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Arctic National Wildlife Refuge: Background and Issues

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Arctic National Wildlife Refuge: Background and Issues

Summary

The rich biological resources and wilderness values of northeastern Alaska have been widely known for about 50 years, and the rich energy resource potential for much of that time. The future of these resources has been debated in Congress for over 40 years. The issue for Congress is whether to open a portion of what is now the Arctic National Wildlife Refuge (ANWR) to allow the development of potentially the richest on-shore source of oil remaining in the United States, and if so under what restrictions. Alternatively, Congress might choose to provide further protection for the Refuge's biological and wilderness resources through statutory wilderness designation or to maintain the current status of the area. Under current law, if Congress chooses not to act, the entire Refuge will remain closed to development under provisions of the 1980 Alaska National Interest Lands Conservation Act.

The coastal northern plain of the Refuge is the focus of debate. This remote and largely untouched area is an example of an arctic ecosystem that, by virtue of being essentially intact, is increasingly rare. It has been called "America's Serengeti", for the vast herd of caribou, for the many nesting and feeding migratory birds, and for its predators such as grizzly bears, polar bears, wolves, and golden eagles.

The area also is an immensely promising oil prospect, which some feel could be as productive as Prudhoe Bay. It is heralded as a place which could help reduce national dependence on foreign oil and keep the Alaskan oil pipeline in use for decades. Advocates for development foresee benefits to the oil industry, the people of Alaska, and the national economy.

For over 20 years, the debate over energy development in the Refuge has been highly polarized and remains so. President George W. Bush is committed to opening the Refuge to development, citing unrest in the Middle East among his reasons. And opposition to development remains strong, as opponents point to other means of achieving national energy goals.

This report does not analyze specific proposals to develop or protect the Refuge. Rather, it provides basic material for analyzing possibilities and implications of the major issues that have been the focus of the legislative debate over its fate. This report will be updated as events warrant.

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Executive Summary

From Alaska's Prudhoe Bay eastward 200 miles to the Canadian border is an area of unique natural wealth. An area teeming with wildlife, it has been called the "Serengeti of the Arctic." The eastern part of the region also contains one of America's best remaining onshore oil prospects, beneath the coastal plain of the Arctic National Wildlife Refuge (ANWR). (See Figure 1.)

This remote and largely untouched area is an example of an arctic ecosystem that, by virtue of being essentially intact, is increasingly rare. It is an important habitat for musk oxen, migratory waterfowl, vast numbers of caribou, and predators such as grizzly bears, polar bears, wolves, and golden eagles.

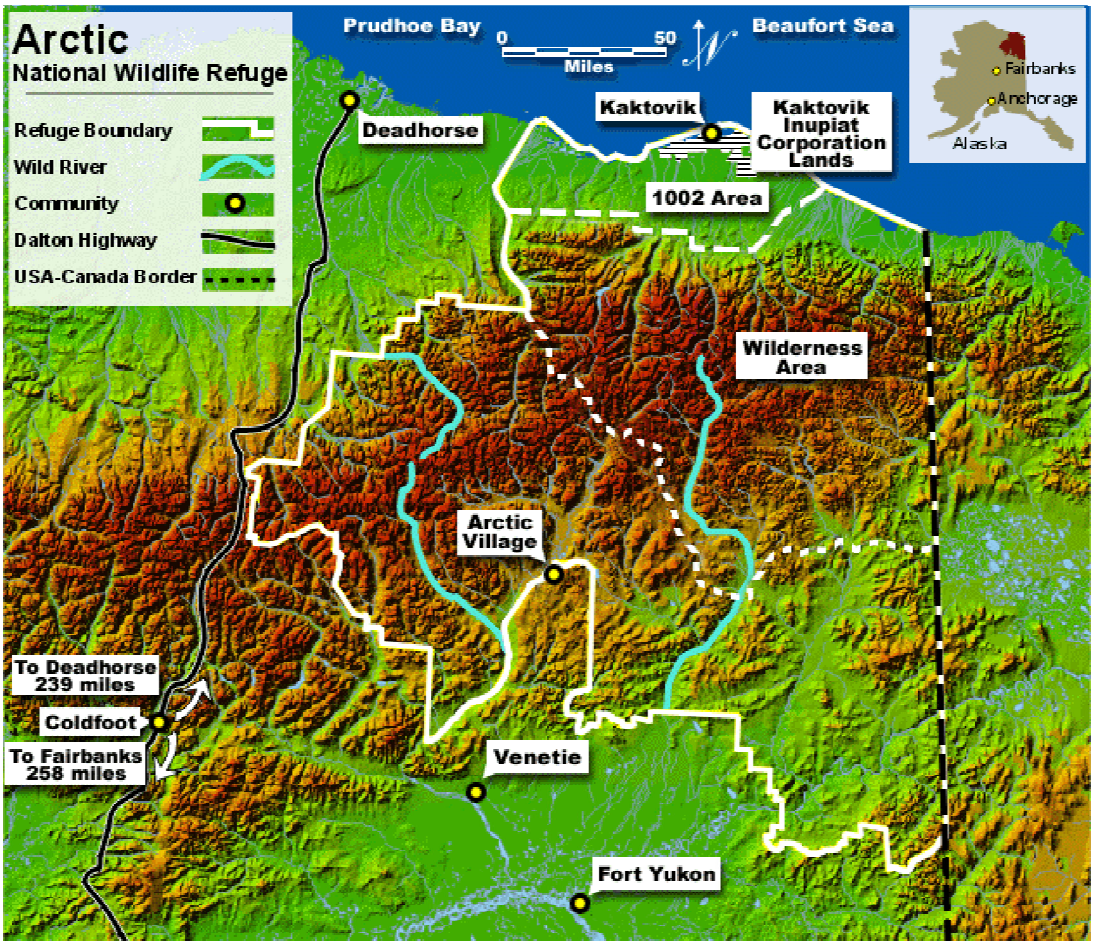
Moreover, the coastal plain is immensely promising for oil and natural gas, possibly on the scale of Prudhoe Bay's resources. Its development could help reduce America's energy dependence to some degree and keep the Alaska pipeline in use for decades – benefitting the national economy, the oil industry, and people in Alaska.

The Purpose of the Report

When Congress expanded the boundary of ANWR in the Alaska National Interest Lands Conservation Act (ANILCA) in 1980, it designated about 8 million acres within the earlier boundaries of the refuge as wilderness – off-limits to any form of development. However, in two sections of ANILCA, Congress postponed a decision on wilderness designation of 1.5 million acres of the coastal plain (called the *1002 area*) – a portion of ANWR thought to be rich in oil and gas resources – and required the Department of the Interior (DOI, or Interior) to prepare a detailed study of the area and to recommend how it should be managed.

Interior finished its detailed analysis of oil potential, wildlife resources, impacts, and mitigation measures in April 1987. In its report to Congress, DOI estimated then that the chance of recovering economic quantities of oil at 19%, a figure that is very high by industry standards. The report recommended that the entire area be made available for leasing. The report and its recommendation generated controversy, as have virtually all subsequent reports on this topic. In intervening years, estimates of oil potential have varied, but enthusiasm for ANWR oil development remains strong, particularly in Alaska. Likewise, opposition to energy development continues to be strong, based on concern for the area's wilderness values and wildlife.

Figure 1. Shaded Relief Map of Northeastern Alaska.



Source: U.S. Dept. of the Interior, Fish and Wildlife Service [http://www.r7.fws.gov/nwr/arctic/shademap.html], Nov. 9, 2001. Minor modifications made to enhance clarity in monochrome.

This report goes beyond reporting the opposing views of development versus protection. Rather, it provides background and basic material for analyzing possibilities and implications of emerging options.

The Tradeoffs and Possible Alternatives

Much is at stake in the ANWR decision, for U.S. energy interests, for proponents of unspoiled wilderness, and for the State of Alaska. On the one side, if oil were found and developed, the additional domestic supply would be seen as enhancing national security (although some opponents of opening ANWR argue that the vulnerability of the TAPS pipeline to sabotage diminishes the national security argument). Further, oil development would create several thousand short-term jobs in Alaska and elsewhere, and a substantial number of long-term jobs as well. The state would benefit from additional royalty income, and many of Alaska's Native groups would benefit as well (though some would face threats to important subsistence resources).

On the other side, many believe developing oil would irrevocably compromise the area's wilderness values – defined as an area "untrammeled by man." Some counter that the area has already been affected by man: there are a few remains of DEWLINE construction and a capped oil well in the 1002 area. Some argue, too, that the coastal plain itself is not of a wilderness quality most would expect. The area is bounded on the south by the spectacular Brooks Range, but is itself mostly flat or rolling – a treeless tundra laced with shallow streams, most of which flow only during the brief arctic summer.

However, the apparently hostile nature of the area belies its national and international significance as an ecological reserve. It protects a virtually undisturbed, nearly complete spectrum of arctic ecosystems, and is one of the last places north of the Brooks Range that remains legally closed to development. Those who favor preservation argue that when the United States is serving as an international leader in the protection of vanishing ecosystems, development of the 1002 area would not set a good international example. Thus, if oil development occurred, the issue would become how to ensure that development would be compatible, as far as possible, with the purposes of the wildlife refuge.

Developing oil in the harsh, fragile arctic environment is expensive and risky. Since oil was discovered at Prudhoe Bay in 1968, oil companies and government agencies have done much to reduce environmental impacts, *e.g.*, through reducing the size of drill pads, numbers of roads, and size and location of support facilities; and through improving waste management. Depending on statutory and regulatory requirements, and with proper investment, monitoring, and enforcement, energy companies could develop the 1002 area in ways that continue to reduce effects on plants and animals.

The Choices Before Congress

In the context of these tradeoffs, the spectrum of alternatives before Congress includes:

- No action, which would maintain the status quo, which prohibits drilling for oil and gas throughout the refuge.

- Authorize leasing in the coastal plain of ANWR to proceed under the current regulatory requirements and capabilities of DOI.

- Allow leasing in the coastal plain of ANWR to proceed, but with special statutory and regulatory conditions, (which could be greater or less than currently required). Among a variety of possibilities or proposals, these conditions might include one or more of the following:
  1. Limiting surface occupancy in the 1002 area to reduce environmental impacts (recognizing evolving technology).
  2. Requiring environmental controls, phasing, special area protection, or enforcement mechanisms.
  3. Requiring various measures for site restoration or removal of infrastructure upon completion of oil operations and/or establishing bonding mechanisms to ensure accomplishing these goals.

