS and Valdez/PWS study areas (but also on the North Slope), for the construction of the pipeline, compressor stations, and the LNG plant, storage facility, and other marine terminal infrastructure. These effects are described in the EIS for the pipeline (BLM and USACE, 1988) and the LNG facility (FERC 1993, 1995). As noted in the TAGS EIS, "The major socioeconomic impact of the TAGS project during preconstruction and construction phases would be increased population and employment." In the TAGS EIS it is stated that "during the five-year detailed design and construction phase, average annual TAGS employment would peak at more than 7,200 people. By comparison, employment on the TAPS pipeline peaked at an annual average of

nearly 22,000 people." Employment and timing reported in the LNG EIS differ from those noted above (possibly because the scope was restricted to the LNG facility), but are substantial. Nonetheless, the Federal Energy Regulatory Commission (FERC) concluded that only limited adverse environmental effects would occur with appropriate mitigating measures. Implementation of a GTL alternative or ANGTS would also result in the influx of new workers. The number of workers required and the length of the construction period depend upon the option selected and, for ANGTS, the pipeline route selected.

Soc6. Job opportunities for Alaska Natives.

Alaska Natives have expressed concern over a lack of employment opportunities in the oil and gas industry. Section 29 of the Federal Grant states, "Permittees shall enter into an Agreement with the Secretary regarding recruitment, testing, training, placement, employment, and job counseling of Alaska Natives."

In furtherance of Alaska Native employment objectives, Alyeska entered into the Alaska Native Utilization Agreement (APSC, 1998d) with the U.S. Department of the Interior, which reaffirmed the "Section 29" obligation and set specific targets for training and hiring of Alaska Natives. The overall goal of this program is to increase the overall level of Alaska Natives in the Alyeska work force to 20 percent by 2004. Specific subgoals were established by employment category (e.g., managers/supervisors, professionals, technicians, and clerical and administrative workers) and by year to achieve this goal (Table 4.5-14). Upon reaching the 20 percent employment level,[9] it is expected that Alyeska will maintain these percentages for the life of the Federal Grant. It is assumed that this agreement would continue with the proposed action.

The employment goals apply to Alyeska and to "designated contractors." The agreement is wide-ranging, addressing recruitment, placement, training, and mentoring programs. It also establishes an advisory board to provide advice and counsel regarding the operation of the Section 29 program, assess the program's success in achieving the agreed-upon goals, make recommendations for improvement, and to report annually to Alyeska management on the overall effectiveness of the program. When successfully completed, this program should resolve Alaska Native concerns regarding TAPS employment.

Natural gas commercialization options would generate additional opportunities for employment of Alaska Natives.

Employment opportunities for Alaska Natives associated with the proposed action alternative are evaluated as having moderate intensity (measurable, but not substantial, change) with a high probability of occurrence.

Soc7. Income potentially affecting social problems.

Another social issue raised in several EISs relating to North Slope petroleum development is that income from oil and gas production may bring about increases in social problems, such as rising rates of alcoholism and drug abuse, domestic violence, wife and child abuse, rape, homicide, and suicide (BLM and MMS, 1998). Other EISs (e.g., Beaufort Sea Sale 97, MMS 1987a) restate this hypothesis but are less definite about the linkage between these effects and cash income derived from oil and gas activities. It is very difficult to identify and quantify the significance of possible causes of various social ills. The incidence of all of the above social ills may be increasing, but the practical question is whether this incidence would decrease if oil and gas income were eliminated—and all other factors were held constant.

Increased cash income (in the form of revenues of Native corporations or individual wages) provides financial resources to North Slope residents. Additional income provides a wide variety of options for the recipients, which include many socially beneficial uses (e.g., improved housing, schools and health care) as well as socially disruptive choices. North Slope communities can and have developed additional social programs to mitigate these effects and/or attempt to control access to liquor and drugs, if warranted.

Another issue of concern to those in North Slope communities is the desire to maintain fluency in the Iñupiaq language. Loss of language skills is perceived by many as an important element in the loss of cultural identity. Historically, federal and state governments were not sensitive to this issue and actively suppressed use of Alaska Native languages (Mead, 1978; Chance, 1970; Roberts, 1992). In more recent times, this situation has changed radically. The NSB believes that the use and preservation of the Iñupiaq language are fundamental to cultural survival and has developed school language instruction programs that have proven successful (NSB, 1999). Thus, it appears that local programs can mitigate this potential effect.

The Northstar EIS (USACE, 1999) states that NSB institutions "work vigorously and quite successfully at preventing any weakening of traditional cultural institutions and practices." The NPR-A EIS (BLM and MMS, 1998) concludes that sociocultural effects can be mitigated and does not include these among the unavoidable adverse effects of

[9]This level of utilization was established in the original 1974 Native Utilization Agreement and was derived from the estimated percentage of Alaska Natives in the total Alaskan civilian population at that time.

Table 4.5-14. *Alyeska Native employment goals.*

Year	1998	1999	2000	2001	2002	2003	2004
Managers/supervisors	4%	6%	7%	9%	10%	12%	14%
Professionals	10%	11%	13%	14%	16%	18%	19%
Technicians	11%	13%	15%	16%	18%	19%	21%
Clerical and administrative	21%	22%	24%	26%	27%	29%	30%
Totals	10%	12%	14%	16%	17%	19%	20%

Source: APSC, 1998d

the cumulative case.

Although the above discussion focuses on the North Slope, similar social concerns have been expressed with respect to the other study areas included in this analysis. As discussed in Section 3, many villages in the Central TAPS and Valdez/PWS study areas have a high percentage of Alaska Natives who have generally similar concerns.

Although it has been argued that increased income can have negative as well as positive effects, it appears that, on balance, the overall effect is positive. Because projected changes in personal income are modest, this effect is ranked as moderate intensity. These effects are judged to have a high probability.

Summary: Social Change

Overall, it is concluded that the effects identified in the social change cluster are high intensity and that the probability of these changes continuing is high. However, although linked in part to oil and gas development, these changes result from many causal events and trends. Moreover, selection of either the proposed action or the no-action alternative is unlikely to change the situation appreciably (the no-action alternative would lessen the degree of contact between Alaska Natives and others on the North Slope, however). It should be noted that not all social changes are adverse. Many of the economic effects discussed in a separate section have clearly beneficial social consequences.

The proposed action provides revenues for government programs designed to facilitate change and minimize adverse effects, but a return to pre-development conditions cannot be achieved because oil and gas development is only one of the factors involved in social change. Selection of the no-action alternative (see below) would be unlikely to reverse or arrest these changes and would almost certainly result in greater social disruption for all population groups as well as in fewer resources to deal with these disruptions.

Proposed Action: Subsistence

As noted at length in Section 3.3.3.2, subsistence is an essential component of Alaska Native life. Effects that threaten subsistence are potentially very important. The proposed action — together with the effects of other projects included in the cumulative analysis — could result in adverse effects on subsistence. Although common subsistence-related concerns exist for each of the study areas, there are differences among these that are sufficient to justify separate discussions for each of these areas.

The proposed action would raise three principal concerns relating to subsistence. The first concern is the possible effects of an oil spill on subsistence resources. The second issue relates to possible access restrictions and/or competitive pressures from others who wish to use subsistence resources. The third issue concerns other possible effects (e.g., noise) of ANS petroleum development that could adversely affect subsistence harvests.

Soc8. Large oil spills affecting quality of subsistence resources: ANS and Central TAPS.

Relevant statistics on spills associated with ANS activities are presented in Section 4.1.2 and Appendix B. ANS oil field spills (both crude and product) have accounted for about half (50.87 percent) of the total number of spills among all Operations elements (including oil fields, pipeline, VMT, and the marine transportation link) over the period from 1977 to 1999. However, the average ANS spill volume has been relatively small, with the result that ANS spills accounted for only 3.36 percent of the total volume spilled. Fifty percent of ANS crude spills were less than or equal to 10 gallons and 50 percent of product spills were less than or equal to 5 gallons. The mean sizes of ANS crude and product spills were 3.9 bbl and 1.34 bbl, respectively. From 1977 to 1999, no ANS oil spills >1,000 bbl occurred.[10] Most small spills are confined to pads, roads, or facilities; therefore, it is unlikely that a small spill would

have a significant effect on subsistence resources.

Based on the observed volumetric spill rate (bbl spilled per billion bbl produced), the expected total volume spilled in the ROW renewal period would be 6,050 bbl, an average of 202 bbl/year. During the period when the data used for the spill projections were gathered, nearly all production was onshore (Table 4.5-4). In the future, more production is likely to come from offshore wells (Table 4.5-4). However, the majority (76 to 81 percent) of future production is expected to come from onshore wells, which supports the spill projections given in Appendix B.

These projections notwithstanding, the possibility of one or more large oil spills in the future cannot be excluded, although this event is not likely on the basis of the historical record. Other EISs (e.g., MMS, 1998; BLM and MMS, 1998; USACE, 1999) have used alternative statistical approaches to estimate future spill volumes in the cumulative case and concluded that the probability of one or more large (>1,000 bbl) spills is relatively high (>90 percent). In the NPR-A EIS, for example, it is concluded that "cumulative effects from oil spills into the Colville River and the Beaufort Sea may significantly restrict subsistence use of fish and marine mammals." The Northstar EIS uses the same statistical methodology as that used in NPR-A and reaches a similar conclusion regarding the probability of a large oil spill. The Beaufort Sea Planning Area Oil and Gas Lease Sale 170 EIS (MMS, 1998) projected that the overall cumulative effects of a large oil spill would "cause one or more important subsistence resources to become unavailable, undesirable for use, or available only in greatly reduced numbers" for periods ranging from one to five years in Nuiqsut to one to two years in Barrow and Kaktovik.

All North Slope EISs conclude that the subsistence effects of a large spill could be significant should it occur. (The effect on subsistence resources depends upon the spill size, location, season, and other factors.) What is uncertain is the probability of occurrence of one or more large spills on the North Slope. The analysis presented in this report (based on analysis of actual ANS spills) indicates that this is at most a moderate probability,[11] while that based on outer-continental-shelf experience (chiefly in the Gulf of Mexico) indicates that the probability of one or more large (>1,000 bbl) spills is high.

Various methods for minimizing the effects of oil spills on subsistence resources include spill recovery capabilities, access to alternative harvest areas, and possible employment in cleanup activities and other remedial economic benefits, as occurred following EVOS.

Refer to Section 4.3.3.3 for additional detail regarding the likelihood and potential effects of an oil spill in the Central TAPS study Area. The probability and consequence of oil spills are discussed there.

Based on the criteria for ranking potential social effects presented in Table 4.5-12, the intensity of the potential effect of a large spill on subsistence is evaluated as moderate. This judgment is reached because the effects are likely to be localized and temporary. The probability of a large spill occurring and affecting subsistence is low, based on historical spill rates.

Soc9. Effects of noise on subsistence whaling.

The second major subsistence concern of North Slope residents is that industrial activity and associated noise will have adverse effects on subsistence whaling. Such effects could result from the bowhead whale's response to noise (particularly that associated with seismic surveys) and activity. This issue was discussed at length in the cumulative effects section of the Northstar EIS (USACE, 1999). This report concluded that such an effect could significantly affect whaling communities including Barrow, Nuiqsut, and Kaktovik. The EIS concludes that the operational noise associated with the Northstar production island should not cause significant disturbance of bowhead whales or the harvest. However, it also states that case-by-case evaluation will be needed for proposed future projects to see if cumulative noise effects will result.

Based upon the ranking criteria presented in Table 4.5-12, this potential effect is evaluated as having moderate intensity and moderate probability. Subsistence whaling is very important to Alaska Natives, but the potential effects of seismic surveys are temporary and can probably be mitigated by appropriate timing of these surveys and other measures.

[10]Several EISs have made projections of possible future large oil spills on the North Slope. No large ANS spills have occurred, and these projections were based on outer-continental-shelf experience in the Gulf of Mexico. However, the factors and operating procedures involved in Gulf of Mexico oil spills differ significantly from what might be expected on the North Slope, and the utility of Gulf of Mexico data is questionable.

[11]Over the period from 1977 to 1999 there were no large (> 1,000 bbl) ANS spills. The largest individual ANS crude spill during this period was 925 bbl. Based upon the historically observed volumetric spill rate and projected future throughput, the average annual ANS spill is approximately 200 bbl. Even if it is assumed that the 925 bbl spill qualifies as a large spill, the estimated number of these spills per billion bbl is 1/12.758 = 7.84 x 10-2 and the projected number of such spills over the ROW renewal duration is this quantity times approximately 7 billion bbl to be produced, or 0.55 (less than one). Using the Poisson approximation discussed in Appendix B, the probability of 1 or more "large" ANS spills over the renewal period is 1-exp(-0.55) = 0.42.

Soc10. Large oil spills affecting quality of subsistence resources: Valdez/PWS.

Potential oil spills from TAPS or associated activities into the Copper or Lowe rivers or into the marine waters of PWS could affect subsistence harvests in the short term by lowering potential harvest resources and/or diverting harvesters away from traditional subsistence activities and into response operations. Longer-term effects would depend on the timing and size of the spill, but might include a decline in availability of certain resources, or food safety issues regarding affected subsistence resources.

In the cumulative case, there is a possible interaction between the operations of the TAPS marine transportation link and LNG tankers if TAGS is commercialized. This is also examined.

Relevant statistics on oil spills associated with VMT and the marine transportation link are presented in Section 4.1.2 and in Appendix B. Based on historical experience from 1977 to 1999, the volumetric spill rate for VMT is 0.32 bbl crude and product spilled in bbl/million bbl throughput. The projected TAPS throughput over the ROW renewal period is approximately 7.02 billion bbl. Thus, the total spill volume from VMT over the ROW renewal period is estimated to be approximately 2,270 bbl, or 76 bbl/year. As with other operations segments, most VMT spills have been relatively small.

Based on historical experience from 1977 to 1999 and estimated improvements in the post-EVOS period, including SERVS and the introduction of double-hull tankers, the analysis presented in Section 4.1.2 concludes that the annual average spill volume for large (>1,000 bbl) spills would range from 690 bbl to 2,750 bbl, depending on the effectiveness of double-hull tankers and other mitigating measures. Small spills are estimated to account for approximately 33 bbl annually. Put another way, this analysis concludes that over the 30 years of the ROW renewal period:

- The probability of one or more spills greater than 1,000 bbl ranges from 50 to 90 percent. The lower probability (50 percent) represents a conservative estimate of the effectiveness of double-hull tankers and other mitigating measures. The upper probability (90 percent) assumes that these measures do not result in any improvement.
- The expected number of large spills over the ROW renewal period ranges from 0.69 (conservative estimate of possible improvement) to 2.75 (no improvement).[12]
- The expected size of a large spill, given that one occurs, is 30,000 bbl.

These probabilities do not reflect any contribution to the possible effects of additional LNG tanker traffic if TAGS is authorized. Figure 4.5-9 shows the historical and projected number of oil tankers loading at Valdez from 1977 to 2020. If the TAGS project were authorized immediately, the earliest that it could be operational would be 2010. The maximum predicted annual number of LNG tankers loaded is 275. These are also shown in Figure 4.5-9. As can be seen, the total (oil and LNG) number of tankers, assuming immediate TAGS go-ahead in the future is well below the traffic in earlier years. This is a conservative depiction, because TAGS is not now economically feasible. Therefore, even if TAGS were implemented at a later date, LNG tankers visits would be postponed and the total traffic would be even smaller, compared to past activity, because of continuing declines in projected oil tanker traffic.

The draft EIS for the LNG facility (FERC, 1993) considered the possibility of a collision between an LNG tanker and an oil tanker and concluded (based on 900 oil tankers loaded per year) that the increase in tanker traffic would be well within the limitations of the Vessel Traffic Safety system and that the probability of a collision would be low.

The draft EIS for the LNG facility included a qualitative analysis of the effects of an LNG tanker accident and concluded that groundings could result in the release of LNG. An LNG spill would not present the same environmental effects as a crude oil spill; much of the LNG would vaporize and form a vapor cloud. This cloud would be flammable, however, until sufficiently dispersed and could present a significant fire and explosion hazard. In the event of a collision of sufficient magnitude to cause the rupture of an LNG cargo tank, it is likely that sparks would ignite the vapors at the spill site which would result in intense thermal radiation levels within several thousand feet of the fire. Groundings are believed to have less potential for ignition of the vapor cloud.

Implementation of a GTL option would increase TAPS throughput by the liquids production rate of the GTL unit(s). Use of the spill methodology discussed in Appendix B will result in a projected increase in oil spill amounts and/or the probability of large spills if TAPS throughput increases.

A large oil spill in the Valdez/PWS area could result in a material impairment of subsistence resources (e.g., reduc-

[12]The upper end of this range falls within the range of from 2 to 4 large spills estimated for the cumulative case by the Minerals Management Service (MMS, 1998). The MMS analysis does not include any allowance for the benefits of double-hull tankers and other measures.

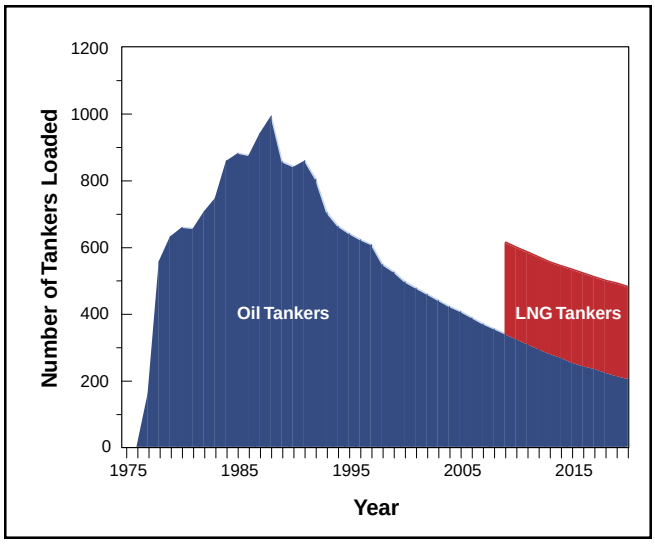


Figure 4.5-9. *Historical and projected tanker loadings at Valdez, 1977-2020*

tion in numbers of marine mammals, fish, and waterfowl) that could take several years to return to pre-spill values (Rice et al, 1996). As noted in the Northstar EIS, fears of consuming contaminated fish and sea birds could cause less tangible effects on subsistence and could continue to affect subsistence harvesting for years after the spill (USACE, 1999).

In accordance with the evaluation criteria shown in Table 4.5-12, the intensity of the effect is ranked as high. The probability is judged as low, based on the conservative estimate (50 percent probability of one or more spills) summarized above. The probability of a large spill affecting subsistence resources is low and would depend on the size, location, and time of year of the spill. The response capability of SERVS should significantly reduce the potential impacts of a large oil spill.

Soc11. Access to subsistence resources.

One of the recurring issues related to subsistence relates to access. Concerns vary to some extent with the study area, so this discussion is organized on this basis.