4. Reducing requirements for environmental review under the National Environmental Policy Act or limiting judicial review of executive actions.
5. Allowing different standards for environmental protection or reclamation to prevail on Native lands than on the remainder of the coastal plain.

- Designate the coastal plain as wilderness, thereby foregoing any energy development and associated economic benefits, but maintaining existing natural values and employment and subsistence opportunities.

Exploring and Developing the Oil Resource

Exploration does not necessarily mean that the coastal plain immediately would be spread with drilling pads, service facilities, and pipelines. Companies may not discover economic quantities of oil – or any oil at all. If they do find economic quantities and development occurs, oil facilities likely would occupy only a small, though dispersed, portion of the total area; and it is unlikely that oil would be produced until 7 to 12 years after any congressional approval of exploration. Drilling proponents argue that this long lead time is a reason for making a decision now.

Assessing the Potential. Parts of Alaska's North Slope coastal plain have proved abundant in oil reserves, and its geology holds further promise.[1] The oil-bearing strata extend eastward from the National Petroleum Reserve-Alaska (NPR-A), past the prolific Prudhoe Bay field and a few smaller fields, and may continue into and through ANWR's 1002 area. Clearly, a key step in making a decision on ANWR is estimating how much oil might be there. Drilling (both exploration and confirmation), now prohibited, is the only method by which the 1002 area's petroleum potential can be ascertained with reasonable assuredness in the context of the uncertainties of oil discovery.

On its part, the Department of the Interior, without drilling, has issued assessments in 1987, 1991, 1995, and 1998 of the amount of oil and gas that might be present in ANWR. Those prepared after 1987 have been based upon progressively newer geological data from outside ANWR and upon reinterpretation of previous information using improving techniques, and have changed estimates of ANWR's oil potential.

Two considerations might be noted at this point. One is that the projected price of oil is a key factor in estimating the amount of oil that might be economically recoverable. The second is that the larger the area open to leasing and resultant oil company participation, the more likely that company bidding will give the government (the people of the United States) a larger return for making resources accessible to private entities.

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[1]For maps of existing discoveries along the North Slope, see the website of the Division of Oil and Gas, Alaska Department of Natural Resources, at :
[http://www.dog.dnr.state.ak.us/oil/products/maps/northslope/northslope.htm]

ANWR Oil, U.S. Oil Consumption, and ANWR Gas. Based upon the results of the 1998 Interior Department assessment, the 1002 area contains some of the most promising undrilled onshore geologic structures with petroleum potential known in the United States. The U.S. Geological Survey (USGS) estimated that, at $24/barrel (in 1996 dollars), there is a 95% chance that 2.0 billion barrels or more could be recovered, and a 5% chance of 9.4 billion barrels or more. In comparison, the Prudhoe Bay field originally was estimated at 11-13 billion barrels of economically recoverable oil.

Many argue that this large potential should be explored and developed to offset the decline in domestic oil production. Domestic production without ANWR is projected by the U.S. Energy Information Administration (EIA) in its base case to be down to 5.6 million barrels per day (bbl/d) by 2020 (from 5.8 million bbl/d in 2000), while consumption is projected to rise from 19.7 million bbl/d to 26.7 million bbl/d. Other things being equal, domestic output without ANWR would supply only about one-fifth of U.S. consumption, with the rest coming from imports. Assuming a higher price of $30 per barrel, it appears that potential peak output from USGS's "low" and "high" ANWR volumes of economically recoverable oil at 300,000 and 1,575,000 bbl/d, respectively. These would represent a 5% and a 28% rise in U.S. output, respectively, at peak production.

Possibly of greater importance are the gathering and transportation economics of both existing and prospective fields, which include the cost of shipment through the TAPS pipeline. Combined production at Prudhoe Bay and other North Slope fields is now at only about half of its peak and is projected to rise only slightly between 2000 and 2020. Development of and production from ANWR would improve the commercial viability of currently producing North Slope fields by spreading the per barrel cost (maintenance and capital charges) of operating the pipeline over a larger number of barrels.

The possibility of large amounts of natural gas in ANWR together with huge amounts of proven gas reserves in the Prudhoe Bay area (not being produced presently) may increase the appeal of oil and gas development of ANWR to energy companies. For economic reasons, natural gas generally has not been emphasized, but becomes more attractive as demand grows and prices rise. Construction of a pipeline to transport natural gas to North American markets and/or a warm water port for shipping liquefied natural gas would be a necessary element.

Controlling Impacts

If Congress decided to authorize development, then the issue would become whether and how to minimize effects on wildlife and the coastal arctic ecosystem, and – through them – on Native cultures. Changes in the ecosystem could result from several facets of oil development. Major intrusions would include large requirements for water and gravel; and the displacement and disturbance of land, animals, and plants by pipelines, roads, airstrips, and other infrastructure. There is particular concern for caribou migration routes; calving and insect relief areas; migratory bird nesting and staging; effects of air and water pollutants; and direct and indirect effects of human presence. In addition, because of mixed ownership in the area, problems arise in how to establish and enforce controls on development.

Infrastructure. The trend in North Slope energy development is toward compactness, reduction in numbers and mileage of roads, centralization or reduction of support facilities, reduction of hazardous wastes, and concentration of exploration and early development activities in winter (when the frozen tundra makes cross-tundra travel possible, and when roads can be built from ice). Industry representatives now argue that the entire ANWR area can be developed with only a 2,000 acre "footprint." Opponents argue that the 2,000 acres would be spread across the entire 1002 area, is achievable only if one fails to count some major facilities, and is misleading in any case, since effects of the area covered by gravel may extend well beyond even a broadly defined footprint. Limitation of the footprint has begun to be a major point of congressional debate.

Physical Environment. Much of the controversy over development of the 1002 area has focused on potential impacts on biological resources in the area. However, if development occurs, there also would be impacts on the physical environment and resources of the area – land, air, and water – as a result of construction, operations, and human habitation. Currently, because the area is uninhabited (except for Kaktovik), the condition of the physical environment has been characterized as pristine and nearly unaffected by human activity.

Exploration and development activities would alter the existing physical environment. For example, oil field operations would result in air pollution emissions. There would be need for large amounts of water for drilling and ancillary activities, including construction of roads, drill pads, and airstrips. There likely would be impacts from both the mining and use of gravel as part of some of these activities. Exploration and development also would result in the generation of several types of waste streams, both from industrial operations and domestic wastes, requiring disposal. At issue are the individual and cumulative effects of such alterations and the ability of the natural environment to recover and be reclaimed when oil-related activities have ceased.

Industry points out that companies use improved technology in the arctic today (compared with that used in the past for development of existing sites in the arctic region) which greatly reduces the "footprint" of operations and relies on practices that minimize and provide for better disposal of wastes. The result is less direct and indirect impact in terms of habitat loss and environmental contamination. Moreover, numerous environmental protection requirements administered by federal and state authorities are intended to govern and regulate activities that might take place. Critics, however, are concerned about environmental effects of routine operations in the fragile 1002 environment, as well as the possibility of leaks and spills of various contaminating substances, and whether adequate safeguards would be adopted and enforced by regulators. Moreover, critics argue that even careful development would lead to lasting changes in the fragile arctic environment.

Alaska Native Ownership. Over 100,000 acres in ANWR are owned by Alaska Natives. The surface of more than 90,000 acres is owned by the Kaktovik Inupiat Corporation (KIC) and the subsurface of these acres is owned by the Arctic Slope Regional Corporation (ASRC). The remaining 10,000 plus acres are owned by individual Natives. Some of the 100,000 acres are within the legal description of the 1002 area; some also lie along the coast but are legally described as outside the

1002 area, and all 100,000 acres are within the Refuge as a whole. Regulation of development on these lands is problematic and is often not considered explicitly in legislative proposals. (See CRS Report RL31115, *Legal Issues Related to Proposed Drilling for Oil and Gas in the Arctic National Wildlife Refuge*.)

Special Areas. Wildlife experts are particularly interested in threats of development to several sensitive or special areas. For example, on the southern edge of the coastal plain, Sadlerochit Spring is of great biological importance because it never freezes. Other areas include the southeast portion of the coastal plain, where caribou calving is particularly likely to occur; certain staging areas for snow geese; riparian areas important to musk oxen; deep rivers and lakes important to overwintering fish; and denning or nesting sites of bears and raptors, to name a few.

Secondary Development. Also of concern are the effects of possible spin-off development both in Kaktovik, an Alaska Native settlement and Distant Early Warning Line (DEWLINE) station on Barter Island just off the coast, and on other Native lands within the Refuge. Kaktovik could be a staging area for oil operations. Such development could compromise wildlife and other environmental values. Currently, Deadhorse (at Prudhoe Bay, the oldest support center), the Kuparuk Industrial Center (west of Prudhoe Bay), and to some extent Alpine (a very modern oil development west of the Kuparuk oil field, with much of its support activities reduced or taking place elsewhere) offer alternate examples of how service support areas might be handled. Deadhorse was left mostly to private decisions, and its sprawl and contamination problems led to the more compact, controlled approach at the Kuparuk Facility. Still later, the Alpine field essentially eliminated the need for some kinds of additional support facilities, reduced the physical size of some of the remaining facilities, and shifted still other operations to other sites by flying material in and out or carrying other equipment in on winter ice roads. In the 1002 area, facility reduction might continue, and some needs might be shifted to Native lands within and near the 1002 area.

Future Recovery

Whether strict statutory and regulatory controls and strong government enforcement could protect wildlife values to the satisfaction of those opposing development is open to question. (Wilderness values, by definition, would be compromised if full development occurred.) But for the long term, an equally important question is whether, after oil production ceased, the area could be and should be restored as nearly as possible to pre-development conditions.

If major oil reserves were found, energy companies might operate on the coastal plain for decades. If natural gas were also found, it too might be developed. (There is currently no means to send natural gas to market, either from the 1002 area or from Prudhoe Bay.) Offshore oil fields might also be found, and might be developed with onshore support in ANWR. Any of these outcomes could lead to significant human activity in the area for a century or more.

Assuming eventual dissipation of industrial presence, would the area eventually revert to something of its former condition? New data exist to show that such an intensive presence could last many decades after activity ceases. Complete removal

of all infrastructure seems unlikely, and resulting water flow patterns might not even make it desirable. The short growing season and low precipitation make complete revegetation of disturbed areas uncertain. Recovery of animal populations and species diversity would depend on viable populations close enough to restock the area or site, and possibly explicit controls limiting future presence so that the site or area can recover. If Congress decides to open ANWR, it may include rehabilitation requirements.

Introduction

The debate over whether to open the coastal plain of the Arctic National Wildlife Refuge (ANWR) to energy leasing has raged for decades, with the main periods of controversy occurring in the late 1950s before the refuge was established; the period 1977-1980 at the passage of the Alaska National Interest Lands Conservation Act; 1987 when the Final Legislative Environmental Impact Statement (FLEIS) was released; the early 1990s during the Persian Gulf War; and the current debate, which began months before the attacks on New York and Washington, but was certainly heated by those events.

The purpose of this report is to collect the background information and new developments that have arisen since the 1987 FLEIS, and to discuss the possibilities and implications of emerging approaches to development. The report does not focus on any particular legislation.[2] Rather, it provides background and basic material for analyzing proposals and ideas about developing or not developing the 1002 area.

The Decision Before Congress

The portion of Alaska's North Slope between Prudhoe Bay and the Canadian border represents this country's largest, most diverse remaining example of a largely untouched arctic ecosystem.[3] All major arctic species are relatively abundant in the area. The coastal plain and adjacent areas are important habitat for caribou, migratory waterfowl, and such predators as wolves, polar bears, and grizzly bears. However, the coastal area is also very likely one of the nation's best remaining oil prospects, possibly containing quantities nearly as great as the fields at Prudhoe Bay.[4]

Congress recognized this conflict in values in 1980 when it expanded the existing Arctic National Wildlife Range, and renamed it the Arctic National Wildlife Refuge in the Alaska National Interest Lands Conservation Act (ANILCA, P.L. 98-487). The major portion of the pre-existing Range was designated as wilderness, and the remainder, which constituted most of the Range's coastal plain, was hotly contested because of its high biological value and potential oil resources. The compromise reached in §1002 of ANILCA required that DOI intensively evaluate the oil potential, environmental impacts, and alternative policies for future disposition of 1.5 million acres of the coastal plain of ANWR. This "1002 area" is approximately 100 miles wide, and is 10 to 25 miles from north to south, roughly to the margin of the Brooks Range. (See Figure 2.) DOI was to

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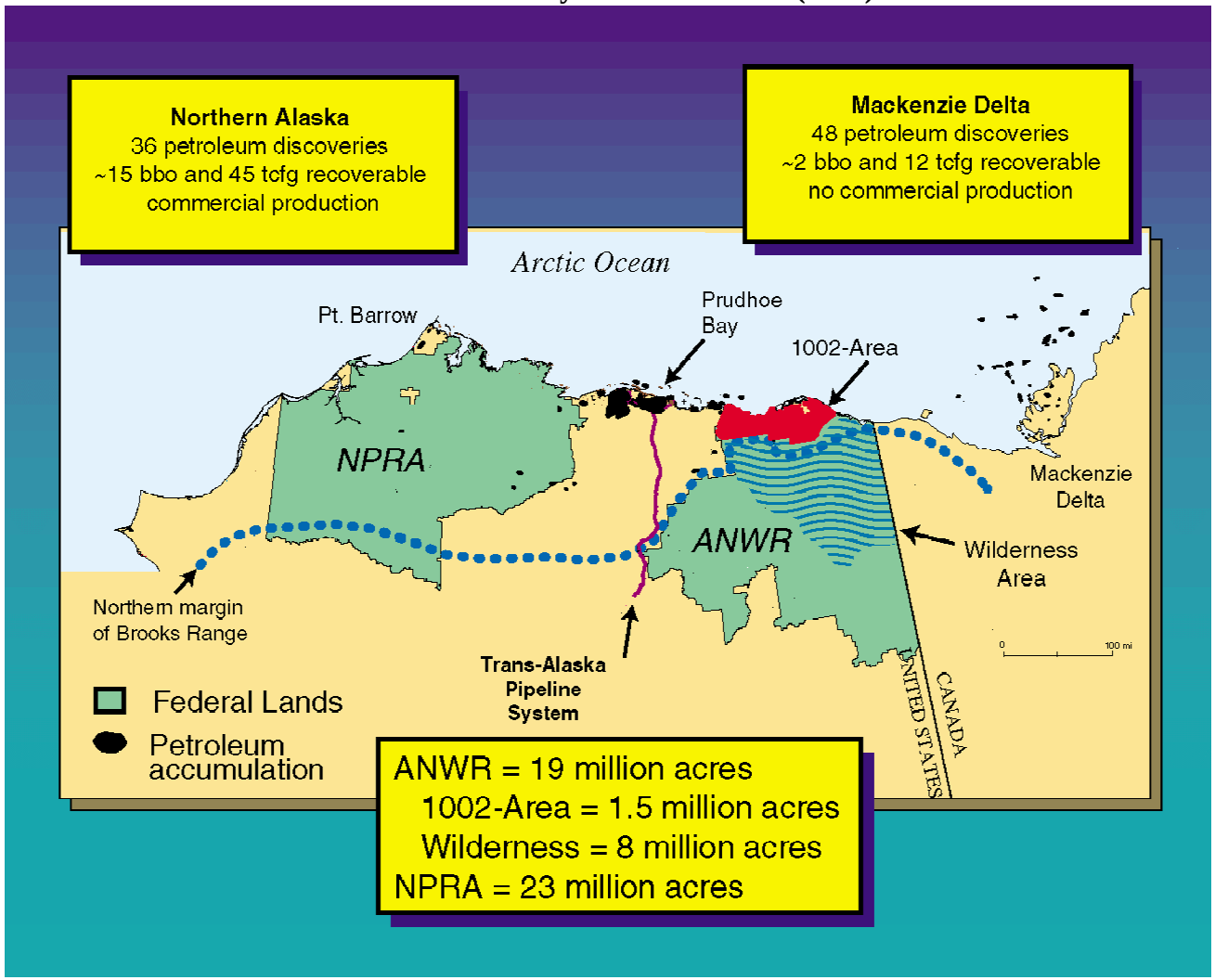
[2]For a discussion of current legislative proposals on ANWR, see CRS Issue Brief IB10111 *Arctic National Wildlife Refuge: Controversies for the 108th Congress*, updated regularly.

[3]Outside of Kaktovik, only a few physical artifacts reflect modern human presence. See *Use of Resources by Non-Natives: Status and Effects*, below.

[4]*National Energy Policy: Reliable, Affordable, and Environmentally Sound Energy for America's Future*, Report of the national Energy Policy Development Group, May 2001. p. 5-9.

Figure 2. Petroleum Accumulations in Northern Alaska and Nearby Parts of Canada (1998).



Notes: "Locations of known petroleum accumulations and the TransAlaska Pipeline System (TAPS) are shown, as well as summaries of known petroleum volumes in northern Alaska and the Mackenzie delta of Canada. Bbo = billion barrels of oil, included cumulative production plus recoverable reserves; tcfg = trillion cubic feet of gas recoverable resources." **Source:** Figure AO1, USGS, *Oil and Gas Potential of ANWR.*

provide the report with its findings and recommendations to Congress, so that decisions relating to development could be made with more information and with the full participation of Congress. In the meantime, §1003 of ANILCA explicitly forbids energy development throughout the Refuge until Congress acts.

The issue has been debated several times since 1980. Congressional interest has been stimulated by fluctuating energy prices and by a favorable environment in Congress and a strongly supportive President. The fluctuating oil prices, close margins in control of the Senate, and concern over terrorism have all complicated the outlook in recent months.

Congressional options can be divided into categories. A decision could be postponed, thereby continuing the development prohibitions of §1003; the area could be made permanent wilderness; development could be permitted under current laws applicable to other federal lands; or development could be allowed subject to specified restrictions.

Scope of the Report

It is unclear whether Congress will present the President with ANWR legislation in the 108th Congress. The House passed an energy bill with an ANWR development title in the 1st session of the 108th Congress. The Senate is taking up energy legislation in the 1st session, but Chairman Domenici (Committee on Energy and Natural Resources) has pledged to exclude ANWR development from a comprehensive energy bill in light of an earlier failure to include ANWR development provisions in a reconciliation bill. (For details of current legislation, see CRS Issue Brief IB10111, *Arctic National Wildlife Refuge (ANWR): Controversies for the 108th Congress*.) In light of the continuing debate, this seems an appropriate time to review the history of the debate and what has been learned about the complex issues surrounding this decision.

This report provides the background for such analysis. It summarizes and integrates relevant information and points of view on the economic, legal, environmental, management, and national energy concerns surrounding any decision on ANWR. The report does not attempt to focus on specific legislative issues, bills, or provisions, but rather attempts to provide a baseline for analyzing such proposals.

Congress faces several difficult questions in deciding whether to open the area to energy development, and if so, under what conditions to do so. These include:

- How much oil might be recovered, and how quickly might it begin to supply the country?

- What would be the economic benefits and costs of development to the nation? To Alaska specifically?

- What role do Native lands on the coastal plain play in the development of any energy resources and what environmental restrictions might apply to those lands specifically in the event of development?

- What environmental impacts are likely to occur if the area is opened and how might these impacts be avoided, reduced, or mitigated?

- Is it possible for industry to limit the "footprint" of development, and if so how widely scattered must the footprint be, in order to permit full development?

- After completion of several decades of energy production, could the coastal plain ever be restored to an approximation of its current condition?
- How should revenues be shared between the federal and the Alaska state governments?

The following chapters provide background and analysis on the questions raised above. Besides extensive information in the 1987 two volume FLEIS, other information is now available in scientific reports, economic analyses, position papers, and testimony. Many of these tend to be focused at one extreme or the other, but not all. Wherever possible, additional materials or references are noted which treat the issues in more depth than is possible in this report.