North Slope. The total land area occupied/disturbed by oil fields on the ANS, shown in Table 4.5-15, is not large — particularly in proportion to the area of the region (Gilders and Cronin, 2000). However, "traditionally, all access for subsistence hunting has been restricted in the oil fields for security and safety reasons" (USACE, 1999). Subsistence access concerns exist in the cumulative case since the amount of restricted land could increase with the development of new fields. The environmental evaluation document for the Alpine Development, for example, notes that the most commonly expressed Nuiqsut concerns about effects of oil and gas development on subsistence involve potential damage to biological resources and habitats, and freedom of access to harvest areas (USACE, 1997).

ARCO agreed to permit access at its Alpine and Tarn developments for subsistence hunting and fishing purposes, with the exception of reasonable security and safety procedures. The following points are relevant to North Slope hunting activities:

- Operators have prohibited firearms, firearm parts, or deadly weapons (including large knives, crossbows, martial arts weapons, etc.) ammunition or explosive material of any kind on the North Slope (BPXA, 1999). A very specific and limited exception may be made to this policy in regards to employees working in remote areas. Such authorization may be granted for bear protection where people are working in such remote areas that bears are of concern. Prudhoe Bay Unit Archery Club members may bring archery equipment to the Prudhoe Bay Unit.
- The Alaska Department of Fish and Game (ADF&G, undated) has established a Prudhoe Bay Closed Area (Game Management Unit [GMU] 26 B) which is closed to the hunting of big game. Small game may be hunted as outlined in the current edition of the Alaska State Hunting Regulations.
- ANILCA requires that subsistence users have a priority over other users to take fish and wildlife on federal public lands where a recognized consistent and traditional pattern of use exists. When necessary to restrict the taking of fish and wildlife on these lands, subsistence uses are given preference over the other consumptive uses.
- Special provisions are in force regarding GMUs 26(A), 26(B), and 26(C). These pertain, among other things, to restrictions on use of aircraft, seasonal restrictions, bag limits, and use of various types of weapons and ammunition.

Beyond restricting hunting by its employees, the oil industry cannot control possible competition from non-residents.

Implementation of one or more gas commercialization options could raise additional access issues. During the construction phase, there might be access restrictions and/or construction activities that would disrupt harvests. Unless constraints were imposed, construction workers could compete with Alaska Natives for subsistence resources.

Central TAPS. The opening of the Dalton Highway to general use is a cumulative effect that has raised concerns among residents of several communities in the Central TAPS study area. This development provides greater access

Table 4.5-15. *North Slope oil fields.*

Oil field (Note a)	First production	Unit area (ha) (Note b)	Number of production facility gravel pads	Area disturbed by mine sites and gravel placement (ha)	Percent of unit disturbed by mine sites and gravel placement	Current (1999) oil production level (bbl/day) (Note c)
Prudhoe Bay	1977	99,103.6	50	2,592.5	2.62%	639,000
Kuparuk	1981	104,514.2	49	1,033.8	0.99%	266,000
Milne Point	1985	22,002.8	11	182.0	0.83%	55,000
Lisburne	1986	32,359.5	8	100.7	0.31%	7,000
Endicott	1987	7,099.1	2	207.1	2.92%	44,000
Pt. McIntyre	1993	4,384.1	2	12.7	0.29%	119,000
Niakuk	1994	2,623.7	1	9.8	0.37%	29,000
Badami	1998	15,139.6	1	74.4	0.49%	4,000
Pt. Thomson/ Sourdough	Planned	33,896.8	4 ±	112.0	0.33%	0
Alpine	Planned	32,576.5	2	56.5	0.17%	0
Liberty	Planned	2,152.9	1	2.2	0.10%	0
Northstar	Planned	12,491.8	1	1.8	0.01%	0
TAPS and Dalton Highway (North Slope)	1977 (pipeline completed)	NA	NA	4,412.9 (Note d)	NA	NA

(a) "Oil field" refers to both units and participating production areas. There are six additional production areas on the North Slope whose oil is processed by existing facilities (i.e., no additional surface impact).
(b) Unit areas cannot be totaled because overlap exists among the unit and participating areas.
(c) Alaska Department of Revenue, Oil and Gas Audit Division, January 25, 2000.
(d) Senner, 1989.
Note: 1 hectare (ha) is equal to approximately 2.47 acres.
Source: Gilders and Cronin (2000).

for tourists, recreation seekers, and hunters/anglers. This increase in access provides benefits to these groups and to tour agencies. However, some residents of communities near this road are concerned that this will adversely affect subsistence harvests as a result of competition for subsistence resources. ADF&G regulations are likely to mitigate this possible effect. The Dalton Highway Corridor Management Area consists of those portions of GMUs 20, 24, 25, and 26 extending 5 miles from each side of the Dalton Highway from the Yukon River to Prudhoe Bay. This area is closed to the use of motorized vehicles except aircraft and boats, and to licensed highway vehicles, snowmachines, and firearms with few exceptions. These exceptions include:

- The use of snowmachines is authorized only for the subsistence taking of wildlife by residents living within the Dalton Highway Corridor Management Area.
- The use of licensed highway vehicles is limited only to designated roads within the Dalton Highway Corridor Management Area.
- The use of firearms within the Corridor is authorized only for the residents of Alatna, Allakaket, Anaktuvuk Pass, Bettles, Evansville, Stevens Village, and residents living within the corridor.

These regulations limit the degree of competition to subsistence users.

Construction activities associated with gas commercialization efforts (e.g., the LNG project) or the NMDS could also effect subsistence.

Valdez/PWS. Subsistence uses in the Valdez/PWS area are presently managed jointly by the ADF&G, U.S. Forest Service, and the U.S. Fish & Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS). The proposed action would not affect access of harvesters in the Prince William Sound communities.

Access issues in the Valdez/PWS study area are less significant than those on the North Slope, although some residents of PWS perceive an increased competition from Valdez-based charter boats for fish and game resources. The draft EIS for the TAGS LNG facility noted that there could be some increase in hunting by construction crews, but the effects were not judged significant. GTL or ANGTS would not result in any effects on access.

Access effects are judged to have moderate significance, as is the probability that these effects will occur.

Subsistence: Conclusions

Probable cumulative effects on subsistence vary with the study area. However, for both the North Slope and Valdez/PWS areas, possible effects of one or more oil spills on subsistence harvests are fairly characterized as having high magnitude, moderate geographic scope, and moderate duration. Not all large spills would adversely affect subsistence resources, the effects of the spill would be temporary, and it is likely that subsistence users would receive some compensation. For these reasons the environmental consequences are judged to be moderate. The probability of one or more large (>1,000 bbl) oil spills in the North Slope study area during the ROW renewal period is estimated to be low in this analysis. The probability of one or more large spills in the Valdez/PWS area also is estimated to be low.

On the North Slope, access to subsistence resources is a concern. Stipulations have been devised (e.g., for NPR-A) that will mitigate these effects.

Proposed Action: Visual/Recreational Effects

Soc12. Effects on visual/recreational resources.

The fourth issue group relates to cumulative visual and recreational effects. In broad terms, the issues related to visual effects concern possible adverse changes in the overall appearance of the landscape as a result of the proliferation of industrial structures (e.g., wells, tanks, pipelines, and terminals) which alter the visible characteristics of an area and the possibility of oil spills (and visible cleanup activities) that would temporarily mar the appearance of land and water bodies. Recreational issues relate to the effects of these facilities on the quality of the recreational experience and also to increased access to lands for recreational use and, therefore, increased levels of recreational use. The nature, severity, and probability of potential adverse effects vary with the study area, so this discussion is organized by study area.

North Slope. ANS developments have a visible footprint, which changes the appearance of the landscape. As noted in the Northstar EIS (USACE, 1999), existing development in the Prudhoe Bay-Kuparuk area has substantially altered the visual character of this area. The presence of industrial structures in an otherwise undeveloped area and introduction of artificial lighting over broad areas where none previously existed are generally perceived as adverse effects of existing North Slope development. Reasonably foreseeable future projects will result in the geographic expansion of these visual effects.

Some of these visual effects are short-term, while others will last until DR&R activities are complete. Among the causes of short-term effects are exploration activities, including seismic surveying work in winter. The moving camps associated with this work would cause a short-term negative effect on scenic quality (BLM and MMS, 1998).

Longer-lasting effects (two to five years) are "green trails" resulting from overland personnel and equipment moves (BLM and MMS, 1998). Vehicles compacting snow and vegetative matter create green trails with greater moisture and the availability of greater nutrients for underlying vegetation in the following growing season; in short, the vegetation becomes greener in a pattern following the tracks of the ground vehicles. This effect is not always apparent from a ground view (although readily detectable from the air) and does not always occur. Vegetative greening also occurs under vacated ice pads, airstrips, and roads.

Exploration and production wells, gravel pads, gathering facilities, pump stations, pipelines, roads, and other industrial structures produce yet longer-lasting (30 years) visual effects. From a statistical perspective, the actual land area occupied by these facilities is relatively small (Table 4.5-15) in both absolute and relative terms, typically occupying less than 1 percent of the unit area and a very much smaller percentage of the total area of the North Slope. Moreover, there has been progress in reducing the operational footprint of these facilities. Following are some of the measures taken to reduce this footprint (Gilders and Cronin, 2000).

- Consolidation of facilities;
- Use of ice road technology to eliminate unnecessary gravel roads adjacent to pipelines, and elevating those pipelines to 1.5 m above the tundra surface to allow free movement of wildlife;
- Directional drilling to reduce the number of gravel pads and wellhead spacing; and
- Improved waste handling and the elimination of reserve pits for surface storage of drilling muds and cuttings (these drilling by-products are now reinjected into confining geological formations).

According to Gilders and Cronin (2000), drill pads can now be built 70 percent smaller than those built in the past.

In addition, aggregate land disturbances are reduced by consolidation/sharing of facilities. The principal impetus for facilities sharing may be economic (minimizing initial capital investments, pooling overhead on otherwise underutilized facilities, see CERA, 1999d), but the effects on land disturbance are beneficial nonetheless. Development of new fields under the proposed action will expand the visible disturbed area. When fields become uneconomic and are finally shut down, DR&R will remove most visible traces of this development.

Selection of any of the gas commercialization options will result in the construction of additional facilities on the North Slope (e.g., a GTL plant or gas conditioning facilities). Selection of either the LNG or the ANGTS pipeline entails the construction of a buried pipeline and other facilities (e.g., compressor stations). The incremental land area required is small.

Statistics on oil spills are discussed above. An oil spill on land would probably affect only a relatively small area (see Section 4.3.3.2) and would cause temporary adverse visual effects. A large spill that entered a river or the Beaufort Sea would have larger adverse effects.

The NPR-A EIS offered the following summary of potential cumulative effects of ANS oil and gas developments on visual/recreational resources on the North Slope (BLM and MMS, 1998):

> There is potential for significant cumulative effects on recreation/visual resources in certain locations on the North Slope. Within the planning area, the area around Nuiqsut has a high potential for significant cumulative effects. However, the region being considered is so large these 'high risk' areas make up only a small percentage of the North Slope. Also although there may be certain areas and times of concentrated activity and development, generally, expected activity and development will be quite dispersed both in time and space greatly reducing the probability of a significant cumulative effect.

Central TAPS. The situation differs in the Central TAPS study area. The pipeline has been constructed, and no additional industrial development is expected in connection with TAPS. As noted in Section 4.3, minor ground-impacting activities — including corrosion digs, slope/workpad maintenance, washouts/river training structure repairs, and below ground valve inspections — will occur in the future. A pipeline reroute is also possible, although reroutes have not been frequent in the past. Collectively these effects are likely to be minor.

As noted in Section 3.3.6.3, TAPS occupies a relatively small land area (16.3 square miles) in absolute terms and a minuscule fraction of the state. TAPS is readily visible from the air and several scenic overlooks have been created (along the Dalton Highway), together with visitor areas at Fairbanks, Pump Station 9, and the VMT.

Section 4.3.3.3 addresses the probability and possible consequences of an oil spill from continued operation of the TAPS pipeline under the proposed action. Oil spills, particularly if these were large and entered water bodies, together with associated cleanup activities could result in substantial but temporary visual/recreational effects in the Central TAPS study area. From 1977 to 1999, there were five large (>1,000 bbl) oil spills along the pipeline. All resulted in minor, localized, and temporary effects. Had any of these spills entered rivers, however, the effects would have been greater.

If TAGS or ANGTS southern route project were built, a new buried pipeline would be constructed near portions of the present TAPS pipeline. Construction of the TAGS gas pipeline and associated compressor stations would result in a disturbed area of 23,216 acres during construction and 8,425 acres during operation. Much of the disturbed land would be located in the Central TAPS study area. If the ANGTS pipeline were built, the aggregate disturbance would vary with the route, but is not likely to be large in any event. This said, a buried gas pipeline would have less affect than TAPS.

If gas commercialization were achieved by use of the GTL technology, no new pipeline or terminal would be required and consequently there would be no increase in the disturbed area. Compared to TAGS, this would minimize the disturbed area and avoid large-scale construction efforts.

The NMDS site at Fort Greely is expected to have little or no effect on visual/recreational resources.

The state's takeover and subsequent opening of the Dalton Highway to general use is a cumulative effect noted in the above discussion of subsistence. In principle, increased tourism could also affect recreational uses, but there is no evidence that this is occurring. With the exception of maintenance of visitor centers, any increase in tourism or related activities is not caused by or under the control of the applicants for the TAPS ROW. Moreover, it is unknown whether selection of the proposed or the no-action alternative would materially affect recreational use of these areas. The proposed action is expected to result in a larger state population and also a larger Fairbanks population. However, if the no-action alternative were selected, there would be greater economic pressures for many in the area to increase subsistence harvests. The severe economic contraction resulting from the no-action alternative might spur development of tourism in an attempt to replace lost earnings. Given the present state of knowledge, this effect is indeterminate.

Valdez/PWS. Because the proposed action would not result in the construction of any new facilities for TAPS, no new adverse visual effects would result from this source. Scenic overlooks would be expected to remain in place, as would the visitor center at the VMT.

If the TAGS project is implemented, a new LNG terminal and vessel berthing facility, occupying approximately

390 acres, would be constructed at Anderson Bay, approximately three miles east of the Valdez Narrows on the south shore of Port Valdez (FERC, 1993, 1995; BLM and USACE, 1988). Anderson Bay and the proposed LNG project site are visible from the city of Valdez, from Shoup Bay State Marine Park, and to boat and plane traffic passing the proposed site (FERC, 1993). Visibility of the site depends on several factors including weather (e.g., clouds and fog), sun angle, and light (FERC, 1993). The FERC EIS (FERC, 1993) concluded that the visual effect of this facility was not significant, but noted that two miles of pristine shoreline would be permanently changed by the development. A GTL option would result in less visual effect with relatively minor new facilities at VMT.

A large oil spill and associated cleanup efforts could create significant, but temporary, adverse visual effects. Appendix B provides information on the probability of an oil spill at either the VMT or the marine transportation link and the mitigation measures (e.g., double-hull tankers, SERVS) that are now or will be in place during the ROW renewal period. Tourism would be adversely affected; however, this adverse economic effect would be compensated for by cleanup activities.

If TAGS were implemented, LNG spills could occur. Various design features to minimize and contain LNG spills are discussed in the TAGS EIS (FERC, 1993, 1995). An LNG spill would volatilize and would not result in similar visual effects to those that would occur with an oil spill. However, LNG is flammable, and a fire or explosion could result in adverse visual effects. Safety issues would be a greater concern in this event, however.

Use of GTL technology would lead to an increase in TAPS (and thus, VMT) throughput to accommodate GTL products. With a constant volumetric spill rate for the TAPS system, the projected annual spill volume would increase proportionately with the amount of GTL product shipped.

Visual/Recreational: Overall Assessment

Cumulative visual/recreational effects associated with implementation of the proposed action include those resulting from construction of additional industrial facilities on the North Slope and at Valdez if one or more gas commercialization alternative is selected. Incorporation of new methods for oil field exploration, development, and production have significantly reduced the visible footprint associated with individual facilities, however. The Central TAPS study area would experience few, if any, effects associated with facility construction, unless TAGS or a southern ANGTS project is implemented. Additional facilities would be built at Valdez for TAGS or a GTL project.

A large oil spill would have significant, but temporary, adverse effects on visual/recreational resources. The probability and consequences of such a spill are mitigated by spill prevention measures. The probability of a large oil spill sometime during the ROW renewal period is estimated to be moderate to high in PWS and low on the North Slope. Overall, it is judged that the intensity of adverse effects on visual resources is moderate (based on the threat of an oil spill) and that the probability of such adverse effects is likewise moderate (based on the estimated probability of an oil spill in PWS).

Proposed Action: Environmental Justice

Executive Order 12898 signed by President Clinton on February 11, 1994, requires federal agencies to identify and address, as appropriate, disproportionately high and adverse human health and environmental effects of their actions on minority populations and low-income populations in the United States and its possessions (Executive Order 12898, 1994). The purpose of this Executive Order is to promote fair treatment of all races and the poor so that no one demographic group suffers adverse environmental effects disproportionately. Section 4–4 of Executive Order 12898 directs federal agencies, whenever practicable and appropriate to collect, maintain, and analyze information on populations who principally rely on fish and/or wildlife for subsistence. Section 6–606 of this order specifically notes that federal-agency responsibilities shall apply equally to Native American programs. This topic has been addressed in recent EISs (e.g., BLM and MMS 1998; USACE, 1999).

Some of the potential effects resulting from selection of either the proposed or the no-action alternative raise environmental justice issues. Selection of the proposed action would have certain effects that are beneficial in this context. As noted above, the Alaska PFD, which is funded by oil and gas revenues, is distributed to all Alaskans who satisfy residency and other minimal requirements. The affect of the PFD on household income is proportionately greater for larger families and for low-income families. Other possible effects of the proposed action are less benign. For example, subsistence users, including Alaska Native and rural residents who principally rely on subsistence could be disproportionately affected as a result of adverse effects on subsistence that might occur from oil spills if the proposed action is selected. As noted in the section on subsistence, such adverse effects would be temporary and could be partially offset by wage income from spill cleanup activities. Moreover, the Trans Alaska Pipeline Authorization Act (TAPAA) established strict liability (except in cases where damages are caused by an act of war or negligence of the

United States, other government entity, or the damaged party) for all damages [Section 1653 (a) (1)] in connection with or resulting from activities along or in the vicinity of the ROW. Other laws (e.g., OPA 90) also address liability and/or the establishment of funds to pay claims for spills associated with the production and/or transportation of oil. For example, under OPA 90, responsible parties are liable for removal costs and damages (including damage for loss of subsistence use of natural resources) [OPA 90, Section 2702 (a),(b)].[13] In the past (e.g., in the case of EVOS), subsistence users have been compensated for the monetary value of lost subsistence harvest. Lack of access to subsistence resources because of constraints imposed by oil and gas development may also raise environmental justice issues, because subsistence users would be disproportionately affected.

Environmental justice is not shown separately on the intensity-probability charts, because the individual effects are addressed as part of other categories (e.g., economics, subsistence).

Proposed Action: Land Use and Related Issues

This issue cluster includes land use, coastal management, cultural resources, and wilderness and related cumulative effects.

Soc13. Land use and related issues.

Because potential effects and their severity vary with the study area, separate discussions are included for each of the study areas.