The report begins with background on the geography or setting of the refuge, and continues with its history. The next portion is on the history of related energy development issues. To set the scene, the likely development sequence if Congress opens ANWR is presented next, followed by an extensive review of the resources of the 1002 area, including the current status, regulations, and potential effects of development of those resources. Finally, the report ends with a presentation of the legislative issues which have arisen most frequently in recent years. A glossary is included to define the key terms and acronyms.

Although the chapters of this report are not entirely independent, readers may find it useful to consult them selectively as background, in order to follow the evolving debate about the possible opening of the 1002 area to development.

The Setting: the Geography of Alaska's North Slope

Physically, what is called the *North Slope* of Alaska consists of those lands north of the Brooks Range where waters drain into the Beaufort and Chukchi Seas. Its area exceeds 100,000 square miles (64,000,000 acres), and includes the northern side of the mountains, foothills, and a relatively flat coast plain. The western part of the North Slope is very broad, with the crest of the Brooks Range being as much as 250 miles from the coast. The eastern part of the North Slope, which includes part of the Refuge, is relatively narrow, with the crest of the range lying as little as 30 miles from the coast. (See Figures 1 and 2.)

The foothills of the Brooks Range merge gradually into the *coastal plain* of the North Slope. The western portion of the plain is extremely flat, and much of it is covered in small lakes. In the narrower eastern coastal plain, the topography is sufficiently rolling that lakes are much less common in the Refuge.

Lying north of the Arctic Circle, darkness and extreme cold prevail much of the year. The area is underlain by permafrost – a permanently frozen layer 1,000 to 2,000 feet thick. During the brief summer, about 3 feet of soil thaws, supporting lichens, mosses, grasses, forbs, and other low shrubby plants that make up the *tundra*. Although precipitation is low, flat areas become wetlands in summer. Most streams and rivers are frozen in winter, flood in spring breakup, and meander in braided channels of gravel until freeze-up. Because the 1002 area has more topographic relief, its drainage is better established, and its vegetation is more woody than the wetland grasses that dominate Prudhoe Bay and other developed areas. Foothills and the hilly portions constitute 45% and 22%, respectively, of the ANWR coastal plain. The foothills reach 1,250 ft, while the hills are mostly less than 100 ft above their surroundings (FLEIS, p. 18-19).

However, conditions on the North Slope have changed somewhat since the FLEIS was prepared in 1987. In recent decades, the climate of the North Slope, like that of most of the area north of the Arctic Circle, has been warming, particularly during winter.[5] The warming has generally resulted in earlier greening of vegetation in the spring and later die-back in the fall. (In 2000 and 2001, spring snowmelt bucked this longer trend and was unusually late.) Arctic Natives, basing their claims on traditional knowledge, have reported decreasing predictability of weather patterns, more dangerous snow and ocean ice conditions, the appearance of insects and birds new to the area, and similar phenomena.[6]

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[5]U.S. Dept. of the Interior. Geological Survey. *Arctic Refuge Coastal Plain Terrestrial Wildlife Research Summaries*. 2002. USGS/BRD/BSR-2002-001. p. 11. (Hereafter referred to as "USGS Wildlife Research Summaries, 2002."

[6]Brown, DeNeen L. "Signs of Thaw in a Desert of Snow." *Washington Post*. May 28, 2002. p. A1.

History of the Refuge

A chronology of the Refuge's history might begin in 1956, with the visit to northeastern Alaska by naturalists Olaus and Margaret Murie, who reported the vast migrating herd of caribou that winter in the United States and Canada around the Porcupine River. Upon their return, the Muries worked with other scientists to set aside the area to protect the caribou herd and the whole relatively intact arctic ecosystem of which they were a central part. However, the first group actually to propose that the area become a national wildlife range, in recognition of the many game species found in the area, was the Tanana Valley (Alaska) Sportsmen's Association.[7] The following is a description, in chronological order, of major events concerning the Refuge, and related energy development in northern Alaska since the 1950s.

Land Orders

All lands in the North Slope were withdrawn January 22, 1943 by Public Land Order (PLO) 82 (8 Fed. Reg. 1,599 (February 4, 1943). In November, 1957, an application for the withdrawal of lands to create an Arctic Wildlife Range was filed. Under the regulations in effect at the time, this application "segregated" the lands in question, removing them from disposal. This fact was important because on July 7, 1958, the Alaska Statehood Act was signed and on January 3, 1959, Alaska was formally admitted to the Union. On December 6, 1960, after statehood, the Secretary of the Interior issued PLO 2214 reserving the area as the Arctic National Wildlife Range. (In Figure 1, the outer boundaries of the "1002 area", plus the wilderness boundaries, were the boundaries of the Range.) The Supreme Court has held that the initial segregation of lands was sufficient to prevent the passage of ownership of certain submerged lands within the Refuge to the State of Alaska at statehood.[8]

Alaska National Interest Lands Conservation Act

In 1980, Congress enacted the Alaska National Interest Lands Conservation Act (ANILCA, P.L. 96-487, 94 Stat. 2371), which included several sections about ANWR. The Arctic Range was renamed the Arctic National Wildlife Refuge, and was expanded, mostly southward and westward, to include an additional 9.2 million acres. Section 702(3) of ANILCA designated much of the original Refuge as a wilderness area, but not the coastal plain.[9] Instead, Congress postponed decisions on the development or further protection of the coastal plain. ANILCA defined the

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[7]U.S. Congress, Senate, Committee on Interstate and Foreign Commerce. *Arctic National Wildlife Range - Alaska*, Hearing, Part I. June 30, 1959. (Washington, DC, 1959). Also see: U.S. Congress, House of Representatives, Committee on Merchant Marine and Fisheries. *Miscellaneous Fish and Wildlife Legislation*, Hearing, July 1, 1959. (Washington, DC, 1959).

[8]United States v. Alaska, 521 U.S. 1 (1997). If this ruling had been in favor of Alaska, certain lands beneath the rivers in the coastal plain might have belonged to the state, which could have developed the oil and gravel in or under them.

[9]Newer portions of the Refuge were not included in the wilderness system.

"coastal plain" as the lands on a specified map.[10] A later legal description of the boundaries excludes most Alaska Native lands, even though these lands are *geographically* part of the coastal plain. Three key sections of ANILCA are discussed below.

Section 1002 Study. Section 1002 of ANILCA directed a study of the "coastal plain" (which therefore is often referred to as the "1002 area") and its resources be completed within 5 years and 9 months of enactment. The executive branch was to conduct a comprehensive baseline study of the fish and wildlife resources of the coastal plain of the Refuge; to develop guidelines for, initiate, and monitor an oil and gas exploration program; to prepare a report to the Congress on the biological resources, the extent of hydrocarbon resources, the impacts of development, transportation of oil and gas, and the need for them; and to make a recommendation on whether exploration, development, and production should proceed. The resulting "1002 report" or Final Legislative Environmental Impact Statement (FLEIS)[11] was issued in April 1987.

The FLEIS recommended full development of the 1002 area. It described the 1002 area as "the most outstanding petroleum exploration target in the onshore United States" (FLEIS, p. vii), and estimated a 19% chance of finding economically recoverable oil. Its mean estimate of economically recoverable oil was 3.2 billion barrels, and the report predicted the area could supply about 4% of total U.S. demand in 2005, and reduce imports by nearly 9%. (See *Oil Potential*, below, for updates of these figures.) It estimated total national economic benefits of $79.4 billion and federal revenues of $38.0 billion. It assumed that oil would be selling at $33/barrel in 1984 dollars by 2000. (In actuality, West Texas Intermediate, a benchmark crude oil, sold from about $25.50 per barrel to about $34.50 per barrel in 2000, which was about $20.30 to $27.50 in 1984 dollars.)

The FLEIS also said the "1002 area is the most biologically productive part of the Arctic Refuge for wildlife and is the center of wildlife activity.... The area presents many opportunities for scientific study of a relatively undisturbed ecosystem." It analyzed the effects of the various development alternatives on the plants and animals, and especially on the calving grounds of the Porcupine Caribou Herd (PCH). It stated that "major effects on the PCH could result if the entire 1002 area were leased and all prospects contained economically recoverable oil" (p. 123). It concluded that full leasing would lead to reductions in bird nesting habitat, loss of over-wintering fish habitat, and loss of polar bear denning habitat. It also predicted moderate effects on polar and grizzly (brown) bears due to direct mortality related to human encounters; and recommended buffer zones of at least 0.5 miles around known polar bear dens. It also noted the special sensitivity of snow geese to aircraft disturbance.

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[10]This map apparently does not exist. See *Legal Definition of the 1002 Area*, below.

[11]U.S. Dept. of the Interior, Fish and Wildlife Service, U.S. Geological Survey, and Bureau of Land Management, *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment,* Report and Recommendation to the Congress of the United States and Final Legislative Environmental Impact Statement, (Washington, DC, 1987). 208 p. (Hereafter referred to as the "FLEIS.")

Legal Definition of the 1002 Area. Section 1002 of ANILCA defines the *coastal plain* as the area shown on a map dated August, 1980. However, the Bureau of Land Management informs us that no such official map or maps with that date depicting the coastal plain exist. The official 1980 maps of the Refuge as a whole, less the area of designated wilderness might be said to indicate the coastal plain. These maps show the Native lands in the Refuge with boundaries crossed out – presumably to indicate they are included within the Refuge. However, the legal description of the boundaries of the coastal plain that were published pursuant to §103 of ANILCA (48 Fed. Reg. 16838, 16869 (April 19, 1983)) exclude the Native lands as of that date from inclusion in the 1002 coastal plain.

Section 1003 Prohibition. In ANILCA, Congress also included §1003, which prevents further development of energy resources, until Congress acts:

> Production of oil and gas from the Arctic National Wildlife Refuge is prohibited and no leasing or other development leading to production of oil and gas from the range shall be undertaken until authorized by an Act of Congress.

Development opponents are well satisfied with the *status quo* under §1003. While many development bills have been introduced since 1987, very few have been reported out of a committee, despite considerable interest by various Members. In the Senate, for example, a willingness to filibuster against development bills has made it difficult for such bills to come to the floor; through the 106th Congress, the sole exception (see *ANWR Consideration in the 101th - 106th Congresses*, below) was in a reconciliation bill which was later vetoed. Development continues to be prohibited.