North Slope. Potential cumulative effects on land use, coastal management, and cultural resources are reviewed in several recent EISs, including Northstar (USACE, 1999), NPR-A (BLM and MMS, 1998), and Beaufort Sea Planning Area Oil and Gas Lease Sales 144 (MMS, 1996a) and 170 (MMS, 1998). All of these are incorporated by reference. The Arctic National Wildlife Refuge (ANWR) is east of oil and gas development areas on the North Slope. Present regulations restrict oil development activity in ANWR and these regulations are assumed to remain in force in the event the proposed action is selected. As noted in Appendix A, no production is assumed to come from ANWR in the baseline throughput forecast.

Onshore areas associated with reasonably foreseeable future projects (e.g., Alpine and Tarn) have been rezoned (USACE, 1999). NSB land management regulations address various aspects of project design and include seasonal restrictions as well as provisions for protection of other land uses (e.g., subsistence) that are intended to mitigate/minimize adverse environmental effects. There is a potential for conflict with other regulations (e.g., 6 AAC 80.070 [Energy Facilities], 6 AAC 80.080 [Transportation and Utilities]; 6 AAC 80.120 [Subsistence], and 6 AAC 80.130 [Habitats]) that would need to be addressed on a case-by-case basis to select appropriate development plans.

A cumulative land use effect that would not be avoided is the geographic expansion of industrial uses beyond the existing developed Kuparuk River Unit/Prudhoe Bay Unit area. This represents a cumulative, large-scale change in the designated land use of the North Slope area (USACE, 1999), although recent technological improvements (discussed above) will reduce the land area occupied by individual oil and gas facilities.

Reasonably foreseeable offshore developments would result in the construction of subsea pipelines built through state waters, requiring rezoning from Conservation Districts to Resource Development Districts and a compliance review with the NSB Coastal Management Plan. This could result in cumulative effects on the existing Resource Development Areas extending land uses to Conservation Districts not presently utilized in this manner. Because the areal extent of seafloor utilized by industry would not be large, this cumulative effect would be minor.

Expansion of the land area used for oil and gas production could effect cultural resources in the area. Cultural resources may be affected by seismic activities and overland moves and similar activities that might disturb the surface (BLM and MMS, 1998). Material borrow pits, gravel roads, and airstrips could also effect cultural resources. Cultural resources (sites, shipwrecks) may underlie offshore areas (MMS, 1998) that would be developed. This said, mitigation methods (and regulatory procedures) have been developed that minimize these effects.

Oil spills could adversely effect cultural resources by

[13]For example, Section 2702 of OPA 90 (33 CFR 40) notes that "each responsible party for a vessel or a facility from which oil is discharged. . . into or upon the navigable waters or adjoining shorelines or the exclusive economic zone is liable for the removal costs and damages specified in subsection (b)." Damage to subsistence resources is covered in subsection b (paragraph (C)) and specifically includes "damages for loss of subsistence use of natural resources, which shall be recoverable by any claimant who so uses natural resources which have been injured, destroyed, or lost, without regard to the ownership or management of the resources." Section 2701 defines "facility" as follows: "facility" means any structure, group of structures, equipment or device (other than a vessel) which is used for one or more of the following purposes: exploring for, drilling for, producing, storing, handling, transferring, processing, or transporting oil. This term includes any motor vehicle, rolling stock, or pipeline used for one or more of these purposes." Thus, ANS spills, VMT spills, or marine transportation spills discharged into or upon the navigable waters or adjoining shorelines clearly fall within the scope of OPA 90. Responsible parties for such spills are subject to damage claims for loss of subsistence resources.

direct damage and by cleanup activities (including the possibility of vandalism). The severity of these effects depends on the volume spilled, location, season, and other factors.

Central TAPS. TAPS-related effects are expected to be at most moderate (see Section 4.3.3.4). No land use changes are anticipated, and no additional effects on wilderness areas are foreseen. Oil spills and cleanup activities could result in adverse effects. The severity of these effects depends on the volume spilled, location, season, and other factors.

Construction of either the TAGS or ANGTS gas pipelines would disturb land, although these effects would be mitigated. Selection of a northern route for the ANGTS pipeline would eliminate effects in this study area. An additional pipeline would not be needed for a GTL option.

Valdez/PWS. No additional TAPS-associated construction activities would create any significant adverse effects in the Valdez/PWS study area. As in the other areas, an oil spill could produce adverse effects on cultural resources. To mitigate the potential effect of spills on cultural resource sites in PWS, SERVS added cultural resource data to the graphical resource database (GRD) for PWS and adjoining areas (Wooley et al., 1997). The GRD is part of the *Prince William Sound Tanker Oil Discharge Prevention and Contingency Plan* and consists of digital "layers" of sensitive environmental areas. The known cultural resource site data for PWS and the Copper River area are digitized and included in a confidential layer of the GRD to assist the Federal On-Scene Coordinator with cultural resource site protection during a spill response.

Development of GTL would increase TAPS throughput, but not result in any significant additional land disturbance.

Implementation of TAGS would entail construction of an LNG facility and result in incremental land disturbance.

Land Use and Related Issues: Overall Assessment

The intensity of cumulative effects to land use and related issues are judged moderate, as is the probability of these effects. Potential effects are greatest in the North Slope (arising from incremental industrial development) and Valdez/PWS (resulting from a possible large oil spill) study areas. The probability of a large oil spill sometime during the duration of the ROW extension period is moderate, but the probability of significant damage to cultural resources is low as a result of mitigating measures.

Proposed Action: Social Resources, Cumulative Effects Summary

Effect groups with high consequences and high probability include economics and social change. The economic effects are largely (if not exclusively) beneficial. Continued operation of the ANS fields is important in a national, state, and local context. Although the benefits of the proposed action are likely to be smaller in the future compared to the past, these effects are very significant. Selection of any of the gas commercialization options would result in additional economic benefits, but it is premature to develop specific estimates.

The effects related to social change are mixed, some are beneficial, and others are adverse. However, as noted in the discussion of these social effects, the choice of development alternative is unlikely to halt or reverse social change. Moreover, selection of the no-action alternative would almost certainly result in much more significant and adverse social changes.

Effects on subsistence are judged moderate to high, and the probability of these effects is moderate. Subsistence effects are expected to be adverse (although generally temporary), resulting principally from the possibility of a large oil spill on the North Slope and the moderate probability of a large spill in the Valdez/PWS study area. Use of double-hull tankers, creation of SERVS, and other mitigation measures reduce the probability and expected size of a large spill. Additionally, liability provisions of various applicable statutes and possible wage and salary employment will cushion the adverse monetary effects on subsistence users. Concerns have been expressed regarding the possibility of increased access resulting from the opening of the former haul road to public use.

4.5.4 Results: No-Action Alternative

4.5.4.1 No-Action Alternative: Physical Resources

By R.G.B. Senner, J.M. Colonell, J.D. Norton, and B. Trimm

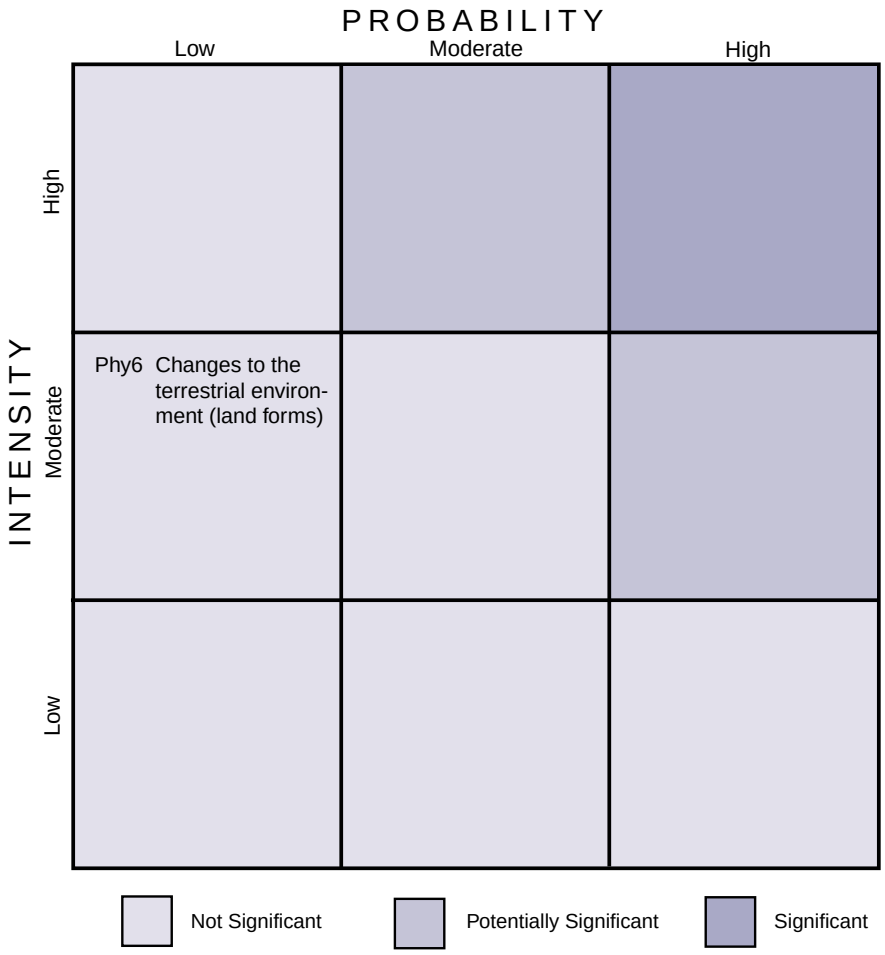
In the no-action alternative, it is assumed that aboveground facilities related to TAPS will be removed during a 3-year period of DR&R. During that time, major activities will occur involving the physical removal of equipment and subsequent transportation to disposal sites. For a relatively short time, these activities will result in disruption to the terrestrial environment along the TAPS ROW, the potential for spills, increased use of heavy vehicles and traffic with attendant increase in emissions and dust, and increased water discharges from the work camps and in cleaning pipe and equipment. After DR&R, it is likely that some of the work pad, access roads, and the Dalton Highway will remain in place. The following discussion and Figure 4.5-10

summarize the one physical impact issue that will endure for the no-action alternative after DR&R is complete. Potential cumulative effects during the three year DR&R are not addressed.

Phy6. Changes to the terrestrial environment (land forms).

Under the no-action alternative, significant restoration of the TAPS ROW will occur after the ROW expires in 2004. Similar DR&R activities would occur to the North Slope production facilities. The effects to the integrity of the terrestrial environment will likely be of relative short duration once the construction activities cease. However, there is the potential for the lasting presence of the work pads, rehabilitated material sites, access roads, pump station sites, and other visible signs of the former pipeline and production systems following DR&R to add to the visible presence of future construction that might occur. The visual or aesthetic effects are discussed in the Section 4.5.4.3.

Potential cumulative effects could be caused by use of the remaining work pads and access roads for recreational or industrial purposes. Such use and future maintenance of access roads would not be under control of the applicants after DR&R is completed to the satisfaction of the authorities. The magnitude of this potential cumulative effect on the terrestrial environment is ranked as low, because resource values and human health would not be impaired after DR&R is complete. Geographic scope is ranked as high, because the effect occurs along the entire length of the pipeline and on the North Slope. It should be noted that the impact is confined to a narrow zone in the TAPS ROW. Frequency/duration is ranked low, because the physical



NOTE: The intensity and probability rankings in this matrix are based on the qualitative criteria in Table 4.5-8.

Figure 4.5-10. *Ranking matrix of cumulative impacts on physical environment (no-action alternative).*

disturbance will be a one time activity (over several years) and the remaining work pads and access roads will stabilize relatively quickly after restoration activities. Intensity is ranked as moderate. The probability that the integrity of the terrestrial environment will be affected is low. The aesthetic impact is discussed in Section 4.5.4.3.

4.5.4.2 No-Action Alternative: Biological Resources

By M.A. Cronin, R.G.B. Senner, S.R. Johnson, L.L. Moulton, H. Whitlaw, W. Ballard, D.W. Fun,. staff of LGL Alaska Research Associates, Inc., and staff of Alaska Biological Research, Inc.

Table 4.5-16 and Figure 4.5-11 summarize the cumulative biological impact associated with the no-action alternative. The analysis in this section follows the procedure described in Section 4.5.1 to analyze potential cumulative effects. Past, present and reasonably foreseeable future actions, in addition to the non-renewal of the TAPS ROW, were identified. Under the no-action alternative, it is assumed that all operations of TAPS, VMT, the ANS oil fields, and oil tanker traffic will stop. DR&R will occur along TAPS and in the ANS oil fields. It is also assumed that no natural gas development will occur on the ANS. The Dalton Highway and other existing roads will remain open to the public, and an NMDS installation will be implemented at Fort Greely. Other industry, such as mining, will continue to develop. The following analysis considered the same impacts and used the same ranking procedure and criteria (Table 4.5-10) as in the analysis of potential cumulative impacts of the proposed action (Section 4.5.3.2).

No-Action: Vegetation and Wetlands

By R.G.B. Senner and D.W. Funk

This section describes the cumulative effects of the no-action alternative on vegetation and wetlands in the Central TAPS and ANS study areas.

Bio36. Wetland and vegetation loss from gravel mining and placement, and dust fallout at roads, pads, and facilities.

DR&R activities would be coordinated from TAPS pump stations, and the labor force would be housed in temporary facilities on pump station sites. These measures would help to ensure that most workers are concentrated at existing facilities on gravel pads and use existing gravel access roads. There may be a requirement for permitted temporary camps and permitted sites for equipment storage and temporarily stockpiled materials at additional locations. If these were needed, vegetation would be removed and/or disturbed at these locations. This is a potential cumulative effect because it might be additive with other construction along the TAPS ROW for installation of an NMDS facility at Ft. Greely, other industry developments, or for construction of campgrounds and facilities for public recreation. In the final stages of TAPS DR&R, disturbed sites would be scarified and fertilized to encourage re-invasion by native plants. Reseeding would occur where erosion is a concern.

Increased dust loads would occur along the Dalton Highway and on TAPS access roads and pads for the three-year period of DR&R. However, dust loads would be high only in a particular location during activity in that sector of the pipeline, and dust loads would decrease substantially following DR&R. Development of the NMDS facility and other industry, as well as increased public access, would have some impact on dust loads as well, primarily concentrated near the facilities and along the Dalton Highway.

The magnitude and geographic scope of this effect are ranked low and frequency/duration is low, for an overall intensity rank of low. The magnitude would be low, because the disturbances would not measurably alter the distribution of a plant community, and other DR&R activity would be conducted on existing workpads and pump station pads. The geographic scope would also be low, because activities on previously undisturbed ground — i.e., off the workpad and off pump stations — would be prohibited except for site-specific permitted facilities as noted above. The frequency and duration would be low, because DR&R will be concluded within about three years. The probability is ranked moderate, because the need for establishing temporary camps or other facilities on previously undisturbed sites during DR&R has not been determined.

Bio37. Changes to natural drainage patterns causing changes to wetlands and vegetation.

Drainage impacts associated with DR&R activities would generally be similar to those occurring for the proposed renewal of the TAPS ROW. Workpads would remain in place, and adjacent impoundments would persist. Conversion of culverts to low water crossings would reduce erosion and scouring associated with cross-drainage and greatly reduce icings at these locations. River training structures would also remain in place and continue to provide habitat for willows and other early successional species where sedimentation occurs in slack-water areas behind the dikes. Some erosion of the unmaintained structures would occur but would be a minor impact. Installation of an NMDS site at Ft. Greely and the development of other industry along the TAPS route would contribute to changes in

BIOLOGICAL CUMULATIVE EFFECTS SUMMARY: NO-ACTION ALTERNATIVE

Potential Effect	PROPOSED ACTION	GAS COMMERCIALIZATION (GTL, LNG, Gas Pipeline)	NORTH SLOPE OIL FIELDS AND ANS TANKER TRADE (Past, Present, Future Development)	PUBLIC ACCESS	MILITARY (NMDS)	OTHER INDUSTRY	Intensity Factors			Ranking	
							Mag	Geo	Freq/ Dur	Int	Prob
VEGETATION AND WETLANDS											
Bio36 **Wetland and vegetation loss from gravel mining and placement, and dust fallout at roads, pads, and facilities.**	DR&R will disturb vegetation along the TAPS ROW. After DR&R, pioneering plant species will colonize the ROW, and plant succession will proceed over the long term. Dust deposition will increase for 3 years during DR&R, then diminish to below existing levels.	No impact.	Well-documented dust shadow effect along heavily traveled roads. Placement of gravel fill for new roads, pads and facilities, has occurred, but newer fields have a substantially reduced footprint and are often roadless. Dust shadow effect along heavily traveled roads would continue if roads are left in place.	Will contribute to dust shadow along the Dalton Highway. Increased ORV use of the TAPS ROW may occur following DR&R resulting in disturbance to plant communities along the ROW.	Gravel placement at facility sites and road dust from construction and facility use.	Gravel placement at facility sites and road dust from construction and facility use.	L	L	L	L	M
Bio37 **Changes to natural drainage patterns causing changes to wetlands and vegetation.**	Because the TAPS workpad will remain in place, impoundments associated with the workpad will continue to affect vegetation productivity and species composition. Conversion of culverts to low-water crossings will eliminate or reduce icing problems at stream crossings.	No impact.	Numerous site-specific changes in natural drainage patterns resulting in localized habitat change and loss of wetlands. Since new facilities with a smaller footprint are sited along natural drainage lines fewer impacts now occur. No impact from future development.	No impact.	Potential localized drainage issues depending on facility siting.	Potential localized drainage issues depending on facility siting.	L	L	H	M	H
Bio38 **Changes in plant community structure resulting from thermokarst.**	Since the TAPS workpad and access roads will be left, revegetated, and not maintained, thermokarst causing localized changes in plant species composition will continue with small amounts of new subsidence.	No impact.	In heavily developed areas about 3% of the total area may be affected resulting in habitat loss and alteration. Thermokarst is probably increasing in those areas. New developments generally cause localized thermokarst. No impact from future development.	No impact.	Minor localized thermokarst.	Minor localized thermokarst depending on the size and location of the development.	L	M	H	M	H
Bio39 **Detrimental impacts on plants from air pollution.**	DR&R will increase exhaust emissions in the ROW over a three-year period. Following DR&R there will be no TAPS associated emissions.	No impact.	No detectable impacts on plants from air pollution have occurred or will occur.	No impact.	Project will probably have little or no impact on plants from air pollution.	Potential for some impacts on local plant communities depending on the type of industry.	L	L	H	L	L
Bio40 **Alteration of the natural fire regime.**	DR&R activities will increase personnel and potential for fire suppression and human caused fires for a period of three-years. After DR&R no impacts will occur.	No impact.	Development has had and will have little or no impact on the natural fire regime.	May increase number of human caused wildfires but is unlikely to have any effect on the natural fire regime.	Potential increase in fire suppression during construction and operation but is unlikely to affect the natural fire regime.	Potential increase in fire suppression during construction and operation.	L	L	L	L	L
Bio41 **Vegetation destruction and alterations from oil, fuel, and chemical spills.**	Minor fuel and oil spills likely but most contained on workpads, some potential for a major spill during pipeline DR&R.	No impact.	Most spills have been contained on workpads, Localized areas of tundra have been killed requiring remediation. No major spills on tundra have occurred. Major spill possible but unlikely. No impact from future development.	Minor fuel and oil spills mostly confined to roadways.	Localized fuel, oil and chemical spills mostly confined to work areas.	Localized fuel, oil and chemical spills mostly confined to work areas.	L	M	L	L	L
Bio42 **Introduction of exotic vegetation from revegetation of disturbed areas.**	Revegetation of the TAPS workpad and access roads will likely introduce some exotic species that are unlikely to displace indigenous species but may slow regrowth of natural communities.	No impact.	Some revegetation of construction and spill impacted sites has occurred and is occurring. Revegetation likely with DR&R of oil fields.	Low level introduction of weedy species.	Revegetation of portions of missile defense site likely.	Revegetation of mined sites and construction impacts are likely to occur.	L	M	M	M	H
FISH											
Bio43 **Obstruction of fish movements in freshwater rivers and streams.**	Removal of culverts at TAPS stream crossings will facilitate fish passage. However, during culvert removal fish may be temporarily stranded.	No impact.	Some impacts have occurred, but populations have not been affected. Some impacts from maintenance activities. Newer developments have a smaller footprint and fewer roads decreasing impacts. No impact from future development.	Little or no impact.	Some impacts possible depending on siting of facility and the road corridors required for the development.	Some impacts possible depending on siting of facility and the road corridors required for the development.	M	M	H	M	H
Bio44 **Obstruction of fish movements in the marine environment due to causeways and docks.**	DR&R of the TAPS ROW will not impact marine fish.	No impact.	Some impacts have occurred at West Dock, but populations have not been affected. Some impacts have occurred, but populations have not been affected. Mitigation efforts have alleviated impacts. No impact from future development. DR&R may remove causeways.	No impact.	No impact.	No impact.	L	L	L	L	L
Bio45 **Alteration of marine habitats.**	DR&R of the TAPS ROW will have no impacts on marine habitats.	No impact.	Impacts have been within discharge and regulatory standards. Minor impacts currently at Northstar development, but DR&R may disturb fish habitat during causeway removal.	No impact.	No impact.	No impact.	L	L	L	L	L
Bio46 **Alteration of freshwater fish habitats.**	DR&R may disturb, dewater, or degrade fish overwintering sites, and may cause stranding during culvert removal. Sedimentation of freshwater habitat in localized areas associated with removal of culverts and erosion of workpads.	No impact.	Some impacts have occurred, but populations have not been affected. Mitigation efforts have alleviated impacts. No impact from future development, but DR&R may disturb fish habitat over the short term.	Following DR&R, public use of ORVs in the ROW may cause erosion and sedimentation at stream crossings, reducing levels of invertebrate prey, fish spawning success, and egg survival.	Potential for some impacts depending on size and location of facilities.	Potential for some impacts depending on size and location of facilities.	M	M	M	M	H