ANILCA and Native Claims. ANILCA also contained provisions in §1431 that followed up on the previously enacted Alaska Native Claims Settlement Act (ANCSA, P.L. 92-203), and gave the Native village corporation of Kaktovik rights to make certain selections and to enter into certain land exchanges. The result is that Kaktovik has surface rights to some lands inside and some lands outside the 1002 area. However, all of the Kaktovik lands are within the *Refuge* and are subject to the current restrictions on oil and gas development of §1003 of ANILCA and to §22(g) of ANCSA, which made Native lands conveyed in a refuge subject to the regulations of the refuge. If Congress were to lift the restriction of §1003 on oil and gas development in the Refuge, development of Native lands would be allowed to occur. (See discussion of ANCSA provisions in *Use of Resources by Alaska Natives*, below.)

ANWR Consideration in the 101st to 107th Congresses

After the FLEIS of 1987, and the *Exxon Valdez* oil spill of 1989 (see below), congressional interest in the energy potential of the 1002 area has waxed and waned. Bills to open the 1002 area to development or to designate it as wilderness have been introduced repeatedly in both House and Senate. In the House, these bills were referred to the Merchant Marine and Fisheries Committee or (beginning with the 104th Congress) to the Committee on Resources. In the Senate they have been referred to the Committee on Environment and Natural Resources or the Committee on Environment and Public Works. Whether they were development bills or

wilderness bills, they have rarely been reported from committees, much less received floor consideration. From 1989 to 1994 (101st to 104th Congresses), no ANWR bill received floor consideration.

In 1995, Congress passed the FY1996 budget reconciliation bill (H.R. 2491) in which §§5312-5344 authorized the opening of ANWR, but the measure was vetoed. President Clinton cited the ANWR sections as one of his reasons for vetoing the measure.[12] Key Senate votes occurred on May 24 and October 27, 1995, on motions to table amendments that would have stripped ANWR development provisions from the Senate version of the bill (Roll Call #190 and #525, respectively). Both motions succeeded.

While bills were introduced, the ANWR issue was not debated in the 105th Congress. In the 106th Congress, bills to designate the key northern portion of the Refuge as wilderness, and others to open the 1002 area to energy development, were introduced. The FY2001 budget resolution (S.Con.Res. 101) reported by the Senate Budget Committee on March 31, 2000 included assumptions about federal revenues that would be obtained if ANWR leasing were approved. An amendment to remove the language was tabled (51-49) on April 6, 2000 (Roll Call #58); however, conferees rejected the language. The conference report on budget reconciliation did not contain this assumption, and the report was passed by both Houses on April 13.[13] These three roll call votes in two Congresses were all in the Senate, and were the only recorded votes on Refuge development from the 101st through the 106th Congress.

Six bills were introduced in the 107th Congress that would have directly affected the future of ANWR. Four of these (H.R. 4, H.R. 39, H.R. 2436, and S. 388) would have opened the Refuge to development; they shared many overlapping provisions. Two (H.R. 770 and S. 411) would have designated the coast of ANWR as wilderness. The following actions were taken on these bills.

On July 25, 2001, the House Resources Committee reported H.R. 2436. Title V would have opened ANWR to exploration and development. These provisions were incorporated into H.R. 4, an omnibus energy bill. A floor amendment was passed to limit some types of surface development to a total of 2,000 acres; another amendment to strike Title V was defeated. H.R. 4 passed the House on August 2, 2001. The Senate Energy Committee held hearings on S. 388. H.R. 39, H.R. 770, and S. 411 had no hearings.

A comprehensive energy bill, but one that lacked Refuge development provisions, was offered in the second session by Senator Daschle as an amendment (S.Amdt. 2917) to S. 517, the bill which served as the vehicle for Senate floor consideration of omnibus energy legislation. An amendment package to open the Refuge by Senators Murkowski and Stevens was filibustered; cloture motions on the amendments lost, and the amendments were withdrawn. The text of S. 517 (amended) was passed in lieu of the House version of H.R. 4. Conferees met, but

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[12]For key provisions of that legislation, see archived CRS Issue Brief IB95071, *The Arctic National Wildlife Refuge*. 16 p.

[13]Budget resolutions do not require the signature of the President.

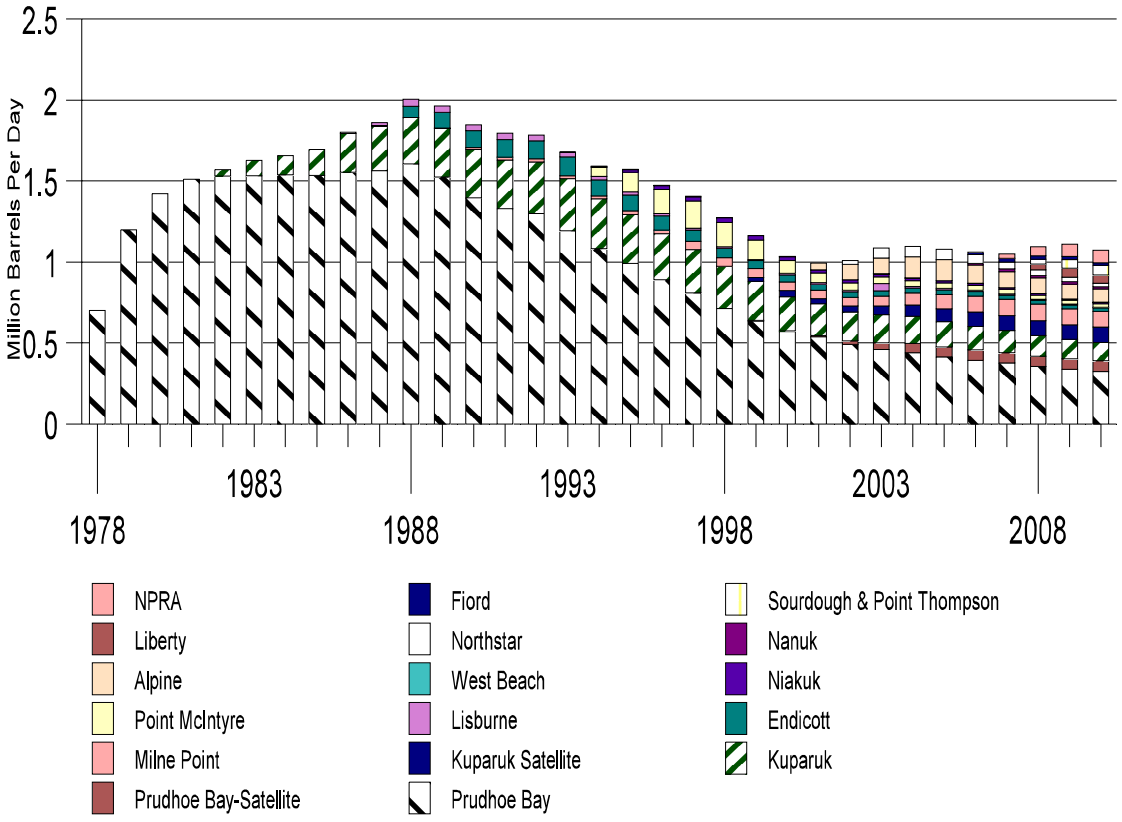
were unable to reconcile the two versions of H.R. 4, in many areas, including Refuge development. The legislation lapsed at the end of the 107th Congress. (For more on past actions, see CRS Report RL31725, *Arctic National Wildlife Refuge: Legislative Issues Through the 107th Congress*.)

History of Related Energy Development

In 1967, oil was discovered on the North Slope of Alaska at Prudhoe Bay, about 60 miles west of ANWR. (See Figure 2.) Since that time, developments following from that discovery have affected the economics, potential support facilities, and understanding of proposed development of the Refuge. This section provides a short history of related energy development on the North Slope and describes how that development has influenced the ANWR debate.

As the years have passed, new fields in the area have been discovered, developed, and produced. As production at the original giant field rose to a peak and then fell again, additional fields have been brought on-line, though this has not reversed a long term decline in North Slope production. (See Figure 3.)

Figure 3. Historical and Projected North Slope Production, 1978-2010. Source: Alaska Department of Revenue, Tax Division. Revenue Sources Book. Forecast and Historical Data. Spring 2002. Table H. (Amounts in millions of barrels/day.)



TransAlaska Pipeline System (TAPS) Authorization

The Prudhoe Bay discovery was a great distance from markets and/or a warm water port from which to transport oil to markets. Development of the resource was thwarted for several years by lack of agreement on how and by which route the crude oil would be transported out of the area.

Alternative Routes Considered. Transporting the oil directly from the area by tanker was considered briefly, but an experiment failed. Pipeline routes were seen as the only viable option. Initially, three general pipeline routes were conceptualized. Two never reached the stage of serious study: one was an easterly route into Canada, to the McKenzie River Delta, then south to a Chicago-area destination, and the other was a southeasterly route along the Alaskan Highway into Canada and then south into the United States. The third was overland, south to the port of Valdez.

Proponents of the first two routes argued that the oil was needed most in the Midwest, because it has no indigenous source of crude oil. Midwestern interests favored it because of the prospective economic gain. Opponents contended that such routes were very long, and therefore would cost more and take longer to build. Oil prices had not reached levels sufficient to justify further investigation.

The third route was ultimately chosen: oil is shipped via TAPS south to the seaport of Valdez on Prince William Sound, then loaded on tankers destined for other ports. Proponents cited its shorter length, and therefore lower total cost and shorter construction period. Some opponents were concerned that the proximity of Valdez to Pacific Rim countries such as Japan and Korea presented too great a temptation to export the oil; others were concerned about possible oil spills along the West Coast.

Export Restrictions in Original TAPS Law. Much of the pipeline's route between the North Slope and Valdez is on federal lands, for which rights-of-way were needed. The Mineral Leasing Act of 1920 prohibits export of oil transported through pipelines granted rights-of-way over federal lands (30 U.S.C. 185(u)). There was considerable opposition to the export of North Slope oil and many saw a growing domestic need for the oil in late 1973 as a result of the Arab oil embargo (imposed during the Arab-Israeli War of October 1973), and of the gasoline shortages (resulting from petroleum allocation regulations). The increased concern over U.S. dependency on foreign oil brought urgency to the pipeline debate. A compromise was soon reached over whether to exempt North Slope oil from this prohibition.