Table 4.5-16.
Biological cumulative effects summary: No-action alternative.

BIOLOGICAL CUMULATIVE EFFECTS SUMMARY: NO-ACTION ALTERNATIVE

Potential Effect	PROPOSED ACTION	GAS COMMERCIALIZATION (GTL, LNG, Gas Pipeline)	NORTH SLOPE OIL FIELDS AND ANS TANKER TRADE (Past, Present, Future Development)	PUBLIC ACCESS	MILITARY (NMDS)	OTHER INDUSTRY	Intensity Factors			Ranking	
							Mag	Geo	Freq/ Dur	Int	Prob
VEGETATION AND WETLANDS (CONT'D)											
Bio47 **Effects of oil, fuel, and chemical spills on fish.**	DR&R of TAPS will not cause spills into marine environments. Small potential for a spill contacting marine waters when the VMT is decommissioned. Off-pad fuel spills during DR&R that reach streams could have lethal or sublethal effects on fish and their food resources in the immediate spill area, but, spills will usually be contained on the gravel pads.	No impact.	Impacts from major tanker spill in past. Potential for spills from marine terminal, tankers and subsea pipelines. Completion of DR&R will eliminate the potential for spills.	No impact.	No impact.	No impact.	M	M	L	M	L
Bio48 **Effects on fish populations from increased fishing.**	Increased sport fishing pressure from public use of decommissioned pads and access roads may lead to overharvest of fish in some areas depending on the level of regulation and enforcement of catch limits.	No impact.	No past or current impact due to access restrictions. Overharvest of fish may occur in some areas depending on the level of regulation and enforcement of catch limits following DR&R of the oil fields.	Increased public access may cause overharvest of fish may occur in some areas depending on the level of regulation and enforcement of catch limits following DR&R of the oil fields.	May increase access somewhat but tight restrictions on access would prevent large impacts from occurring.	May increase access to previously inaccessible areas -- may lead to increased fishing pressure depending on level of regulation/enforcement.	M	H	H	H	H
BIRDS											
Bio49 **Obstruction of bird movements by roads, causeways, pipelines, and other structures.**	There may be minor impacts during DR&R with increased traffic. After DR&R no impact.	No impact.	No permanent obstructions to bird movements have occurred; birds habituate to structures and traffic. After DR&R, most structures and traffic will be gone and there will be no impact.	Increased public access may increase traffic along the TAPS ROW and ANS with a minor impact.	No impact.	There are potentially local impacts	L	L	L	L	L
Bio50 **Disturbance and displacement of birds by traffic, aircraft, and other activities.**	Disturbance of birds may occur during the 3-year DR&R period along TAPS. Following DR&R there will be no impact.	No impact.	Localized disturbances infrequently impact small numbers of birds. Disturbance to birds may occur during the 3-yr DR&R period along TAPS and on the ANS, but there will be no impact after DR&R.	Increased public access may disturb birds, but impacts will be minor.	Local disturbance may occur at the NMDS during construction.	Local impacts may occur at specific sites.	L	L	L	L	M
Bio51 **Bird use of man-made habitats including gravel pads, causeways, artificial islands, and pipelines.**	Removal of TAPS structures will eliminate artificial nesting, perching, and resting sites.	No impact.	Birds use oil-field structures for nesting, perching, and foraging. After DR&R bird use of structures will diminish. Remaining gravel structures will continue to provide habitat. No impact from future development.	No impact.	Birds may use new developments at the NMDS for nesting, perching, and foraging.	Birds may use new developments for nesting, perching, and foraging.	L	M	M	M	M
Bio52 **Loss of bird habitat from roads, pipelines, and other facilities.**	Following DR&R, habitats will be restored to pre-TAPS conditions or some other viable habitat over most of the ROW.	No impact.	Habitats have been altered by gravel and facilities, but there have been no population-level impacts. After DR&R, habitats will be restored or created and there will be limited impact depending on extent of gravel roads and pads left. No impact from future development.	No impact.	Small amounts of habitat will be altered, but impacts to bird populations will be minor.	Small amounts of habitat will be altered, but impacts to bird populations will be minor.	L	L	L	L	L
Bio53 **Early vegetation green-up and habitat use by birds due to deposition of dust from roads.**	Following DR&R, effects from dust fallout will diminish along with traffic levels on the Dalton Highway. Formerly altered habitats will gradually approach pre-oil field and pre-TAPS conditions or some other viable habitat.	No impact.	Positive impacts have occurred where birds aggregate in areas of early spring green-up to feed. After DR&R in ANS oil fields the impact will diminish.	After DR&R, there may be increases in public access along the TAPS corridor that will maintain dust to some extent.	No impact.	Positive impacts may occur near roads.	L	M	M	M	M
Bio54 **Bird habitat changes caused by water impoundments.**	After DR&R some impoundments may remain and will continue to provide bird feeding and nesting habitats.	No impact.	Some impoundments have affected bird habitats and resulted in changes in species using habitats. DR&R may remove some impoundments.	No impact.	Some impacts may occur depending on facility location and design.	Some impacts may occur depending on facility location and design.	L	M	L	L	L
Bio55 **Mortality of birds from highway vehicle roadkills.**	Following DR&R traffic and road kills along the Dalton Highway will decline in frequency.	No impact.	No impact.	Road kills may increase with increased public access.	No impact.	Some mortality possible with increased road traffic; depends on extent and ion of developments.	L	M	L	L	L
Bio56 **Incidental bird mortality at facilities.**	No impact after DR&R.	No impact.	Small numbers of bird mortalities have occurred at oil-field structures. No impact after DR&R.	No impact.	Bird mortality could result at facilities.	Bird mortality could result at facilities.	L	L	L	L	L
Bio57 **Increased predation on birds.**	During the 3-year DR&R period proper garbage management will result in little or no impact. After DR&R no impact.	No impact.	Impacts have occurred in the past, particularly predation on waterfowl and shorebird eggs. During the 3-year DR&R period, proper garbage management will result in little or no impact. No impact after DR&R.	Potential impacts could occur, depending on garbage management by the public.	Potential impacts could occur, depending on garbage management.	Potential impacts could occur, depending on garbage management.	L	L	L	L	L
Bio58 **Injury or death of birds from oil, fuel, or chemical spills.**	No impacts from TAPS and tanker traffic. During DR&R, small fuel spills could have a small impact.	No impact.	No impact in past. Fuel spills during DR&R could impact birds. No impact from future developments.	Small fuel spills could impact small numbers of birds.	Small fuel spills could impact small numbers of birds.	Small fuel spills could impact small numbers of birds.	L	H	L	L	L
Bio59 **Increase in bird hunting from increased access.**	There is a potential impact from increased numbers of workers during DR&R. After DR&R no impact.	No impact.	Access via the Deadhorse airport may have increased hunting pressure on the ANS where hunting is allowed. No impact after DR&R.	Impacts may increase with increases in public access.	Possibly increased hunting will result from new military personnel.	Impacts may increase with increased access, depending on location and extent of development.	L	H	M	M	M

Table 4.5-16 (Cont'd).
Biological cumulative effects summary: No-action alternative.

BIOLOGICAL CUMULATIVE EFFECTS SUMMARY: NO-ACTION ALTERNATIVE

Potential Effect	PROPOSED ACTION	GAS COMMERCIALIZATION (GTL, LNG, Gas Pipeline)	NORTH SLOPE OIL FIELDS AND ANS TANKER TRADE (Past, Present, Future Development)	PUBLIC ACCESS	MILITARY (NMDS)	OTHER INDUSTRY	Intensity Factors			Ranking	
							Mag	Geo	Freq/ Dur	Int	Prob
TERRESTRIAL MAMMALS											
Bio60 **Obstruction of mammal movements by roads, pipelines, and facilities.**	Removal of the above-ground pipeline in the TAPS ROW will completely stop this impact. During the 3-year DR&R period, traffic and other activity may cause localized obstruction to movement of terrestrial mammals.	No impact.	Some wildlife movements may have been obstructed, but no population level impacts have occurred. Some obstruction of movement may occur during DR&R, but no impact after that.	Increased traffic may cause some obstruction of terrestrial mammal movement.	No impacts are expected except possibly during the construction phase.	Depending on extent and location of activity, vehicle traffic or new roads may deflect wildlife movements.	L	L	L	L	L
Bio61 **Disturbance and displacement of large mammals by human activities.**	Noise and activity associated with DR&R will disturb and displace some mammals. No impact after DR&R.	No impact.	Some disturbance and displacement of calving caribou on the ANS have occurred, but with no population-level impacts. Some disturbance displacement of calving caribou may occur during DR&R. No impact after DR&R.	Increased public access in PWS, the TAPS ROW, and the ANS may result in increased disturbance of terrestrial mammals.	No impacts are expected except possibly during the construction phase.	Depending on extent and location of activity, vehicles, aircraft, or other human activity may disturb and displace terrestrial mammals.	L	M	L	L	L
Bio62 **Reduced habitat quality for terrestrial mammals caused by fragmentation and alteration of habitat.**	During DR&R, habitat alteration will result from ground disturbance, and dust fallout. Following DR&R, later successional stages will gradually replacing currently disturbed areas.	No impact.	Mammalian habitats have been altered in the ANS oil fields, but no population-level effects have occurred. Insect relief habitat will be lost as gravel, and buildings and pipelines providing shade are removed in DR&R. Revegetation of gravel fill may provide more foraging areas. No impact from future development.	No impact.	Minor impacts may occur at the development site.	Impacts may occur at development sites, depending on the location and extent of projects.	L	L	L	L	L
Bio63 **Mortality of terrestrial mammals from highway vehicle roadkills.**	During DR&R, the incidence of roadkills could increase as a result of higher traffic levels on the Dalton Highway. No impact after DR&R.	No impact.	Occasional roadkills have occurred in the ANS oil fields. Occasional roadkills may occur during DR&R. No impact after DR&R.	Increased public access could result in increased numbers of roadkills on public highways.	Traffic associated with new military developments could result in increased road kills.	This impact depends on the amounts of traffic associated with new industry activity.	L	M	L	L	L
Bio64 **Effects on predators from anthropogenic food sources and habitat enhancement.**	DR&R activity may attract predators and scavengers, potentially increasing the mortality. No impact after DR&R.	No impact.	Predator populations have probably been enhanced by anthropogenic food in the ANS oil fields. However, mortality in adjacent areas has also occurred. Recent mitigation and management actions may have reduced this impact. DR&R should have minimum impacts if strict control of anthropogenic food sources is implemented. No impact after DR&R.	Increased public access could provide anthropogenic food for predators depending on the extent of garbage and other foods made available to wildlife.	This impact depends on the quality of control of anthropogenic food sources at the military installation.	This impact depends on the quality of control of anthropogenic food by other industries and regulators.	L	M	L	L	L
Bio65 **Mortality, injury, or disturbance of terrestrial mammals from oil, fuel, or chemical spills.**	Fuel spills could increase in frequency during DR&R, but they are not likely to affect terrestrial mammals. No impact after DR&R.	No impact.	No impact in past. Fuel spills could increase in frequency during DR&R, but they are not likely to affect terrestrial mammals. No impact after DR&R.	No impact.	No impact.	No impact.	L	L	L	L	L
Bio66 **Increased hunting of terrestrial wildlife from increased access**.	There is a potential impact from increased numbers of workers during DR&R. After DR&R no impact.	No impact.	Access provided from Deadhorse airport has increased hunting pressure on ANS outside the oil fields. There is a potential impact from increased numbers of workers during DR&R. No impact after DR&R.	Increased access from TAPS roads, Dalton Highway, and facilities has increased hunting pressure. Regulatory changes maintain populations to meet objectives.	Increased military personnel could add to hunting pressure.	New human presence in rural areas could increase hunting pressure.	M	H	H	H	H
MARINE MAMMALS											
Bio67 **Disturbance and displacement of marine mammals by petroleum-related operations.**	DR&R of the TAPS ROW will not disturb marine mammals.	No impact.	Offshore exploration and development at Endicott and West Dock may have disturbed some marine mammals. Potential disturbance could occur during DR&R of offshore facilities. No impact after DR&R.	Increased public access in PWS may disturb marine mammals.	No impact.	No impact.	L	L	L	L	L
Bio68 **Mortality, injury, disturbance, or alteration of habitats for marine mammals from oil, fuel, or chemical spills.**	Spills from TAPS DR&R activities will not impact marine mammals. No impact after DR&R.	No impact.	Past spill of ANS oil into PWS from the *Exxon Valdez* resulted in mortality of sea otters and seals and potential impacts on whales. Small potential for fuel spills during DR&R of offshore facilities. No impact after DR&R.	No impact.	No impact.	Spills near the coast could impact marine mammals.	L	L	L	L	L
THREATENED / ENDANGERED SPECIES											
Bio69 **Collisions of eiders with onshore or offshore structures.**	DR&R will remove aboveground structures eliminating collisions. No impact after DR&R.	No impact.	There are possibly a few instances where this impact occurred. DR&R will remove the threat of this impact. No impact after DR&R.	No impact.	No impact.	No impact.	L	L	L	L	L
Bio70 **Disturbance of Spectacled and Steller's eiders on the North Slope from noise and activities from oil-field operations.**	DR&R of TAPS on the North Slope may disturb a few eiders. No impact after DR&R.	No impact.	Some disturbances of eiders probably have occurred but with no effect on the population. Some disturbances of eiders currently may occur but will be minimized by regulation. Noise and activities from oil-field DR&R may result in disturbance of Spectacled and Steller's eiders on the North Slope. No impact after DR&R.	No impact.	No impact.	No impact.	L	L	L	L	L

Table 4.5-16 (Cont'd).
Biological cumulative effects summary: No-action alternative.

INTENSITY \ PROBABILITY	Low	Moderate	High
High			Bio48 Impact on fish populations from increased fishing Bio66 Impacts on terrestrial mammal populations from increased hunting
Moderate	Bio47 Impact on fish from spills	Bio51 Bird use of man-made habitat Bio53 Bird use of dust shadow vegetation Bio59 Increased bird hunting because of increased access	Bio37 Wetland change/loss from water flow changes Bio38 Plant community changes from thermokarst Bio42 Exotic plants introduced by revegetation Bio43 Fish movement obstructions in freshwater streams Bio46 Alteration of freshwater habitats
Low	Bio39 Plant damage from air pollution Bio40 Alteration of natural fire regime Bio41 Habitat change from toxic spills Bio44 Fish movement obstructions in marine water from causeways Bio45 Alteration of marine habitats Bio49 Bird movement obstructions from facilities Bio52 Loss of bird habitat from facilities Bio54 Bird habitat changes from impoundments Bio55 Bird mortality on roads Bio56 Increased predation on birds Bio57 Incidental bird mortality at facilities Bio58 Bird mortality or injury from spills Bio60 Obstruction of mammal movements by facilities Bio61 Disturbance/displacement of mammals by human activities Bio62 Decrease in habitat quality for terrestrial mammals because of habitat fragmentation/alteration Bio63 Roadkills of mammals Bio64 Impacts on predators from anthropogenic food sources Bio65 Impacts of oil spills on terrestrial mammals Bio67 Disturbance/displacement of marine mammals by activities Bio68 Impacts of oil spills on marine mammals Bio69 Eider mortality from collision with facilities Bio70 Disturbance of Spectacled and Steller's eiders from noise	Bio36 Wetland change from gravel mining/placement and dust Bio50 Disturbance/displacement of birdsfrom traffic and activities	

Not Significant | Potentially Significant | Significant

NOTE: The intensity and probability rankings in this matrix are based on the qualitative criteria in Table 4.5-10.

***Figure 4.5-11**. Ranking matrix of cumulative impacts on biological environment (no- action alternative).*

drainage patterns in localized areas. Increased public access along the ROW would have little impact on drainage patterns.

Magnitude and geographic scope are ranked low and frequency/duration is ranked high, giving an overall intensity rank of moderate. The probability is ranked high. Magnitude and geographic scope are ranked low because impacts would occur at specific locations and would not measurably alter the distribution of a plant community. The frequency/duration of the impacts would be high since the altered drainage patterns are likely to remain after DR&R. The probability of these impacts is high because the effects of changes in drainage patterns will remain since roads and workpads will remain in place after DR&R.

Bio38. Changes in plant community structure resulting from thermokarst.

Thermokarst associated with TAPS workpads left in place would have little additional effect on adjacent areas, but may enhance revegetation by increasing soil moisture and creating a diversity of habitats around the workpads. Thermokarst associated with TAPS impoundments would persist and continue developing in place. Minor localized thermokarst would be likely from development of an NMDS site at Ft. Greely and from other industry developments along the ROW. The amount of thermokarst occurring from these developments would depend on the size and locations of the facilities.

Cumulative thermokarst impacts from DR&R activities and future developments would have low magnitude and moderate geographic scope but would be of high frequency/duration, giving an intensity rank of moderate. The probability of impacts occurring is high. Magnitude is ranked low because effects are site-specific and would not alter the distribution of a plant community. However, the geographic scope is moderate reflecting the continued effects of current thermokarst that would remain and develop in place in the ANS oil fields and along the TAPS route. Frequency/duration is ranked high because these effects will continue following DR&R. Because effects will continue, the probability is high.

Bio39. Detrimental impacts on plants from air pollution.

DR&R activities along the TAPS ROW will cause little or no impact on plants from air pollution. Vehicle emissions will increase during the three-year period of DR&R but will end when DR&R is completed. Development of other industry along the TAPS route may have localized impacts on plants from pollution depending on the type of industry and location of the facility. An NMDS site at Ft. Greely is unlikely to impact concentrations of air pollutants reaching plants. No cumulative impacts on plants from air pollutants are anticipated from DR&R activities.

Magnitude and geographic scope are ranked low and frequency/duration is ranked high, for an overall intensity of low. Probability is ranked low. Magnitude and geographic scope are ranked low because potential impacts would occur in only a few locations and would not alter the distribution of plant communities. Frequency/duration is ranked high because emissions from potential development facilities would occur on a regular basis. Intensity is ranked low despite the high ranking for frequency/duration because removal of TAPS would greatly limit impacts. The probability of impacts occurring is low since current facilities have not produced detectable impacts on vegetation.

Bio40. Alteration of the natural fire regime.

DR&R activities will increase the number of people and the amount of equipment along the ROW for a three-year period. During that time, potential fire suppression would increase for work areas. Conversely, there would also be an increased potential for human-caused fire. Neither of these effects of DR&R are likely to impact the natural fire regime. Development of other industry and an NMDS site at Ft. Greely will also increase the number of people and facilities in the vicinity of the ROW and would increase the potential for fire suppression and for human-caused fires. These activities could alter the natural fire regimes in areas of human development.

Magnitude, geographic scope, and frequency/duration are all ranked low, giving an intensity ranking of low. Probability is also ranked low. The magnitude and geographic scope of these impacts are low because they would be site-specific. Frequency/duration of the impacts is also ranked low because they would be infrequent. The probability of influencing the natural fire regime is low.

Bio41. Vegetation destruction and alteration from oil, fuel, and chemical spills.

Fuel, oil, and chemical spills may occur during the three years of DR&R, because of the large number of vehicles involved and the potential for spills as pipe is decommissioned. Most of these spills would be confined to gravel pads and roads, but some could contact vegetation. After DR&R, spills from TAPS would not occur. Some fuel spills could still occur along the road system from public access. Most of these spills would be confined to the roadways and would be unlikely to contact vegetation. Development of an

NMDS site at Ft. Greely and the development of other industry would also likely contribute to spills of toxic material. These spills would probably occur in defined work areas and would not in most cases contact vegetation.

Magnitude is ranked low, geographic scope moderate, and frequency/duration low, giving an intensity rank of low. Probability is low. The magnitude of these impacts would be low because spills would be confined to small areas and would not alter plant community distributions. The geographic scope is moderate because spills could occur along TAPS and on the ANS but primarily during DR&R. Spills would likely be infrequent, and frequency/duration is thus ranked low. The probability of a spill reaching vegetation is low. Following DR&R, the probability of a spill would decrease to that associated with other industry developments and the NMDS facility.

Bio42. Introduction of exotic vegetation from revegetation of disturbed areas.

As for the proposed action, this unintentional effect of revegetation would very likely follow any reseeding conducted during DR&R. The removal of above-ground pipeline and facilities along the TAPS ROW would require extensive site rehabilitation. Much of this effort could be accomplished with scarification and fertilization alone, without reseeding, to encourage the invasion of pioneer species from surrounding native plant populations. However, in erosion-prone areas, reseeding is an effective mitigation measure, and the introduction of exotic weedy species would be a probable side-effect. The result of introducing exotic plants on the North Slope and along the TAPS ROW in this fashion has usually been benign and has not led to large-scale replacement of indigenous plant species. However, in some cases these species may slow the reformation of natural plant communities and successional patterns on disturbed sites. This impact could occur in localized areas along the TAPS ROW near other construction, for example, with the Ft. Greely NMDS installation or with the development of recreational facilities.

The magnitude of this impact is ranked low, the geographic scope moderate, and frequency/duration moderate, giving an overall intensity of moderate. The probability for at least occasional unintended introductions of exotics would be high. The magnitude is ranked low because revegetation would be site-specific and not alter the distribution of plant communities. Geographic scope is moderate because revegetation would occur along the TAPS ROW and throughout the ANS oil fields during DR&R. The frequency/duration is ranked moderate because revegetation would occur intermittently during and after DR&R.

No-Action: Fish

By L.L. Moulton

Bio43. Obstruction of fish movements in freshwater rivers and streams.

Although culverts will be removed during DR&R and TAPS traffic at low water crossings will cease, the public will probably use the workpad for subsistence and recreational access for the foreseeable future. Vehicles — including trucks, ATVs, and snowmachines — will continue to cross streams at or near the points where the workpad intersects them. This may occur whether or not measures are taken to prevent this and whether or not the workpad drive-lane is publicly regulated and maintained after the TAPS ROW is terminated. Development of other industry sites and an NMDS site at Ft. Greely would potentially cause some additional site-specific impacts depending on the size and location of the facilities and access roads.

Magnitude is ranked moderate, geographic scope is moderate, and frequency/duration is high, for an overall intensity rank of moderate. Probability is ranked high. The magnitude is moderate because impeding fish migration at problem crossings can lead to loss of upstream spawning groups. Because these types of impacts can occur all along the TAPS route, geographic scope is rated moderate. The frequency/duration of impediments to migration can be high since the crossings are dynamic and subject to alteration at least annually during the spring flood and more frequently if there are high flows during summer. High traffic levels at low water crossings, particularly during high-use periods such as the moose-hunting season, will also influence the frequency and duration of the effect. The probability is also high because this problem may occur after DR&R.

Bio44. Obstruction of fish movements in the marine environment due to causeways and docks.

DR&R of TAPS will not affect marine fish movements, and DR&R of the North Slope oil fields will probably remove causeways. Past and current developments have had some impacts on fish movements at West Dock, but no population-level impacts have occurred. Current mitigation techniques have reduced or eliminated most impacts to marine fish. Increased public access to the ROW, development of an NMDS site at Ft. Greely, and development of other industry along the TAPS route will have no impact on marine fish movements.

Magnitude and geographic scope of this effect are ranked low, and frequency duration is ranked low, giving an intensity rank of low. Probability of this impact is low. The

magnitude is low because it will not affect fish populations. Geographic scope is also ranked low because only marine fish nearshore to the North Slope oil fields have been affected. Frequency/duration and probability are low since structures will be removed during DR&R.

Bio45. Alteration of marine habitats.

DR&R of TAPS would have no impacts on marine fish habitats. DR&R of the North Slope oil fields would have impacts on marine fish habitats during removal of offshore man-made structures. Some disturbance of habitats near causeways and islands may occur but would impact a limited area. Recreation/tourism, new industry, or development of an NMDS site would not impact marine fish habitat.

Magnitude, geographic scope, and frequency/duration are ranked low, for an overall intensity of low. Probability is low. Magnitude and geographic scope are ranked low because potential effects are site-specific and will not affect fish populations. Frequency/duration and probability are low because the impact will be stop after DR&R.

Bio46. Alteration of freshwater fish habitats.

DR&R activities may contribute to erosion and increased sedimentation in some streams. DR&R may also disturb, dewater, or degrade fish overwintering sites, and may cause stranding during culvert removal. Following DR&R, public use of off-road vehicles in the ROW may cause erosion and sedimentation at stream crossings. New industry developments and construction of an NMDS will also contribute to sedimentation in freshwater streams. The amount of impact from these new developments will depend on their location and size, and the number of stream crossings required.

Magnitude, geographic scope, and frequency/duration are ranked moderate, giving an intensity rank of moderate. Probability of the impact occurring is high. The magnitude is moderate because increased sedimentation and other forms of habitat loss can lead to loss of overwintering or spawning habitats downstream from problem areas. These types of impacts can occur along the TAPS route, which leads to a moderate geographic rating. The frequency/duration is moderate because the impact occurs intermittently, at least through the DR&R phase. The probability of this impact is high, because it will occur during DR&R and when public access restrictions in the TAPS ROW end.

Bio47. Effects of oil, fuel, and chemical spills on fish.

During DR&R, off-pad fuel spills that reach streams could have lethal or sublethal effects on fish and their food resources in the immediate spill area. However, spills have usually been contained on the gravel pads, and it is probable that this would also occur during DR&R. Following DR&R, spills would be limited to those caused by public access, which would most likely be small and would occur along the road system. New industry development and an NMDS site would also probably contribute to oil, fuel, and chemical spills. In most cases these would be confined to workpads and would be small, but there is potential for spills contacting fresh water and impacting fish in the local area.

Magnitude is ranked moderate, geographic scope is moderate, and frequency/duration is low, giving an intensity rank of moderate. The probability is ranked low. The magnitude of this impact is moderate because spills could result in measurable lethal or sublethal effects on fish. The geographic scope is moderate because spills could occur along the TAPS ROW and on ANS during DR&R, but would be unlikely to contact water and fish in most instances. The frequency/duration is ranked low since spills that contact water and fish would be infrequent and generally are short-term events. The probability of the impacts is low. It is likely that spills will occur, but unlikely those spills will contact fresh water and impact fish.

Bio48. Effects on fish populations from increased fishing.

Increased access and increased human presence — i.e., elimination of the “refuge” effect — may intensify fishing after DR&R along TAPS and on the ANS. As discussed under the proposed action, overharvest can occur when access is provided to desirable resources and fishing regulations and enforcement do not adequately control harvest. Developments in remote areas, such as along the TAPS ROW and the Dalton Highway, can allow access to previously unavailable harvest opportunities (BLM, 1972). The problem is magnified in northern areas because productivity is low and populations are more susceptible to excessive harvest. While DR&R activities will decrease access to some areas as facilities are decommissioned, other areas may become more accessible to the public as current restrictions for use are eliminated. The end of oil industry operations will be accompanied by significant reductions in statewide employment. This may increase the subsistence or commercial harvest of fish to compensate for the loss of income (see Sections 4.4 and 4.5). If decreased state revenue results in less enforcement of fish and game regulations, this impact could be intensified. However, it is also possible that the human population (and fish and wildlife harvests) will decrease in response to the economic decline

Development of other industry may also increase access

to areas not previously used for fishing. Development of an NMDS site at Ft. Greely is unlikely to contribute to this impact since the site would have high security.

Magnitude is ranked moderate, geographic scope is high, and frequency/duration is ranked high, for an overall intensity rank of high. Probability of this impact is high. The intensity of this impact is rated high, but the impact can be controlled through regulation and enforcement. The magnitude is moderate because overharvest at former TAPS access points could lead to substantial reductions in local stocks. Harvest impacts could occur all along the TAPS route or on the ANS, leading to a high geographic scope rating. The frequency/duration is high because overharvest could occur annually during the open-water season when fish are migrating between feeding, rearing, and spawning areas. The probability of this impact is high because it is a current and continuing issue, and because the policy for mitigating it in the event of TAPS ROW termination and North Slope oil field decommissioning has not been established.

No-Action: Birds

By S.R. Johnson

Bio49. Obstruction of bird movements by roads, causeways, pipelines, and other structures.

This impact may occur from traffic associated with DR&R activity. After DR&R, the TAPS and ANS pipelines will be gone, and traffic on oil field roads reduced or stopped entirely. Impacts from public access and other industry could occur, depending on levels and locations of traffic. The magnitude, geographic scope, and frequency/duration of the impact are low, for an overall intensity of low. The probability of the impact is low.

Bio50. Disturbance and displacement of birds by traffic, aircraft, and other activities.

Birds could be disturbed or displaced by DR&R activity. After DR&R, there will be no disturbance from activity along TAPS, in the ANS oil fields, or at the VMT. Other industry developments and increased public access along the Dalton Highway and remnants of the TAPS workpad and side roads could disturb and displace breeding, postbreeding, molting or brood-rearing birds. The NMDS may have local impacts during construction. The magnitude, geographic scope, and frequency/duration of the impact are low, for an overall intensity of low. The probability is moderate that human activities will disturb and displace some birds on a site-specific and intermittent basis.

Bio51. Bird use of man-made habitats including gravel pads, causeways, artificial islands, and pipelines.

The nature and extent of this impact depend on the nature of the DR&R efforts. Since above-ground pipelines will all be removed, these structures will no longer be available for nesting and perching. The use of gravel habitats for nesting and perching along TAPS and on the ANS will continue if pads, roads, artificial islands in the Beaufort Sea, and the Endicott Causeway are left in place. Many gravel structures will be revegetated, naturally or as part of the DR&R plan. The impact will be negative for species that currently use TAPS and oil field structures and potentially positive for those that do not.

The magnitude of this impact will be low, the geographic scope moderate, and the frequency/duration moderate, for an overall intensity of moderate. The probability of the impact is moderate.

Bio52. Loss of bird habitat from roads, pipelines, and other facilities.

In general, bird habitats lost to TAPS, ANS oil fields, and VMT facilities will be reclaimed during DR&R, although the habitat type may be different from the original. Some roads, pads, and facilities may remain, but most infrastructure will be removed or revegetated. The magnitude, geographic scope, and frequency/duration of the impact are low, for an overall intensity of low. The probability of the impact is low.

Bio53. Early vegetation green-up and habitat use by birds due to deposition of dust from roads.

Traffic associated with non-petroleum industry and tourism and recreation will probably maintain dust shadows along the Dalton Highway and adjacent side roads as long as roads and gravel pads remain unpaved. The extent of the dust shadows may decrease with decreasing traffic in the ANS oil fields and along the Dalton Highway. The duration of impacts is annual, primarily in early spring. The effects on the energy balance of bird populations have not been studied, but they are likely highly beneficial. The magnitude of this impact will be low, the geographic scope moderate, and the frequency/duration moderate, for an overall intensity of moderate. The probability of the impact is moderate.

Bio54. Bird habitat changes caused by water impoundments.

In some areas along the TAPS ROW and in the ANS oil fields, road and gravel pad construction has resulted in

impounded water bodies that affect bird habitats. DR&R may remove most structures that cause impoundments, but some may remain. The amount of habitat and numbers of birds affected will be small relative to other habitat available. The magnitude of this impact will be low, the geographic scope moderate, and the frequency/duration low, for an overall intensity of low. The probability is low.

Bio55. Mortality of birds from highway vehicle roadkills.

Highway traffic will continue to kill some birds during and after DR&R of TAPS and the ANS oil fields. The attraction of birds to the unpaved roads, including the Dalton Highway, by the early green-up effect will continue. However, roadkills will decline since commercial traffic to the ANS will stop. The magnitude of this impact will be low, the geographic scope moderate, and the frequency/duration low, for an overall intensity of low. The probability of the impact is low.

Bio56. Incidental bird mortality at facilities.

Facilities at the VMT, TAPS pump stations, and in the ANS oil fields will be removed during DR&R. Incidental mortalities will not occur any longer. The magnitude of this impact will be low, the geographic scope low, and the frequency/duration low, for an overall intensity of low. The probability of the impact is low.

Bio57. Increased predation on birds.

Operations at the VMT, TAPS pump stations, and in the ANS oil fields will stop after DR&R. It is possible that anthropogenic foods will be available to predators during the DR&R phase, as during construction. However, recognition of this problem should result in better management of garbage and feeding of wildlife during DR&R. Predator populations will not be enhanced by anthropogenic food from oil and gas operations after DR&R. Increased predation on birds will therefore stop. Increased public access or other industry activity could maintain this impact to some extent. The magnitude of this impact will be low, the geographic scope low, and the frequency/duration low, for an overall intensity of low. The probability is low.

Bio58. Injury or death of birds from oil, fuel, or chemical spills.

This impact will decline dramatically after oil and gas operations stop. There will no longer be the potential for large spills from TAPS or ANS pipelines or tankers in Prince William Sound. Small fuel spills during DR&R and from public access and other industry may occur from PWS to the ANS. The magnitude of this impact will be low, the geographic scope high, and the frequency/duration low, for an overall intensity of low. The probability is low.

Bio59. Increase in bird hunting from increased access.

Bird hunting will probably stay at the same levels after oil and gas operations stop along TAPS and on the ANS. If public access is allowed in the abandoned and restored ANS oil fields, bird hunting may increase there. The end of oil industry operations will be accompanied by significant reductions in statewide employment. This may increase the subsistence harvest of birds to compensate for the loss of income (see Sections 4.4 and 4.5). If decreased state revenue results in less enforcement of fish and game regulations, this impact could be intensified. However, it is also possible that the human population (and fish and wildlife harvests) will decrease in response to the economic decline.

The magnitude of this impact will remain low, the geographic scope will be high if the ANS is opened to hunting, and the frequency/duration moderate, for an overall intensity of moderate. The probability of the impact is moderate.

No-Action: Terrestrial Mammals

By W. Ballard, M.A. Cronin, H. Whitlaw

Bio60. Obstruction of mammal movements by roads, pipelines, and facilities.

After DR&R, above-ground pipelines will be removed, and traffic will decrease substantially along TAPS and in the ANS oil fields. The obstruction of wildlife movements will be restricted to impacts from public and other-industry traffic on roads. Most traffic would probably occur in summer. During the three years of DR&R, traffic along TAPS could increase from associated activity, with some effect on animal movements. However, traffic during construction and operation of TAPS have not affected wildlife at the population level, and this will also be the case during the DR&R phase as well.

The magnitude of this impact will remain low, the geographic scope low, and the frequency/duration low, for an overall intensity of low. The probability is low.

Bio61. Disturbance and displacement of large mammals by human activities.

After DR&R, activity along TAPS, at the VMT, and in the ANS oil fields will stop, and this impact will be greatly diminished. Public access and other industry activity will include year-round human presence (mainly recreational vehicles, ATVs, snowmachines) along the Dalton Highway

and TAPS ROW and will cause some noise and disturbance of wildlife. The level of recreational use of the highways and TAPS remnants following DR&R is unknown but can be assumed to be similar to current levels.

The DR&R phase will involve some disturbance along the TAPS ROW and on the ANS from noise, and vehicle and equipment operations. This can be minimized by restricting or prohibiting activity during sensitive times such as when caribou are calving.

The magnitude of this impact will remain low, the geographic scope moderate, and the frequency/duration low, for an overall intensity of low. The probability is low.

Bio62. Reduced habitat quality for terrestrial mammals caused by fragmentation and alteration of habitat.

In general, DR&R will restore habitats to the pre-TAPS condition or to other viable habitat. In the ANS oil fields, removal or revegetation of roads and pads may provide additional foraging habitats but will remove insect-relief habitat. The removal of oil field buildings and pipelines will decrease the amount of shade available to caribou, thus reducing the relief available from oestrid flies.