The compromise was the Trans-Alaska Pipeline Authorization Act (P.L. 93-153, 87 Stat. 584, 43 U.S.C. 1651 *et seq*.), signed November 16, 1973. It specified among its many provisions that oil shipped through the pipeline could be exported only under certain restrictions.[14] Subsequent legislation strengthened the export

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[14]Many opponents of the pipeline (or at least of its presence on federal lands) argued that potential environmental damage was unjustified if the primary beneficiaries would be Pacific Rim nations receiving the oil. Therefore, they wished to prevent export of the oil, (continued...)

restrictions further.[15] The restrictions proved to be, in effect, a complete ban on exports of North Slope oil. However, the restriction was not to last, as market forces created pressure to change the law. (See *Export Restrictions Loosened*, below.)

Exxon Valdez Oil Spill

The grounding of the *Exxon Valdez* on March 24, 1989, near the southern terminal of the TAPS in Prince William Sound played a major role in placing the development debate on hold. Environmental damage at the time included an estimated 300,000 to 645,000 dead seabirds; 4,000 to 6,000 dead marine mammals; and $100 million in other losses, including commercial fishing impacts. Some cleanup methods were criticized as doing more harm than good. Lawsuits were abundant.

Today, there is still disagreement over the impact of the spill. Some scientists note the lack of toxicity of the water, and a visitor in the area would still see rugged beauty on most beaches. But other observers stress the accumulation of oil in some species, such as mussels (which filter sea water), and the effects on species that consume contaminated organisms. For example, a 2001 study of seabirds in the area showed that of the 17 groups (containing a total of 33 species) "most [groups] for which injury was previously demonstrated are not recovering and others continue to show potential population effects nine years after the spill."[16] The affected birds included species of sea ducks, grebes, terns, murres, and gulls. Exxon Mobil responded that bird populations may not be recovering due to a variety of other environmental changes in the area, *e.g.*, higher water temperatures.[17]

Export Restrictions Loosened

The Trans-Alaska Pipeline System was completed in 1977, and oil was being shipped through by the end of the year. Continued oilfield development on the North Slope resulted in a 10-year increase in production to a peak of 2.0 million barrels per day (bbl/d) in 1988.

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[14](...continued)
even though the oil would fetch higher prices if it could be sold on world markets.

[15]These restrictions included the Energy Policy and Conservation Act of 1975 (P.L. 94-163), the 1977 amendments to the Export Administration Act (P.L. 95-52 and P.L. 95-223), and the Export Administration Act of 1979 (P.L. 96-72), which replaced the Export Administration Act of 1969.

[16]Brian K. Lance, *et al.*, "An Evaluation of Marine Bird Population Trends Following the *Exxon Valdez* Oil Spill, Prince William sound, Alaska," *Marine Pollution Bulletin*, Vol. 42: p. 298-309. Elsevier Science, Ltd. (April 2001). Species were considered to be recovering if either (a) the populations in the oiled areas were increasing, or (b) if their trend was similar to that of populations of the same species in areas without oil.

[17]Unnamed ExxonMobil spokesperson, cited in Pearce, Fred. "Alaska's oil spill may still be hitting wildlife hard." *New Scientist*. May 2, 2001. [http://www.newscientist.com].

With exports effectively banned, much of North Slope oil went to West Coast destinations. The rest was shipped to the Gulf Coast via the Panama Canal or overland across the Panamanian isthmus. Such Gulf Coast shipments reduce average effective wellhead prices on the North Slope, which must absorb at least the cost of transportation through the pipeline and by tanker, and therefore always are a few to several dollars below Lower-48 wellhead prices.

In the early and mid-1990s, California – the nation's third largest oil producing state – was producing about 800,000 bbl/d on average. Another 150,000 bbl/d were being produced in federal waters off the West Coast, and about 100,000 bbl/d of crude oil were being imported. At the same time, total consumption of petroleum in California was falling – 8% between 1989 and 1995. The combination of Californian and federal offshore production, North Slope oil,[18] and imports, resulted in such large quantities relative to demand that prices of crude oil in California fell below those elsewhere in the United States. Prices obtained by producers – from California and North Slope – naturally suffered as well, and elicited concern and complaints from those producers.

Attempts to obtain help were unsuccessful until 1995 despite arguments that the gains of exporting would outweigh the losses. For example, a June 1994 Department of Energy (DOE) study found that exporting Alaskan crude oil would increase prices for both Californian and Alaskan producers and result in up to 100,000 bbl/d more production in California and Alaska (combined) than would be the case with continued export restrictions.[19] As a result of avoiding the trip through Panama, Alaskan oil would gain higher prices (net of transportation costs) if sold in Japan. DOE predicted that higher resulting prices on the West Coast would spur additional production. In addition, the study found, exporting North Slope oil would stimulate imports of crude oil better suited to California's petroleum product demand mix. However, the study acknowledged, exporting Alaskan oil would divert cargoes away from the U.S. domestic merchant marine fleet and workforce.[20]

These expected benefits and costs, less concern about petroleum in 1995 (after three or four years of low world oil prices), relative calm in the Mideast, and continued pleadings from West Coast producers (after two years of wellhead prices averaging below $12 per barrel) helped open the way to repeal of the export restrictions. The Clinton Administration was supportive, and bills in the House and Senate (H.R. 70 and S. 395) passed by large margins. On November 28, 1995, the President signed P.L. 104-58 (109 Stat. 557), Title II of which amended the Mineral Leasing Act to provide that any oil transported through the Trans-Alaska Pipeline may be exported unless the President finds, after considering stated criteria, that it is not in the national interest (30 U.S.C. 185(s)). The President may impose terms and

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[18]North Slope oil production had fallen by 0.5 million bbl/d, to 1.5 million bbl/d by 1995 – still a very large quantity.

[19]U.S. Department of Energy. *Exporting Alaskan North Slope Crude Oil, Benefits and Costs*, DOE/PO-0025 (Washington, DC, June 1994).

[20]The Jones Act of the Merchant Marine Act of 1920 (P.L. 66-261; 46 U.S.C. 883) requires that cargoes transported from one U.S. port to another be carried in U.S.-flag ships; export cargoes (from a U.S. port to a foreign port) may be transported in foreign-flag ships.

conditions; and authority to export oil may be modified or revoked. Beginning with 36,000 bbl/d in 1996, ANS exports rose to a peak of 74,000 bbl/d in 1999. The latter represented 7% of North Slope production. Exports of ANS oil ceased voluntarily in May 2000.

NPR-A Developments

Almost concurrent with the push to allow export of North Slope oil, production of North Slope oil began to fall, reducing if not eliminating the California oil surplus, but also spurring discovery and development of other North Slope fields. The successful exploration, although not sufficient to stop the production decline, increased geological information and strengthened belief that there are commercial quantities of oil in the National Petroleum Reserve - Alaska (NPR-A). (See Figure 2.)

Established in 1923 by President Harding as Naval Petroleum Reserve Number 4, the 33 million acre Reserve, together with other government petroleum reserves, was intended to help assure availability of fuels for the Navy. Rationale for the Reserves faded over time, however, as the likelihood of a sustained interruption in oil supply declined, and markets showed a capacity to allocate and price petroleum when supply was uncertain. In 1981, stewardship of the Reserve passed from the Navy to the Department of the Interior (DOI), and its designation was changed to National Petroleum Reserve - Alaska. Public Law 96-514 authorizes the Secretary of the Interior to conduct oil and gas leasing and development in the NPR-A. Four lease sales were held between 1981 and 1984. An exploratory well drilled in 1985 was dry; but none of these leases was developed and all have expired. The area actually has been explored (including drilling) and/or mapped by various federal government agencies or on their behalf on and off from 1901 through 1998.

By 1996, total Alaskan oil output had fallen below 1.4 million barrels per day. Many Alaskans supported exploration of NPR-A, hoping that output from there would help offset the drop in royalty payments from reduced Prudhoe Bay production. Some argued that NPR-A might assure sufficient throughput to keep the Trans-Alaskan Pipeline running. In addition, lease sales provide bonus bid revenue to the U.S. Treasury; and the government collects royalties if there is production.

Leasing. In early 1997, the Department of the Interior (DOI) initiated a study of potential drilling areas in a 4.6 million acre portion of the northeast part of the Reserve, and of the steps that would be needed to protect wildlife. The discovery of the commercially successful Alpine Field (discussed later in this report) adjacent to the eastern boundary of NPR-A was important in spurring development of a leasing proposal for NPR-A. On August 6, 1998, DOI released its Final Integrated Activity Plan and Environmental Impact Statement (EIS), making 4 million acres available for leasing, with surface pipelines banned on 20% of that area. The EIS was prepared to meet National Environmental Policy Act requirements and to serve as the basis for managing the area; its preferred option provided for a number of restrictions intended to strike a balance between permitting exploration and protecting the

environment.[21] DOI officials estimated that the quadrant under review for leasing could hold 500 million to 2.2 billion barrels on an assumption of a crude oil price of $18-30/barrel.[22]

A lease sale held in May 1999 drew 174 bids from six companies on 3.9 million acres. More than 130 bids were accepted, totaling $105 million. ARCO initially picked up the leases and then sold these holdings to Phillips Alaska Inc. as required by the Federal Trade Commission for the takeover of ARCO by British Petroleum (BP). In the spring of 2001, Phillips Alaska and minority partner Anadarko Petroleum Corporation reported findings of oil and gas, and indicated the find might be commercial.[23] Phillips resumed exploration in the winter of 2001-2002. Additional NPR-A lease sales are anticipated in late 2002.

New Assessment of Resources. Increasing interest in Alaska's petroleum potential spurred the USGS to initiate in 1998 a re-assessment of undiscovered oil and gas resources in the NPR-A. The results, published in May 2002 suggest that there is appreciably more crude oil and natural gas than indicated by previous assessments.[24] The new estimates are based upon field studies, well and geophysical data analysis, and reinterpretation of previous exploration performed over the last four years, plus analysis of the recent discoveries of oil just east of the NPR-A.