The magnitude of this impact is low, the geographic scope low, and the frequency/duration low, for an overall intensity of low. The probability of the impact is low.

Bio63. Mortality of terrestrial mammals from highway vehicle roadkills.

Highway traffic will continue to kill some wildlife during and after DR&R of TAPS and the ANS oil fields. A small proportion of the roadkills in Alaska are on the Richardson or Dalton Highways (ADOT, 1996). Wildlife mortality due to collisions with vehicles has not been identified as a significant limiting factor for populations in the vicinity of the TAPS ROW. There is no evidence of adverse population-level effects. Increased traffic during DR&R of TAPS may increase the numbers of roadkills for three years, but the subsequent reduction in TAPS and ANS traffic will then reduce the numbers. Local and recreational traffic will continue after DR&R and cause some roadkills.

The magnitude of this impact is low, the geographic scope moderate, and the frequency/duration low, for an overall intensity of low. The probability is low.

Bio64. Effects on predators from anthropogenic food sources and habitat enhancement.

Garbage and other anthropogenic food sources from oil and gas industry sources will no longer be available after DR&R, and this impact will stop in the ANS oil fields. The impact could occur along TAPS, at the VMT, and in the ANS oil fields during DR&R. The intentional feeding of wildlife and the use of garbage occurred during TAPS construction (McCarthy and Seavoy, 1994; Follmann and Hechtel, 1990; Miller and Chihuly, 1987; Milke, 1977; also see Section 4.3.2.5). However, this impact is no longer a problem in the TAPS ROW because of Alyeska's improved garbage management and prohibition on feeding animals. These same management practices can be implemented during DR&R to limit this impact. The recreational-use areas along TAPS may result in this impact after DR&R. However, mortality of nuisance wildlife has not been identified as a significant limiting factor for populations in the vicinity of the TAPS ROW, and there is no evidence of adverse population-level effects.

The magnitude of this impact is low, the geographic scope moderate, and the frequency/duration low, for an overall intensity of low. The probability is low.

Bio65. Mortality, injury, or disturbance of terrestrial mammals from oil, fuel, or chemical spills.

The potential for oil spills from TAPS and ANS pipelines or tankers will cease after operations are stopped. A potential for fuel spills during DR&R and from other industry operations and public vehicles will remain, but such spills are unlikely to impact terrestrial mammals.

The magnitude of this impact is low, the geographic scope low, and the frequency/duration low, for an overall intensity of low. The probability of the impact is low.

Bio66. Increased hunting of terrestrial wildlife from increased access.

Hunting of terrestrial mammals will probably stay at the same levels after oil and gas operations stop along TAPS and on the ANS. Hunting is currently prohibited in he Prudhoe Bay Closed Area. If this changes with DR&R, wildlife populations could be impacted more than they are with the oil fields in operation. Hunting of caribou, grizzly bear, polar bear, and muskoxen, and trapping of furbearers from the oil field roads after DR&R could change distributions and numbers. Since oil-field development, the caribou and grizzly bear populations have been able to grow and use traditional habitats in the oil fields, but this could change if hunting and trapping were allowed in this area. Depending on the regulation of hunting and trapping after DR&R, access provided by oil field roads would make this issue potentially important to maintain current numbers and distribution of terrestrial wildlife. It is likely that hunting regulations would be imposed, as in other areas, to achieve herd objectives.

The end of oil industry operations will be accompanied

by significant reductions in statewide employment. This may increase the subsistence harvest of mammals to compensate for the loss of income (see Sections 4.4 and 4.5). If decreased state revenue results in less enforcement of fish and game regulations, this impact could be intensified. However, it is also possible that the human population (and fish and wildlife harvests) will decrease in response to the economic decline.

Hunting could increase during the three years of DR&R with the influx of workers. Hunting will probably not be allowed while workers are on-shift, but access to remote areas may allow them to hunt while off-duty.

The magnitude of this impact is moderate, the geographic scope high, and the frequency/duration high, for an overall intensity of high. The probability is high.

No-Action: Marine Mammals

By R. Senner and M.A. Cronin

Bio67. Disturbance and displacement of marine mammals by petroleum-related operations.

After DR&R, there would be no impacts on marine mammals from the oil and gas industry in either the Beaufort Sea or Prince William Sound. The DR&R phase would include some noise at offshore facilities (Northstar and Endicott), but restricting activity outside the bowhead whale migration would minimize impacts. Increased public access, primarily in Prince William Sound, could disturb some marine mammals.

The magnitude of this impact is low, the geographic scope is low, and the frequency/duration low for an overall intensity of low. The probability of the impact is low.

Bio68. Mortality, injury, disturbance, or alteration of habitats for marine mammals from oil, fuel, or chemical spills.

After DR&R, there would be no potential for oil and gas industry spills that impact marine mammals in either the Beaufort Sea or Prince William Sound. The DR&R phase would include the potential for fuel spills at offshore facilities (Northstar and Endicott), but most spills would be confined to the gravel islands.

Increased public access and other industry activity, primarily in Prince William Sound, may include fuel spills that could impact marine mammals. The volumes spilled and numbers of animals impacted would be relatively small.

The magnitude of this impact is low, the geographic scope is low, and the frequency/duration low for an overall intensity of low. The probability of the impact is low.

No Action: Threatened and Endangered Species

By R. Senner and M.A. Cronin

Bio69. Collisions of eiders with onshore or offshore structures.

Onshore and offshore facilities in the ANS oil fields will be removed during DR&R. Collisions of eiders with structures will not occur. The magnitude of this impact is low, the geographic scope low, and the frequency/duration low, for an overall intensity of low. The probability of the impact is low.

Bio70. Disturbance of Spectacled and Steller's eiders on the North Slope from noise and activities from oil-field operations.

After DR&R, oil field activity on the ANS and along the northern portion of TAPS will stop, and this impact will not occur. Other industry activity or public access in the range of eiders could result in disturbance. During the three years of DR&R, noise and human activity could disturb some eiders. The magnitude of this impact is low, the geographic scope low, and the frequency/duration low, for an overall intensity of low. The probability of the impact is low.

No-Action: Biological, Cumulative Effects Summary

In summary, under the no-action alternative, two potential biological cumulative impacts met the significance criteria of high intensity and high probability:

- **Bio48**. Impacts on fish populations from recreational fishing.
- **Bio66**. Impacts on terrestrial mammal populations from increased hunting.

Both of these impacts can be mitigated by regulation and enforcement by the appropriate agencies. Other impacts could potentially be biologically important, depending on chance events (e.g., oil spills) or mitigation during and after DR&R. In general after DR&R, TAPS, ANS oil fields, and oil tanker traffic will have ceased operations and direct impacts will no longer occur. The primary cumulative impacts that will continue relate to the increased access to remote areas provided by roads built during operation of TAPS, such as increased hunting or fishing pressure.

4.5.4.3 No-Action Alternative: Social Issues

By L.D. Maxim, O.S. Goldsmith, M. Galginaitis, C. Gerlach, P. Bowers, C. Wooley, R. Niebo

This section examines the cumulative effects that would

result from selection of the no-action alternative. In brief, the no-action alternative would halt all ANS production at the end of 2003 and initiate DR&R activities for ANS facilities, the pipeline, VMT, and tanker transport of crude oil from Valdez. Refineries dependent on ANS output would also close. Alaska would become a net importer of crude oil and/or refined products, and tanker shipments into Alaska would be increased to satisfy in-state demand.

The no-action alternative would also foreclose gas commercialization, including GTL, TAGS, and the ANGTS pipeline for the foreseeable future. It is assumed that the NMDS site at Fort Greely is implemented in any event, although the incremental effects of this action are minor and very localized.

Table 4.5-17 shows a list of issues potentially relevant to the no-action alternative, while Figure 4.5-12 presents the summary effect-ranking matrix. As for the proposed action, these are grouped into "issue clusters" for analysis: economics, social change, subsistence, visual/recreational, environmental justice, and land issues. Effects are characterized in terms of intensity and probability.

The economic and social consequences of selecting the no-action alternative would be adverse and prolonged. Because many of these changes would begin within a relatively short period (i.e., by 2004), the effects would be particularly disruptive.

No-Action: Economics

Economic issues resulting from the no-action alternative are addressed in Section 4.4.3.1. Aside from the incremental economic effects from loss of revenues and employment associated with gas commercialization, Section 4.4.3.1 addresses cumulative economic effects at some length, and only a summary of these effects is presented here.

The economic consequences of the no-action alternative are relevant in national, state, and local contexts.

- **National:** Elimination of ANS production would reduce domestic oil production by nearly 20 percent, increase the balance-of-payments deficit in crude oil, reduce federal revenues, and eliminate the demand for double-hull tankers to serve the ANS trade (and therefore reduce output of domestic shipyards and the demand for U.S. seafarers)
- **State:** Elimination of ANS production would bring about some short-term gains in employment (though not necessarily Alaskan-resident employment) and income resulting from DR&R activities. In the intermediate and long-term, however, these small gains would be overshadowed by substantial and continuing losses. Direct employment in the North Slope oil fields, pipeline, and VMT would be eliminated, starting ripple effects through the economy. Employment in firms that provide goods and services for the oil and gas industry would fall off, as would indirect employment supported by purchases made by these workers. State revenues would decline, and the state would have to implement measures (e.g., the imposition of an income tax and elimination of PFDs) to conserve resources so as to continue to provide essential services. State economic activity would decline, resulting in additional revenue losses, and a prolonged economic contraction would be precipitated. Disposable personal incomes would decline, and unemployment and out-migration would rise.
- **Local:** These same effects would also be felt locally. Property tax revenues paid by the oil and gas industry would fall, straining municipal budgets. Employment losses and out-migration would lead to a fall in property values, increased bankruptcies, and other adverse trends, which would further reduce local revenues. Not all communities would be equally affected. The most severe effects would occur on the North Slope, and in Fairbanks and Valdez/Cordova.

Soc14. National economic effects.

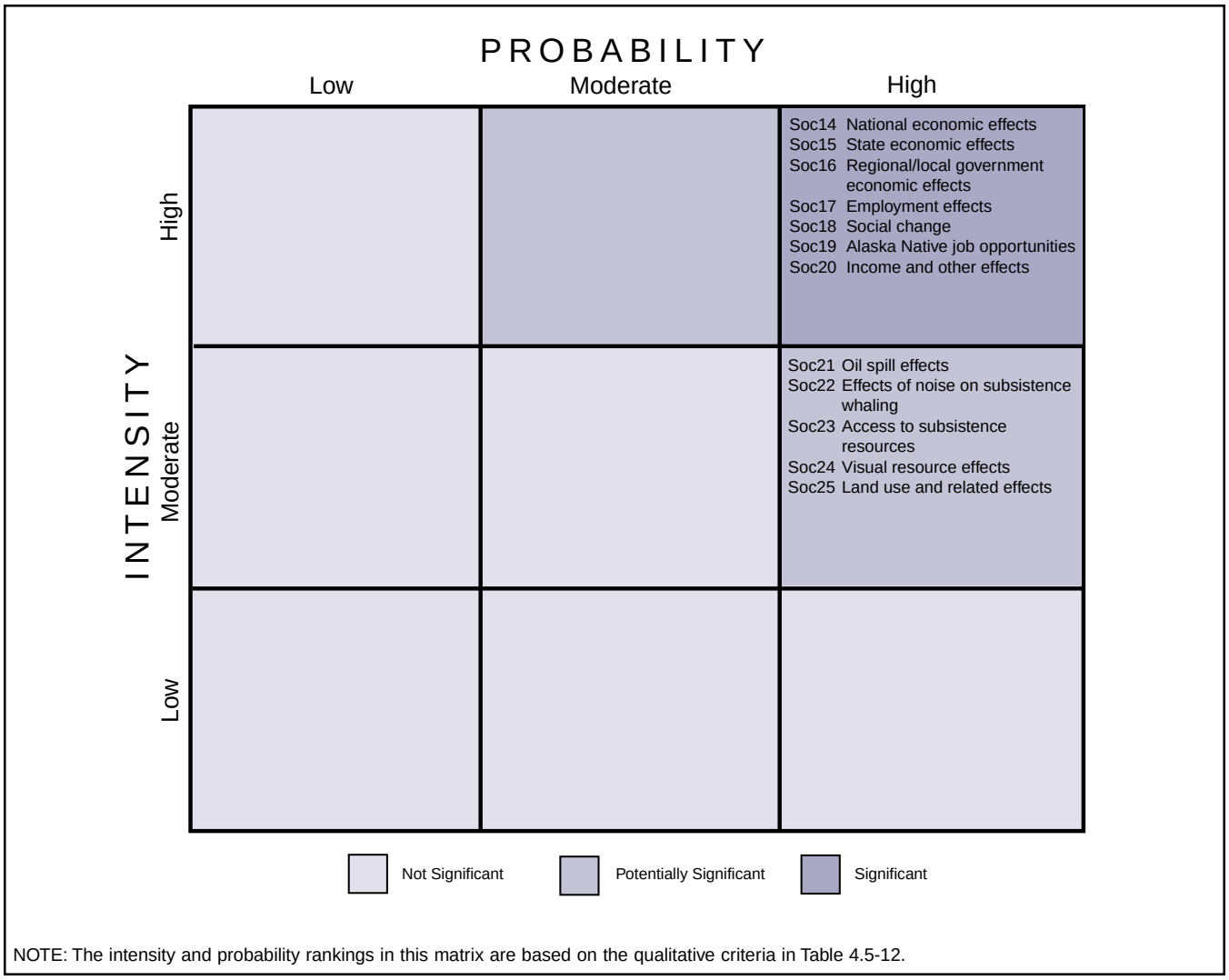
As noted in the discussion of the proposed action, ANS production accounts for about 20 percent of domestic oil production. This will decrease over time, but an appreciable amount of production will continue throughout the ROW renewal period. Closure of the ANS fields would increase the balance-of-trade deficit by approximately $150 billion in 1998 dollars (based on USDOE energy price forecasts) and reduce federal revenues by approximately $10.8 billion from 2004 to 2033.

The no-action alternative not only leaves ANS oil reserves stranded, but also prevents commercialization of natural gas in the foreseeable future, which entails revenue losses, increases the balance-of-trade deficit, and likewise increases U.S. dependence on imports.

Application of the criteria shown in Table 4.5-12 indicates that the intensity of this effect is high, as is the probability that this will occur.

Soc15. State economic effects.

At the state level, selection of the no-action alternative would result in the loss of revenues from royalties and severance taxes associated with ANS production and the pipeline. Figure 4.5-13 shows these losses cumulatively from 2004 to 2034; cumulative losses at the end of this period total $14.2 billion ($ 1998) in comparison to the proposed



NOTE: The intensity and probability rankings in this matrix are based on the qualitative criteria in Table 4.5-12.

Figure 4.5-12. *Ranking matrix of potential cumulative impacts on social environment (no-action alternative)*

action. This revenue loss is particularly significant because of the relatively large share of state revenues contributed by oil combined with the large share of total economic activity supported by public spending.

Gross state product (GSP) is a measure of the importance of different activities to the economy and the overall level of economic activity. GSP includes wages paid to workers, taxes paid to government, and investment in new equipment and profits. Loss of oil production would cause GSP to fall about 30 percent and the ripple effect would cause non-oil GSP to fall about 17 percent in the no-action alternative compared to the proposed action.

Considering both direct and indirect (multiplier) effects, the no-action alternative would reduce state employment substantially (Soc17, ranked below). Figure 4.5-14 (left y-axis) shows statewide employment under both the proposed action and no-action alternatives. Following a small in-

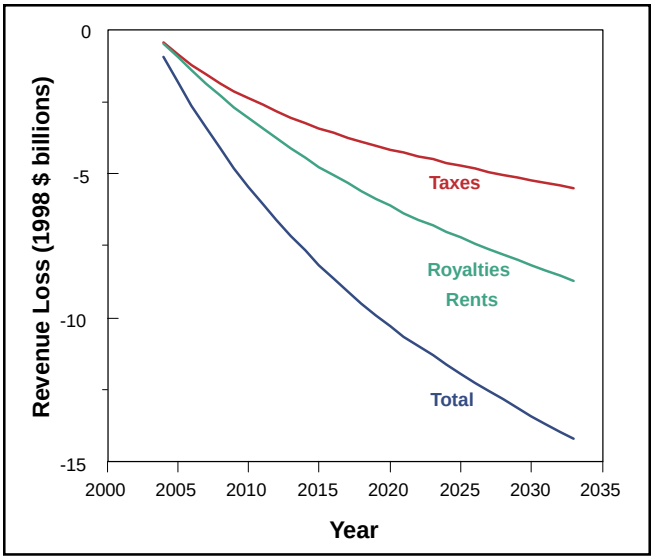


Figure 4.5-13. *Revenue losses to state.*

SOCIAL RESOURCES CUMULATIVE EFFECTS SUMMARY: NO-ACTION ALTERNATIVE

Potential Effect	PROPOSED ACTION	GAS COMMERCIALIZATION (GTL, LNG, Gas Pipeline)	NORTH SLOPE OIL FIELDS AND ANS TANKER TRADE (Past, Present, Future Development)	PUBLIC ACCESS	MILITARY (NMDS)	OTHER INDUSTRY	Intensity Factors			Ranking	
							Mag	Geo	Freq/ Dur	Int	Prob
ECONOMIC											
Soc14 **National economic effects.**	The no-action alternative will result in closure of TAPS and commencement of DR&R activities.	All ANS gas commercialization opportunities would be foregone, because the production infrastructure on the North Slope would be terminated. Potential federal revenues from these future developments would not materialize.	All ANS production would cease because of closure of TAPS. Remaining oil reserves would be stranded, U.S. oil production would decrease, the balance of trade would be adversely affected, and federal revenues (from taxes, royalties, and lease bonuses) attributable to ANS activities would cease.	No impact.	Closure of ANS fields and the pipeline would not affect the NMDS program. National security benefits of this program would not be affected.	No impact.	H	H	H	H	H
Soc15 **State economic effects.**	Shutdown of the pipeline would reduce APSC purchases, resulting in decreased economic activity. In the short term, DR&R activities would generate some economic benefits.	All potential revenues associated with gas commercialization would be foregone.	Remaining oil reserves would be stranded, Alaska oil production would decrease dramatically, gross state product would decrease, and state revenues (from taxes, royalties, and lease bonuses) attributable to ANS activities would cease. The state would suffer a substantial and long-lasting economic contraction. The PFD would be eliminated.	No impact.	The state would receive some benefits resulting from the economic activity associated with the NMDS.	No impact.	H	H	H	H	H
Soc16 **Effects on local governments and communities.**	Local government would lose property taxes associated with TAPS facilities. Other revenues also would decline as the economy and population contract by both direct and indirect (multiplier) effects.	Local governments would lose property tax revenues associated with potential gas-related facilities (e.g., pipeline, LNG facility) and direct and indirect benefits associated with the economic activity associated with these facilities.	Local government would lose property tax revenues associated with ANS and VMT facilities and the direct and indirect economic benefits associated with these operations. Lost revenues would precipitate budget crises for many communities.	No impact.	No impact.	No impact.	H	H	H	H	H
Soc17 **Employment effects.**	Pipeline closure will result in loss of jobs for operations and oversight workers.	Failure to commercialize ANS gas reserves forecloses future employment opportunities associated with these operations.	ANS oil-and-gas-industry jobs would be lost. Jobs would also be lost in those industries that directly or indirectly support the oil and gas industry. Losses in state and local government revenues would precipitate further employment declines.	No impact.	Construction of the NMDS facility will necessitate a small, temporary influx of workers during the 5-year construction period.	No impact.	H	H	H	H	H
SOCIAL CHANGE											
Soc18 **Social change effects.**	Many factors will combine to alter traditional lifestyles. DR&R activities will create an influx of workers, but this will be temporary. In the longer term, there will be a net out-migration. Employment losses associated with shutdown of TAPS will create individual hardships and create pressures on social systems.	The potentially adverse social effects associated with the influx of workers associated with gas commercialization would not occur.	Closure of ANS oil and gas operations would lead to net out-migration, easing certain social pressures. Revenue losses to the state, North Slope Borough, and other entities would create budget pressures that would result in a loss of social services and an increase in other social pressures.	No impact.	Construction of the NMDS facility will necessitate a small, temporary influx of workers.	No impact.	H	M	H	H	H
Soc19 **Job opportunities for Alaska Natives.**	Alaska Natives employed by Alyeska, subcontractors, and vendors would lose jobs.	Failure to commercialize ANS gas reserves forecloses employment opportunities.	Alaska Natives employed in ANS operations, subcontractors, and vendors would lose jobs. Moreover, pressure on state and North Slope Borough budgets could lead to additional employment losses.	No impact.	No impact.	No impact.	H	M	H	H	H
Soc20 **Income potentially affecting social problems.**	Reduction of real incomes and budget pressures on state and local government will force reductions in various social programs at a time when the need for these programs might increase. Closure of TAPS will create budget problems for several communities in the vicinity of TAPS.	No impact..	Closure of ANS operations will create budget problems for ANS communities and those effected by state budget cutbacks.	No impact.	No impact.	No impact.	H	H	H	H	H