According to the new assessment, there is a 95% chance that 5.9 billion barrels or more of crude oil are technically recoverable, a 5% chance that 13.2 billion barrels are technically recoverable, with a mean estimate of 9.3 billion barrels. At an oil price of $24 per barrel (1996 prices), 3.1 billion barrels would be economically recoverable.[25] USGS's 1980 assessment indicated technically recoverable amounts of from 0.3 billion barrels (95% chance) to 5.4 billion barrels (5% chance).[26]

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[21]U.S. Department of the Interior. Bureau of Land Management. *Northeast National Petroleum Reserve-Alaska. Final Integrated Activity Plan/Environmental Impact Statement*. August 1988.

[22]Gee, Robert W., Asst. Secretary for Fossil Energy, U.S. Department of Energy. Testimony before the U.S. House of Representatives, Committee on Energy. April 12, 2000.

[23]*Oil & Gas Journal*, Phillips Makes Own Mark on North Slope with Alpine Start-up, NPR-A Strikes. August 6, 2001. p. 68 et seq.

[24]U.S. Department of the Interior. Geological Survey. *U.S. Geological Survey 2002 Petroleum Resource Assessment of the National Petroleum Reserve in Alaska (NPRA)*, by Kenneth J. Bird and David W. Houseknecht USGS Fact Sheet 045-02, 2002.

[25]See *Glossary* and *What the Numbers* Mean (Box) for an explanation of the terms *technically recoverable, economically recoverable amounts*, and *mean estimate*.

[26]USGS did not estimate economically recoverable amounts in its 1980 assessment.

Possible Development Sequence

There are five phases of oil development on federal lands: the leasing process, exploration, development, production, and reclamation. If economic quantities of oil are not found, only three phases – leasing, exploration and reclamation – would occur. In a large area with numerous tracts, all of these phases could be occurring simultaneously: exploration in some fields, development in others and production in still other fields. Exploration specialists might move from prospect to prospect for several years, followed by construction and other workers carrying out development where discoveries occurred, and so on. The following section describes these five phases.[27]

Where newer technologies are used, they may reduce not only environmental damage or risk, but also costs. Cost-effective technologies would likely be used whether specified in legislation or not. Where savings are less likely, legislation could be required to ensure use of advanced technologies or to ensure environmental standards (with the latter perhaps driving development of still newer technologies). However, any federal requirements to use advanced or environmentally friendly technology may not necessarily apply to Native lands unless Congress explicitly applies them. (See CRS Report RL31115, *Legal Issues Related to Proposed Drilling for Oil and Gas in the Arctic National Wildlife Refuge*.)

Leasing Phase

Through §1003 of ANILCA, Congress has clearly reserved to itself the decision on whether to lease the coastal plain. If it passes development legislation, it may choose to deviate from the typical pattern of leasing on other federal lands or other national wildlife refuges. This section highlights how the leasing process would normally work, and some of the leasing issues that might be considered by Congress in legislation to open ANWR.

In the leasing phase as it is carried out under the Mineral Leasing Act of 1920,[28] BLM gathers information about an area of federal land, based on data from federal agencies and industry submissions. The leasing phase involves a series of decisions and actions by the federal government and by oil corporations, with each decision or action influencing the next. Then BLM determines how much, and what specific lands would be offered. Generally, BLM offers federal leases on a competitive basis, though non-competitive leases may be offered in some circumstances. BLM solicits bids on the tracts, selecting the winning companies based on these bids. Competitive leases would probably be the norm in the 1002 area. The entire process, from initial

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[27]Aspects relating to the technology of ANWR petroleum development are treated more extensively in CRS Report RL31022, *Arctic Petroleum Development: Implications of Advances in Technology*, by Terry R. Twyman. June 19, 2001. 29 p. (Hereafter referred to as CRS Report RL31022.)

[28]For a slightly more detailed guide, see U.S. Department of the Interior. Bureau of Land Management. *The Federal Onshore Oil and Gas Leasing System*. Washington, DC. September, 1994. BLM/WO/GI-92/001+4110+REV94, 7 p. (Hereafter referred to as *The Federal Onshore Oil and Gas Leasing System*.)

public notice, to sales, and to any production, with public input along the way, generally requires several years. Broadly speaking, Congress may choose to pass legislation which entirely replaces the normal processes for leasing on other federal lands, or may selectively override, or substitute for, some of those processes. The following is an abbreviated outline of the steps in a competitive oil or gas lease sale. It indicates as well the areas in past bills where there were proposed changes from current practices.

Leasing must be in accordance with relevant land management plans, such as those for National Forests or for BLM lands, but an analogous plan does not exist for ANWR, though the 1987 FLEIS carried out some of the same functions. These plans are developed with public input and information, as did the FLEIS. Even if the federal lands in question are not subject to general land management planning, the NEPA processes or special statutory provisions may provide opportunity for public participation. If ANWR were opened to leasing, Congress might choose to specify that some of these planning steps, or measures for public participation, be included in the ANWR leasing process. Alternatively, given past reviews such as the FLEIS, it might override some or all of the NEPA process. (See *Compliance with NEPA*, below.)

The Director of BLM may elect to accept formal or informal nominations of lands to be leased. If nominations are to be accepted, a company would normally nominate more land than those areas it felt most promising, in order to conceal its intentions and avoid excessive attention by future competitors on what it believes are the best prospects. In the case of ANWR, it seems highly likely that formal nominations would be part of any leasing process, and measures to provide for formal nominations have been included in bills in previous Congresses. In deciding which (if any) nominations to make, companies would already be considering factors such as likely operating costs, future oil prices, and alternative or perhaps more attractive prospects in the United States or elsewhere. In Alaska, the North Slope's generally high operating costs would tend to be an especially important consideration as companies decided which tracts to nominate. Those companies with past experience elsewhere on the North Slope might be more interested in participating than those lacking such experience.

BLM would use the nominations and other information to determine how much land to offer (if this is not set in legislation) and in what tract sizes.[29] For example, the geology of the area is markedly different on either side of the Marsh Creek anticline (see Figure 5), and the agency might wish to recognize that in some way in its selection of tracts. In previous Congresses, bills have often directed a particular schedule, usually setting a fairly fast pace for the initial and subsequent lease offerings. BLM would not normally choose to offer millions of acres for bidding at once, but instead offer portions over a number of years, using previous discoveries and geologic information to determine future offerings.

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[29]The Mineral Leasing Act sets a maximum of 5,760 acres for tracts in competitive sales in Alaska.

At the time of any offering, BLM would also specify terms or conditions that may apply to particular tracts. These conditions might include, in the case of ANWR, limits on surface occupancy, size of footprint, seasonal availability to exploration, wildlife protection measures, reclamation standards, and the like. Congress could also specify particular terms or conditions in legislation to open the 1002 area to development, and these terms and conditions could be a major vehicle for environmental protection measures in the 1002 area. (Though these terms and conditions might not necessarily apply to Native lands; see *Alaska Native Lands and Rights*, below.) It would be essential for industry to have a firm idea of the terms and conditions of a lease, since these provisions would likely affect the cost of operating the lease, and therefore the amount a company might be willing to bid for the tract. Leases under the Mineral Leasing Act are for 10 years and continue as long afterwards as oil and gas is being produced commercially; Congress could choose any length for the leases.

Under current law, on the date of a competitive sale, oral bidding takes place at a specified location. Competition among companies is based on the size of their up-front offer, called the *bonus bid*. A bonus bid is required to be at least $2 per acre, but bonus bids can total many millions of dollars for some tracts, while others may receive no bid at all. Payment of the bonus bid will occur at a point when the winning bidder cannot yet be certain that oil will be present. As a result, even an ANWR utterly devoid of commercial oil deposits might still earn millions of dollars for the federal government, whether oil is ever produced or not. According to BLM, leases on other federal lands are granted "on the condition that the lessee will have to obtain BLM approval before conducting any surface-disturbing activities."[30] Congress may choose to specify certain conditions or modifications on the requirement for this final step after a lease is sold and before construction of roads or drilling platforms.

In a typical lease under the MLA, a successful bidder must pay $1.50/acre in rent for its tract(s) in the first 5 years, and $2.00/acre thereafter. The first year's rental payment, plus the minimum bonus bid and a $75 administrative fee is due on the date of the sale. The remainder of the bonus bid must be received within 10 work days. Subsequent *rental payments* are due on the anniversary date of the lease. In addition, once production starts, companies pay a standard 12.5% *royalty* on the sale of the oil they produce. Leases expire after 10 years unless production or specified steps toward production are occurring. Lessees may also voluntarily surrender the lease, subject to requirements concerning abandonment of wells, clean up, and any final payments that may be owed. Generally speaking, few bills in previous Congresses have treated an ANWR leasing program in this level of detail (save for a willingness to specify a 12.5% royalty rate). Instead, development bills usually direct the Interior Secretary to promulgate rules and regulations to carry out the leasing program in order to carry out the provisions of the legislation.

Frontier Variations. In a typical frontier area, where energy leases have been rare to non-existent, and geological knowledge is sparse, BLM might allow companies to conduct seismic exploration in the general area before specific tracts

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[30]See p. 5, *The Federal Onshore Oil and Gas Leasing System*, previously cited.

are designated. (ANWR is not typical, however, because ANILCA had specific exploration provisions for the 1002 area.) Once the sale tracts have been named, further exploration might take place. Congress might specify whether additional exploration could occur before nominations were required. However, due to the seasonality of North Slope exploration, this choice could lengthen the time required to make a first lease offering. In the NPR-A (which has its own distinct regulations), this exploration occurred for the first lease sale; exploration took place during the arctic winter, and companies focused on data analysis once melted tundra made the area inaccessible. Far more exploration then took place on leased tracts, in order to help the companies select specific drill sites.

In addition, in frontier areas such as NPR-A and elsewhere, the NEPA impact assessment process is occurring both before and during preparation for the sales. A full EIS can add substantially to the time required to carry out a sale, even if it occurs concurrently. Congress has, in several ANWR development bills, shown a willingness to modify or eliminate NEPA requirements, on the basis that the 1987 FLEIS fulfilled that function.