Table 4.5-17.
Social resource cumulative effects summary: No-action alternative

SOCIAL RESOURCES CUMULATIVE EFFECTS SUMMARY: NO-ACTION ALTERNATIVE

Potential Effect	PROPOSED ACTION	GAS COMMERCIALIZATION (GTL, LNG, Gas Pipeline)	NORTH SLOPE OIL FIELDS AND ANS TANKER TRADE (Past, Present, Future Development)	PUBLIC ACCESS	MILITARY (NMDS)	OTHER INDUSTRY	Intensity Factors			Ranking	
							Mag	Geo	Freq/ Dur	Int	Prob
SUBSISTENCE											
Soc21 **Oil spills affecting quality of subsistence resources.**	TAPS pipeline-related oil spills would be eliminated, and effects on subsistence resources would be reduced because the potential for oil spills would be reduced.	There would be no spills, fires, or explosions associated with ANS gas activities.	Oil spills associated with ANS and Valdez tanker operations would be eliminated. Oils spills in Alaska would not be eliminated, however, because crude oil and/or refined products would have to be imported for in-state consumption.	No impact.	No impact.	No impact.	M	H	L	M	L
Soc22 **Effects of noise on subsistence whaling.**	Closure of TAPS would have no effect on whaling.	No impact.	DR&R of ANS production facilities and cessation of exploration activities would prevent adverse effects on whaling.	No impact.	No impact.	No impact.	M	L	L	M	L
Soc23 **Access to subsistence resources.**	Little to no effect on access to subsistence resources as a result of TAPS closure.	Failure to commercialize gas reserves avoids additional constraints on access to subsistence resources.	Removal of ANS oil and gas infrastructure would eliminate access constraints on the North Slope.	No-action alternative would not eliminate public access to former haul road.	No impact.	No impact.	M	M	L	M	L
VISUAL/RECREATIONAL											
Soc24 **Effects on visual/ recreational resources.**	Closure of TAPS eliminates visual effect of pipeline and related facilities. Closure also diminishes some recreational activities because highway observation points and visitor centers would be eliminated.	Elimination of potential gas development options prevents adverse effects on visual/recreational resources.	Closure and DR&R of ANS facilities eliminate potentially adverse effects of these facilities on visual/recreational resources.	No impact.	Construction of this facility would result in an added visual effect.	No impact.	M	M	L	M	L
LAND USE AND RELATED ISSUES											
Soc25 **Land use and related issues.**	Closure and DR&R of TAPS make additional areas available for other land uses.	No impact.	Closure and DR&R of ANS facilities make additional areas available for other land uses.	No impact.	Localized effects possible.	No impact.	M	M	L	M	H

Table 4.5-17 (Cont'd).
Social resource cumulative effects summary: No-action alternative

crease in 2002 and 2003 resulting from DR&R activities, employment would drop sharply below that associated with the proposed action in succeeding years. By 2010, employment would be 18 percent lower. An improved measure of adverse employment effects is the total worker-years lost, which is the area between the two curves (the cumulative sum of worker losses in each year). Cumulative wage and salary worker-years lost are plotted on the right y-axis of Figure 4.5-14. Cumulative wage and salary worker-years lost are 561,000 through 2015. Statewide employment in the no-action alternative would ultimately recover after many years and equal the level before the pipeline was shut down. However, the total loss in worker-years will not recover unless employment ultimately becomes much greater than it would have under the proposed action — and for many years — a very unlikely outcome. In this sense, worker-years are irretrievably lost. (The same point is valid for most of the other economic measures discussed in Section 4.4.3.1, including personal income and GSP.) The loss of jobs translates into unemployment and out-migration.

Section 4.4.3.1 identifies and quantifies many other adverse effects statewide, including decreases in total personal income, personal income per capita, population, non-oil GSP, and increases in unemployment. Collectively these developments would result in a recession/depression that is projected to be considerably more severe and longer lasting than the recessions of 1976 or 1985. Figure 4.5-15 shows actual employment dips for these two recessions compared to that projected if the no-action alternative were selected. Measured by the size of the trough generated by the drop in employment, the projected no-action alternative recession would be more than 6 times as severe as the one Alaska experienced during the 1980s.

Selection of the no-action alternative would foreclose gas commercialization options for the foreseeable future, resulting in the potential loss of additional state revenues.

The combination of substantial revenue declines, reductions in economic activity, employment declines, and a severe and prolonged economic contraction fully justify an intensity ranking of high. These effects have been estimated from the best available data and econometric models and the predictions are believed to have high reliability. The probability of occurrence is high.

Soc16. Effects on local governments and communities.

There are substantial adverse regional effects in many of these same measures. Moreover, these effects are not evenly distributed; some communities are likely to experience relatively small effects, others proportionately larger.

Several local governments depend on property taxes on

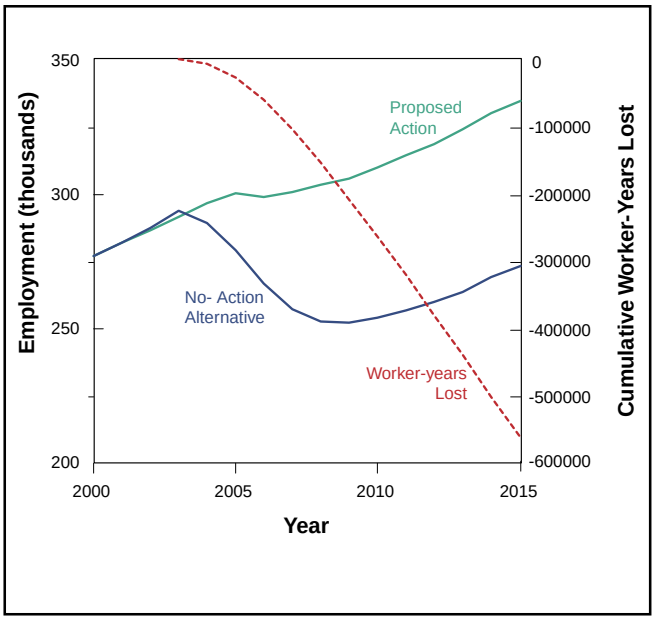


Figure 4.5-14. *State employment.*

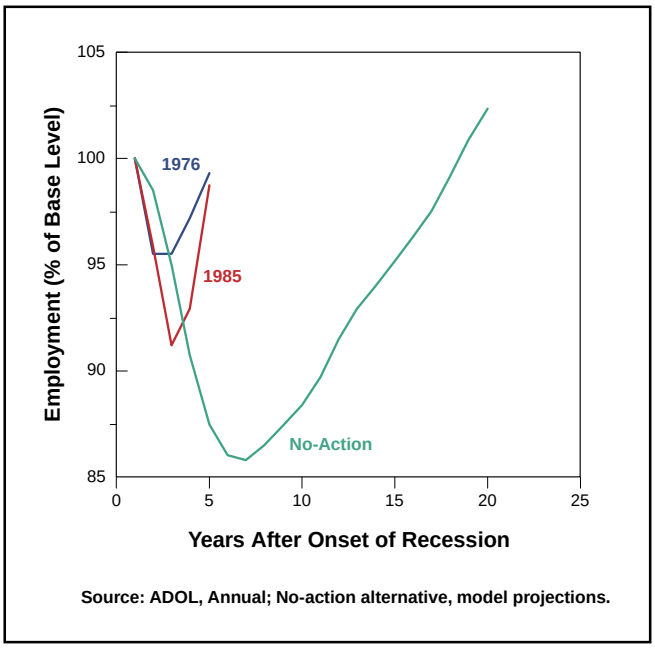


Figure 4.5-15. *Employment as percent of base level.*

North Slope oil production and pipeline facilities to support public services. The aggregate loss of revenues to local governments from 2004 to 2033 from affected oil facilities is projected to be $2.098 billion in 1998 dollars. As shown in Figure 4.5-16, these losses are greatest for the North Slope Borough ($1.896 billion), and smaller, but still significant, for Valdez/Cordova ($126 million), Fairbanks ($51 million), and Anchorage ($25 million). These estimates make no allowance for the opportunity lost because natural gas will not be commercialized.

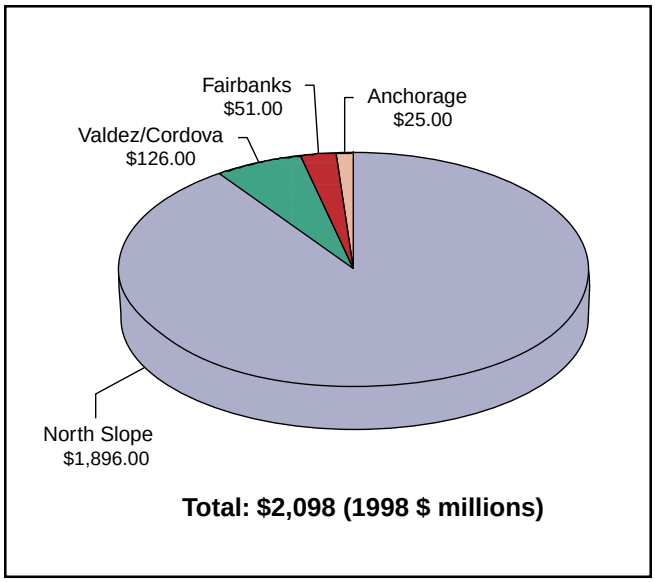


Figure 4.5-16. *Regional revenue losses.*

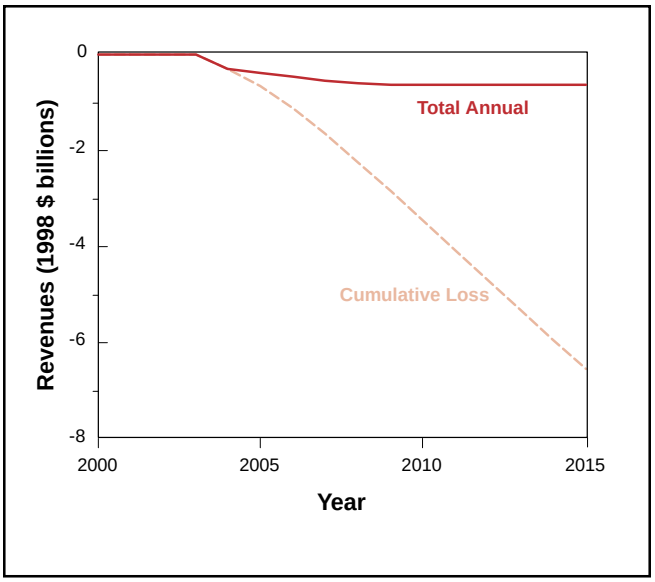


Figure 4.5-17*. Revenue.*

As with state government, the "ability to pay" of local government is reduced in the no-action alternative by the loss of property taxes associated with oil production and transportation. Other revenues also decline as the economy and population contract by both direct and indirect (multiplier) effects, and as state transfer payments fall. Figure 4.5-17 shows this decline in both annual and cumulative terms from 2000 to 2015. Total annual revenues in 2010 fall 24 percent below the proposed action and exceed the projected drop in population, so that the ability of local government to pay for public services is also reduced.[14] Even though annual losses seem to have stabilized by 2015 (Figure 4.5-17), cumulative losses continue to mount. From 2000 to 2015, local revenues are lower in the no-action alternative by a total of more than $6.5 billion (1998 dollars) — a very substantial adverse effect.

The no-action alternative brings about reduced employment, increased unemployment and out-migration, reduced personal income, loss of property values, and other losses. Figure 4.5-18, for example, shows the effect on resident employment in 2015 by community. All communities suffer, but the North Slope and Valdez/Cordova would experience particularly large employment losses compared to the proposed action. The large losses are due both to the loss of employment opportunities in the petroleum industry and to the loss of employment in industries dependent on petroleum revenues.

Employment losses on the North Slope would include direct losses of all oil and gas industry jobs. Although these

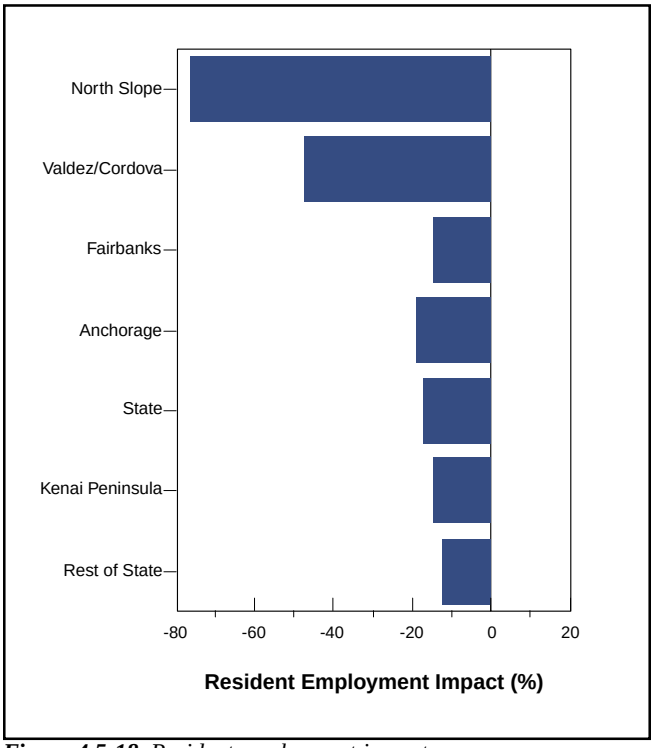


Figure 4.5-18. *Resident employment impact.*

jobs do not account for a large fraction of North Slope resident employment, they are relatively high paying. Figure 4.5-19, for example, shows the average monthly earnings for North Slope residents by job category (NSB, 1999). Oil industry jobs are the highest paying among all job categories reported in the North Slope Borough 1998/99 Economic Profile and Census Report, but under the no-action alternative, job losses would not be limited to those in the

[14]Unit costs (i.e., costs per capita) of providing services would also increase, because fixed costs would be spread over fewer people.

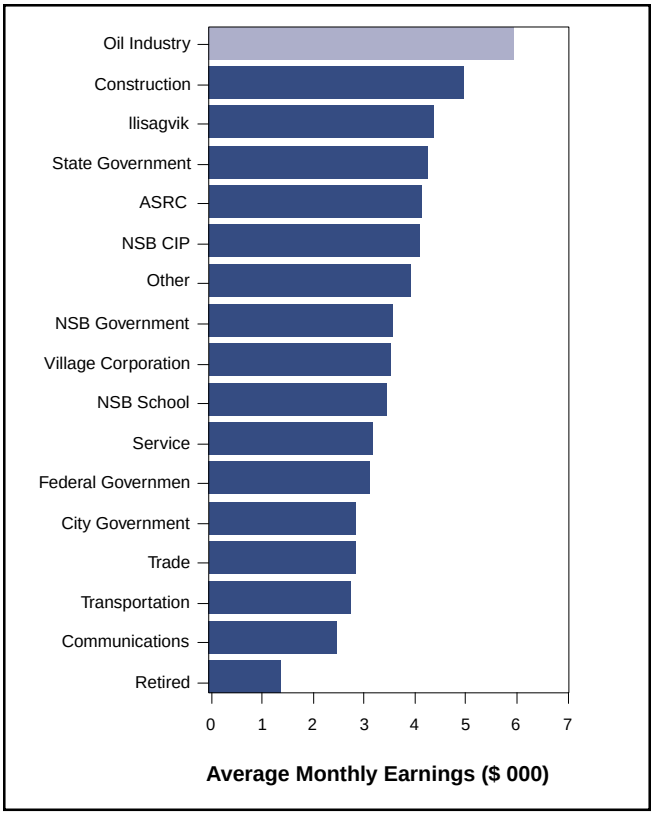


Figure 4.5-19. *Average monthly earnings.*

oil and gas industry. Many other jobs would be lost as a result of indirect and multiplier effects and because of revenues losses to the state and local governments. Jobs in several of the categories shown in Figure 4.5-19 (e.g., construction, state government, Arctic Slope Regional Corporation, NSB government) are linked directly to state and local government revenues.

How state and local governments would cut budgets to accommodate revenue shortfalls cannot be predicted with any certainty. It is noteworthy that education is a large line-item in both state and local government budgets and it is financed in most communities through a combination of local property taxes and state assistance. The state's "foundation program" (kindergarten through 12th-grade education) accounts for about one-third of the state general fund budget. For example, the NSB spent slightly more than $45 million on local education in 1998, 35 percent of total spending on public services (ADCED, 2000). However, the NSB received only about $25 million in state/federal education funds in this same year (ADCED, 2000). It is reasonable to believe that continued funding of education would be a priority in any budget cutting, but it is unlikely that any program would survive unscathed, given the magnitude of the necessary budget cuts.

Application of the criteria shown in Table 4.5-12 indicates that the intensity of this effect is high, as is the probability that this will occur.

Soc17. Employment effects.

These effects are summarized above. Application of the criteria shown in Table 4.5-12 indicates that the intensity of this effect is high, as is the probability that this will occur.

Economic Effects Summary

Collectively, these economic effects are adverse and very substantial. Smaller economic changes have brought about social and political upheavals in other countries. For all study areas included in this analysis, these economic effects are rated as high in intensity and virtually certain to occur.

No-Action: Social Change

Social change issues related to the proposed action include possible cumulative effects associated with population changes (influx of new workers), potential for social strains as a result of increased contact between Natives and non-Natives, demand for increased housing, the effect of wage and salary employment on Alaska Natives, concern over possible loss of cultural identity in an industrial society, the need to maintain proficiency in Native languages.

Some of these issues and concerns would be eliminated or become less important if the no-action alternative were implemented. For example, the influx of new workers would certainly be halted except for a short-term increase during DR&R. However, social concerns associated with the proposed action would be replaced by others that are nearly intractable and ultimately of greater consequence. It is almost impossible to imagine that most Alaskan Natives, let alone most Alaskans, would be better off under the no-action alternative.

Soc18. Social change effects.

Selection of the no-action alternative will not enable a direct resumption of pre-oil culture or return to the status quo before oil. The abrupt exit of the oil industry from Alaska (with the exception of the Kenai Peninsula fields and refinery) would certainly reduce the influx of workers to the North Slope and other communities. Indeed, the no-action alternative would result in substantial out-migration. Contact between Alaska Natives and non-Natives on the North Slope would be reduced. This would eliminate some incidental opportunities for friction.

Concerns over the consequences of social change are legitimate. It is likely that there will be continuing pressures on Alaska Natives and others for cultural assimilation. But,

largely because the causes of these pressures are many and complex, it is difficult to imagine that selection of the no-action alternative would materially alter these pressures.

Accordingly, this effect is judged to have high intensity and high probability — just as it is in the case of the proposed action.

Soc19. Job opportunities for Alaska Natives.

Concern over employment of Alaska Natives in the oil and gas industry would also cease to be an issue, but because overall employment would be lower under the no-action alternative, unemployment and underemployment would increase. As noted in the economic sections, the adverse effects of the no-action alternative on employment would be substantial. Compared to the proposed action, resident employment on the North Slope would decrease by more than 76 percent by 2015. Employment decreases in other areas would be less severe, but substantial nonetheless. Projected employment decreases by 2015 resulting from selection of the no-action alternative include Fairbanks (15 percent), Anchorage (19 percent), Kenai Peninsula (15 percent), and Valdez/Cordova (47 percent).

Reductions in real per-capita income are also likely to have adverse social, as well as economic, consequences. By 2015, for example, the real per-capita income changes (1998 dollars) would be more than $3,700 in the NSB, $3,200 in Valdez/Cordova, and nearly $1,600 in Fairbanks.

How should these effects be evaluated? In the case of selection of the proposed action, the magnitude of the jobs effect is evaluated as moderate (measurable and noteworthy, but not substantial), the geographic scope moderate (because the effect would be limited), and the duration high (because the effect would be nearly continuous). Weighed together, these are ranked as having moderate intensity, but high probability. Considering now the effects of the no-action alternative, the magnitude is ranked high (more jobs are lost than would have been gained under the proposed action), the geographic scope moderate (because jobs in more than one study area, possibly the entire state, would be affected), and the duration high. Taken together the intensity is rated as high and the probability high.

Soc20. Income potentially affecting social problems.

If the no-action alternative were selected, there might be fewer and/or less intense cultural pressures on Alaska Natives for assimilation, including those that might lead to a loss of familiarity with Native languages. But there would also be severe budget pressures to reduce education expenditures, because both the state and local governments would have sharply reduced revenues.

Rather than eliminating or easing social changes, the no-action alternative would only substitute a different set of problems and challenges. Employment opportunities would be sharply reduced, not only because of direct losses resulting from the closure of the ANS fields and other TAPS elements, but also because of the substantial decrease in oil revenues provided to state and local governments. State and local governments, schools, and Native corporations are major sources of employment. Sharply reduced budgets translate into fewer employment opportunities and fewer government services.

Setting budget priorities when revenues are plentiful and expanding is a difficult enough task. Reducing budgets requires making painful and often unpopular choices. It can also be divisive: "shared hardships" are generally more difficult to manage than "shared wealth."

Whether or not sharply reduced income would reduce domestic violence and/or substance or alcohol abuse is unknown. Some of the views contained in other EISs imply that it might. Implementing the no-action alternative amounts to initiating a large, uncontrolled, and irreversible social experiment without any certainty of a successful outcome. What is certain is that funds for social programs to combat existing ills would be reduced.

Much of the above material is particularly relevant to the North Slope. Many other communities/areas would suffer social effects if the no-action alternative were selected. Valdez residents would experience increasing unemployment, reduced government revenues, and diminished per capita incomes. Historically, Valdez residents held positive attitudes about the construction of the pipeline terminus and port development. The town had a poor economic base prior to TAPS construction, and adverse effects of the construction activities were made tolerable by the prospects for long-term economic benefits from the pipeline. However, residents would probably not maintain the same positive attitudes toward the effects of DR&R because there would be no compensating long-term benefits. Loss of VMT and SERVS employment among Chenega Bay and Tatitlek villagers (Tatitlek Chenega Chugach contracts) would negatively affect these communities.

Application of the criteria shown in Table 4.5-12 indicates that the intensity of this effect is high, as is the probability of its occurrence.

No-Action: Subsistence

Soc21. Oil spills affecting quality of subsistence resources.

The no-action alternative would eliminate the possibil-

ity of crude oil spills on the North Slope, Central TAPS, and Valdez/PWS study areas. Not all oil spills would be eliminated, however. Relatively large volumes of crude oil and/or refined products would be imported into Alaska to satisfy in-state demand. Incoming tankers would not have the protection provided by SERVS as it would no longer exist. Elimination of crude oil spills in the three study areas would also eliminate any adverse effects of these spills on subsistence resources and harvests — a potentially significant benefit.

DR&R activities might have adverse spill-related effects on subsistence, but these would be temporary. These effects would also result if the proposed action were selected, though not in the time frame of this analysis of cumulative effects, because DR&R will ultimately be required at the end of TAPS' economic life.

Based on the ranking criteria presented in Table 4.5-12, this potential effect is evaluated as having moderate intensity, but a low probability of occurrence.

Soc22. Effects of noise on subsistence whaling.

The no-action alternative would eliminate this concern because exploration activities (including seismic surveys) would cease on the North Slope. The probability is, therefore, low. The intensity of this effect is ranked as moderate.

Soc23. Access to subsistence resources.

Although access would be increased by the elimination of constraints in certain areas (e.g., the North Slope), the no-action alternative might actually have mixed effects on subsistence harvests. As noted above, adverse economic developments would provide an economic incentive for residents to increase subsistence efforts in order to compensate for income reductions. Balanced against this, subsistence users would also have less cash income to pay for various types of equipment (e.g., snowmachines, all-terrain vehicles, small boats, outboard motors, fuel, guns, and ammunition) that increase the efficiency of hunting/fishing efforts. Population on the North Slope and Valdez-Cordova would decrease with the no-action alternative, and pressure on subsistence resources in these areas could ease as a result. The net effect of these factors cannot be predicted.

Overall, this effect has moderate intensity and low probability.

No-Action: Visual/Recreation Aspects

Soc24. Effects on visual/recreational resources.

The no-action alternative would eliminate ANS oil and gas activities. DR&R activities would ultimately eliminate most visible evidence of industrial development on the North Slope, along the pipeline, and in Valdez. Potential damage from oil spills would also be eliminated. Some recreational opportunities would also be eliminated/reduced, because pipeline observation points would be removed, as would visitor centers. Overall, the negative effects of the no-action alternative are moderate and the probability low.

No-Action: Environmental Justice

The no-action alternative would raise some environmental justice issues. These are linked to the economic effects of the no-action alternative and, in particular, the effects of revenue reductions on the various social programs of state and local government including the PFD. Employment losses might also have an environmental justice component because, although Alaska Natives are not employed in large numbers by the oil industry, the effective shutdown of this industry in Alaska would eliminate the future benefits of Section 29 initiatives and also because government is a large employer of Alaska Natives in certain geographic areas (e.g., the NSB).

As noted in the discussion of economics, it is assumed that no-action alternative would result, among other things, in elimination of the PFD. Because this dividend is a flat sum given to all eligible residents, the proportional significance of the dividend is greatest for large and for low-income families. Alaska Natives, among others, would be disproportionately affected. Figure 4.5-20 shows the average household income for villages on the North Slope in 1998 (NSB, 1999). According to these data, Iñupiat households have lower average incomes than do non-Iñupiat households for most villages and for the NSB as a whole. Figure 4.5-21 shows the distribution of the number of people per household for the NSB in 1998 for both Iñupiat and non-Iñupiat households (NSB, 1999). As can be seen, Iñupiat households have a larger number of people (3.87) on average than non-Iñupiat households (2.08). Thus, elimination of the PFD would have a disproportionate effect on Iñupiats on the North Slope.

Other environmental justice issues associated with the no-action alternative include adverse effects on Native corporations. For example, the Arctic Slope Regional Corporation (ASRC), one of the largest private businesses in Alaska, derives revenues from outright ownership or joint venture arrangements with oil industry and oil field service companies, engineering, and construction firms. ASRC owns the subsurface resources underlying Kuukpik surface lands (USACE, 1997). If commercial quantities of oil and gas are discovered and produced from those lands, the principal economic beneficiary would be ASRC. Many resi-

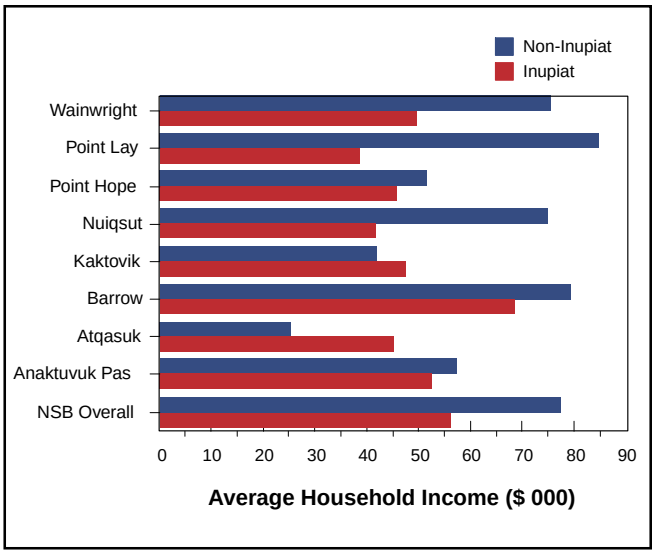


Figure 4.5-20. *Average household income.*

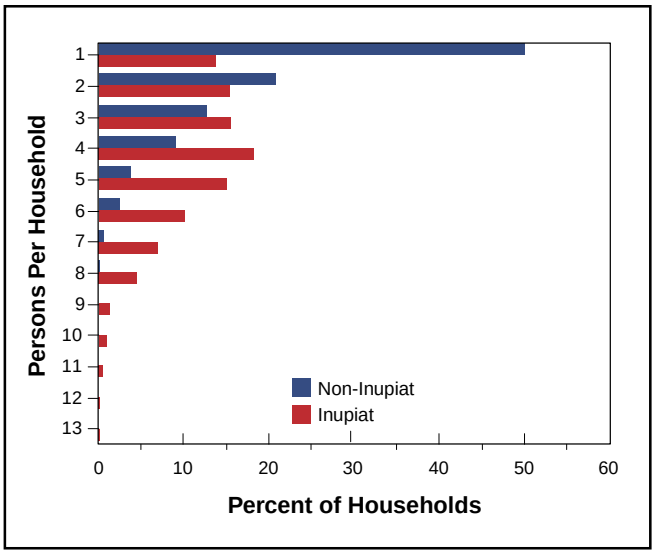


Figure 4.5-21. *Persons per household.*

dents of the North Slope are also shareholders in ASRC and would be adversely affected if its revenues were to decline.

No-Action: Land Use and Related Issues

Soc25. Land use and related issues.

The no-action alternative would eliminate the potential land-use issues identified for the proposed action, but would result in land-use changes. The same applies to closure and DR&R of ANS facilities. The consequences relative to land use are judged to be moderate, and the probability of such effects is high.

No-Action: Social Resources, Cumulative Effects Summary

Effects with high consequences and high probability include economics, social change, and subsistence. Although all of these fall into the same classification, the effects are quite different. The economic and social change effects are principally (if not exclusively) adverse, whereas the effects on subsistence are likely to be beneficial. Visual/recreational effects are judged moderate and largely beneficial, with a high probability of occurring. Effects on land use and related issues are moderate, but with a high probability of occurrence.

4.5.5 Summary and Conclusion

By R.G.B. Senner

Renewal of the TAPS ROW would extend current oil production and transportation operations for 30 years, until 2034. Although specific features and procedures would change if new facilities and processes were added, the same basic attributes that have been documented on the Alaska North Slope, along the Central TAPS study area, and in the Valdez/PWS study area would continue with little change. This means that the baseline established since 1974 can serve as an accurate basis for predicting the potential cumulative effects of the North Slope oil fields, the TAPS pipeline, and the VMT and tanker link in combination with other reasonably foreseeable future actions.

The most important cumulative effects of ROW renewal would be economic and social. ANS oil production, which is viable only if the TAPS ROW is renewed, currently total about 20 percent of U.S. production. The estimated 7 billion barrels of future production during the renewal period will result in a reduction of the U.S. foreign trade deficit by approximately $150 billion in 1998 dollars (based on USDOE energy price forecasts). Revenues to the State of Alaska from continued operation and development of the ANS oil fields, in combination with employment income to a broad sector of Alaskans and continuation of the PFD, would produce statewide multiplier effects. Royalties and severance taxes would continue to contribute to the state capital and operating budgets, funding a wide range of public facilities and services and supporting the long-term maintenance of highways and public facilities that have already been built with federal and state funds. The commercialization of ANS natural gas, whether by a GTL technology using the existing TAPS pipeline, or transport of natural gas by one or more new pipelines, would enhance these economic benefits over the long term.

Continuation of ANS production and TAPS will provide

a large employment base for residents of Alaska and Alaska Natives. Social changes will continue to occur, with positive benefits related to employment opportunities and social services funded in large part by oil revenues and potentially negative benefits related to increased competition for subsistence resources via hunter access along the Dalton Highway. There is also a risk that subsistence resources could be affected if there is a major oil spill.

Potential cumulative effects to fish, wildlife, and their habitats would not be significant, because they would not reduce the population size or geographic range of any species. On the North Slope, caribou and other large mammal populations would continue much as now, with evidence of sporadic local perturbations similar to those currently observed. In the Central TAPS study area, the most notable potential for an adverse cumulative effect would result from the construction of a buried, chilled, large-diameter natural gas pipeline parallel to the existing TAPS pipeline. If built by winter construction using a workpad made of ice, the new pipeline would produce little lasting impact to terrestrial and wetland habitats, other than localized gravel extraction and placement required for compressor stations. Any new pipeline built within the existing BLM utility corridor would likely use the existing TAPS workpad, material sites, access roads, and other infrastructure to the maximum extent compatible with continued safe operation of TAPS.

The greatest potential for an adverse biological cumulative effect along the TAPS ROW could result from increased recreational hunting and fishing via access from the Dalton Highway. The Dalton is a state highway on its own right-of-way, and the applicants have no control over its use. Hunting and fishing effects can be mitigated by game management regulation and enforcement. Additional impacts on fish could occur at stream crossings, where short-term, construction-related streambed disturbance and siltation would result from burial of a natural gas pipeline. Downstream siltation is of concern because of the potential for silt to cover fish eggs and to degrade water quality. Mitigation would be achieved through the Title 16 permitting process by scheduling in-stream construction to avoid sensitive periods, and by employing construction practices designed to minimize erosion and siltation. Longer-term effects associated with equipment and vehicle traffic would be mitigated by using existing TAPS stream crossings. However, the addition of a new pipeline approximately parallel to the TAPS pipeline would necessitate heavier traffic loads on the drivelane of the existing TAPS workpad and at low-water crossings. This effect can be mitigated by continuing monitoring and maintenance of the stream crossings. Clearing of vegetation along both the TAPS and new pipeline ROWs would be minimal and limited by strict dimensional guidelines.

Some change in habitat could occur as a result of future ANS development or a gas disposition project which would add cumulatively to effects of the continued operation of TAPS. The potential altered habitats would be relatively small compared to the total land area along TAPS and on the ANS. Effects will be mixed. Additional wetlands will result from thermokarsting, and manmade structures will provide positive benefits, while additional gravel pads and above-ground facilities could cause loss of habitat and obstruct movement.

If a natural gas pipeline terminated at Prince William Sound, a new marine terminal incorporating an LNG plant would be constructed at Anderson Bay near the existing VMT. The new terminal would produce habitat loss roughly equivalent to that associated with the VMT, and tanker traffic in Port Valdez and PWS would increase. Although LNG tankers would not introduce the potential for crude oil spills, there would still be an increased cumulative risk of fuel spillage that would require careful preventive measures similar to those currently employed by Alyeska Pipeline Service Company.

Cumulative effects on physical resources would relate primarily to oil spills, water discharges, and air quality, and none are expected to be significant with respect to the integrity of the terrestrial environment or long-term air or water quality. As the ANS oil-field infrastructure expanded with the addition of new fields, the aggregate length of oil pipelines would increase, raising the potential for spills. However, the existing pattern and character of oil and fuel spills documented for the North Slope would not change with the expected small increments of new pipelines and facilities necessary to develop marginal fields. If gas commercialization were to proceed through GTL technology, new breakout tanks and other modifications could be required at TAPS pump stations to allow the pipeline to be operated as a batch line. There could be transient flaring, with brief releases of black smoke, associated with diversion of liquids to the breakout tanks. This effect would be minimized through the careful scheduling and precise timing that would be required for switching the pipeline load between crude oil and GTL products.

If the TAPS ROW were not renewed, the North Slope oil fields would be decommissioned, and all above-ground facilities and structures associated with the TAPS pipeline would be removed. This would reduce the potential for cumulative effects related to TAPS. Without the North Slope oil fields, commercialization of natural gas would be unlikely because the infrastructure developed on the ANS

at a cost of many billions of dollars would not be available for use in a gas disposition project. Along the TAPS ROW, the greatest potential for biological cumulative effects would come from the increased public access and use of the TAPS workpad for recreational and subsistence pursuits. With existing access restrictions removed, the public could make greater use of the TAPS workpad drivelane, and it is possible that an expanding zone of habitat disturbance would gradually develop along the ROW unless regulatory controls were imposed.

Most significantly, severe economic dislocations from decreased state revenues and increased unemployment could not be replaced by other sectors, necessitating greater dependence on Permanent Fund earnings to fund the annual budget, the reinstatement of a state income tax, and increases in local property and sales taxes. The Alaskan economy would go into a deep recession and would require a period of years to reconfigure and stabilize following these dislocations.

In conclusion, there will be longer-term cumulative effects on physical, biological, and social resources associated with TAPS ROW renewal than with ROW termination. The combined intensity of these effects, however, would be less than the direct and indirect economic dislocations that would result from termination of the ROW. While ROW renewal would perpetuate the status quo, with some additional local impacts due to additive or synergistic effects with new actions, TAPS DR&R would result in statewide adverse economic impacts that would outweigh the less intense, smaller-scale effects of renewal.