Thus, a leasing phase may overlap substantially with an exploration phase. In the 1002 area, while both of these phases might be shortened by reducing requirements for environmental review, for example, there is a limit to how much the process might be truncated. Furthermore, in the arctic, current technology limits exploration to the winter season only. Since BLM would wish to consider the views of industry in selecting the tracts to be offered – views that will take time and further exploration to develop – this too could lengthen the leasing process.

Leasing on National Wildlife Refuges. A factor which Congress might consider, should it decide to open ANWR, would be the special circumstances that apply to leasing part of a National Wildlife Refuge, since leasing would normally have to be determined to be "compatible" with the major purposes of the National Wildlife Refuge System and with the purposes of the particular unit of that System. (See *Compatibility with Refuge Purposes*, below.) While energy leasing does occur in the National Wildlife Refuge System, it occurs in less than 10% of refuges, and in virtually no instance has leasing occurred after a compatibility determination. (See Box for examples.) If Congress wished ANWR development to occur as expeditiously as possible, it could override the compatibility test. In previous Congresses, bills have expressly addressed the potential conflict by stating that Congress has determined energy leasing to be compatible with the purposes for which ANWR was designated.

Energy Leasing in National Wildlife Refuges

A survey by the General Accounting Office in 2000 found that of the 567 refuge system units, 45 units had producing oil or gas wells, of which 19 units were in Texas or Louisiana. (See *Wildlife Refuge Oil and Gas Activity*, Oct. 31, 2001. 16 p. GAO Report GAO-02-64R.) In only eight of the units did the federal government own the oil and gas rights. (Due to an apparent mis-communication with FWS, Kenai NWR (see below) was not included among the eight, but should have been.) Where there are pre-existing rights, FWS has little control over the determination to develop energy or minerals, though it may determine its timing or manner. The refuges with energy development had special features that make comparison with proposals to develop ANWR difficult. However, there appear to be no instances to date in which FWS has had full control of surface and subsurface rights, formally determined leasing to be compatible with refuge purposes, and then allowed new leasing to proceed. The examples below illustrate refuges in which leasing occurs.

In Medicine Lake (MT) and J. Clark Salyer and Upper Souris (ND) NWRs, BLM offered leases because of "drainage" in which oil was being extracted on adjacent land from oil fields which extended into the refuge. If no leases had been given, then adjacent leases would have drained the (federally owned) oil underlaying the refuges. Oil drainage from adjacent development is not occurring around ANWR at this time.

In one refuge (Delta, LA), some activity occurred due to privately owned subsurface rights; and some federal government leases had been issued before the refuge was created in 1935. In the 1002 area, while private subsurface rights are held by Alaska Native corporations, their activities are governed by laws that do not apply at Delta NWR.

At Hagerman NWR (TX), FWS has secondary jurisdiction on land owned by the Army Corps of Engineers. As a result, FWS does not have control of leasing decisions there. In ANWR, FWS has primary jurisdiction.

Bitter Lake NWR (NM) has several leases that were granted when the land was owned by BLM. The lands were gained by FWS in an exchange of outlying FWS lands for inholdings or adjacent parcels owned by BLM. The purpose of the exchange was to increase administrative efficiency.

Kenai NWR (AK) has 12,000 acres under federal leases, with the refuge zoned into leasing and non-leasing areas. The first oil leases were in 1956 under the Mineral Leasing Act; no formal compatibility determination was required at that time, but the Secretary of the Interior determined that leasing could proceed. As a result of a lawsuit, FWS in 1994 determined that leasing was compatible. After passage of the National Wildlife Refuge System Improvement Act (1997), this informal determination was rescinded, with the approval of the Regional Administrator. While the decision does not affect pre-existing leases, nor subsurface rights not owned by the federal government, it would prevent future development where the federal government owns the mineral rights. In addition, Cook Inlet Regional Corporation owns 3.58 townships of coal, oil, and gas rights; and sand and gravel rights for use in the production of the energy rights. They also have rights for other structures such as rights of way for roads, drill pads, pipelines and other facilities necessary to produce these resources.

Exploration Phase

As the previous section makes clear, the leasing and exploration phases overlap. The exploration phase is the time at which industry and the federal government accumulate data about the area that will be, or has already been leased. Exploration activity is most intense after leases have been purchased. Preliminary seismic exploration, using two dimensional (2-D) imaging technology, continues to be used in early exploration in new areas. It is carried out directly across frozen tundra (without special ice roads) in widely spaced grid lines. Seismic exploration uses trains of rolligons (large vehicles with enormous soft tires that spread their weight evenly across the surface) for vibrating the surface and recording the result, plus vehicles for carrying fuel, mechanical repair facilities, and a crew of 80 to 120 people. Damage in the area around Prudhoe is prevented by waiting until the tundra is well-frozen, though tractors with heavy rubber treads are required to pull some of the heavier equipment. For the much less expensive, but less precise 2-D surveys, lines may be several miles apart, but for the high accuracy of 3-D seismic, lines are about 1100 feet apart. More exploration using 3-D seismic technology becomes economic in defining more precisely the boundaries of potential structures, though drilling may occur based on 2-D alone. Under the more advanced 3-D technology, finer grid lines are also run directly across the tundra. The better data resulting from 3-D increase the chance that a given well will be successful from 1 in 10 to perhaps 3 or 4 in 10.

Modern arctic exploration on the state-owned lands of the North Slope is carried out in winter; while early phases involve travel across frozen open tundra, subsequent exploration drilling uses a combination of ice roads, and ice pads. Each mile of ice road uses an estimated one million gallons of liquid water, and road builders typically transport liquid water no more than 10 miles, since it may freeze before it is used. Technical solutions to water shortages could involve greater use of chipped ice scraped from lakes to supplement liquid water, and/or development of new technologies using a desalination plant and a heated elevated pipeline.[31] Though such technologies could prove feasible and some are already in use on the North Slope, they could also change the economics of exploration and later development.

If data indicate economic quantities of oil may be present, a hole is drilled entirely in winter, on thick insulated pads of frozen water. These pads melt in summer, leaving the tundra in relatively good condition.[32] If no commercial quantity of oil is found, the pipe is plugged and temporarily or even permanently abandoned, covered by a small cube-shaped building. Use of these methods, in comparison to

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[31]W. Wayt Gibbs, "The Arctic Oil and Wildlife Refuge", *Scientific American* (May 2001), pp. 62-69. (Hereafter referred to as Gibbs, "The Arctic Oil and Wildlife Refuge.")

[32]With insulating panels, ice pads can be maintained over the summer, allowing the drilling rig to remain in place for additional drilling in the early winter, thereby eliminating the need to remove the rig in spring and replace it in the next winter. Such a practice can increase the drilling season 50 to 70 days. (See CRS Report 31022, p. 17, previously cited.)

the technology available in 1987, can substantially reduce impacts of exploration on the landscape.[33]

Development Phase

In the development phase, companies construct the infrastructure needed to go from a find to actual production; employment peaks in this phase. If economic quantities of oil are found, a gravel drill pad is built and multiple wells are drilled from the pad. The newest arctic development technology is demonstrated in the Alpine field, at the extreme western edge of current oilfield development, on state lands near the NPR-A. (See Figure 4, showing the Alpine field.) Two gravel pads, linked by a 3-mile long combined road and runway, support 112 wells. Heavy equipment to be used in the field was delivered to the nearest staging area in summer via gravel road. Once winter ice roads were built, the equipment was transported to the field. In summer, access to Alpine is by aircraft only. While no gravel roads link Alpine with other North Slope development, pipelines connect the Alpine field to collection lines from several fields and these in turn connect to TAPS to carry the oil south.

Since the 1987 FLEIS, considerable advances have been made in the technologies surrounding the development phase. These advances contribute to efficiency and often to reduced environmental impacts, and some would likely be used, required or not, due to cost savings. Others might be used if required by the federal government or the state; such requirements could change the economics of development. One clear improvement since 1987, as a result of improved data analysis at the exploration phase, is that development can be more efficient, since fewer "dry holes" are likely to be drilled. Other improvements are as follows.

Advanced Drilling. Drilling technology has evolved from a single hole straight down into a prospect, to directional, extended reach, horizontal, multilateral, and designer wells. All of these designs permit more efficient production of hydrocarbon reserves, and allow easier connection to production facilities, with fewer pipelines. They also reduce the number of wellheads. Drill bit technology has improved, allowing wells to be drilled faster. Drilling muds are less toxic; cuttings generated during drilling can be stored in temporary reserve pits and then used in construction, or reinjected into special wells for waste disposal.[34] Efforts are made to avoid any surface discharge of wastes. Savings make it likely that these technologies would be used if ANWR were opened; legislative provisions might push further requirements.

Drill Pads. With this advanced drilling technology, more of the oil-bearing structure can be tapped from a well head, and drill pads can be located, under very favorable conditions, up to 7 miles in horizontal distance from a target. These technologies reduce development's footprint, as well as allow greater protection of

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[33]For more information on exploration technology, see CRS Report RL31022, previously cited.

[34]For more extensive discussion of these technologies, and for illustrations of types of drilling methods, see CRS Report RL31022, previously cited.

surface features. Since each drill pad can develop a greater area, fewer drill pads are needed than in the past. Technologies developed largely in the 1990s also permit closer spacing of wells, and more wellheads can be placed on a smaller drill pad. Drill pads in the 1970s were about 44 acres. In contrast, Alpine's 2 drill pads are 36 acres and 10 acres.[35] The larger pad is the main production pad, and includes a central processing facility, housing, and storage area, along with wellheads. The secondary pad contains only drilling facilities and wellheads; workers there commute from the main pad. If the Prudhoe Bay oilfield and surrounding fields had been developed using this technology, only 4,000 acres, instead of the present 12,000 acres, would be needed.[36] Production facilities (like those at Alpine) would be scattered in a network over producing fields, due to the 7-mile maximum reach of horizontal drilling, and multiple pads could be needed for producing fields. (Pipelines would carry oil from the pads to a collection line; see *Production Phase*.)

Roads. If a development phase followed the model at Alpine, heavy equipment would be carried to a staging area as near as possible to the drill site and accessible to the gravel road network that services the currently developed areas. As soon as ice roads could be built, the equipment would be moved to the drill site, where a gravel pad would have been constructed previously. All heavy equipment would be transported to the site during the winter; equipment needed in the summer would be flown in along with personnel to an adjacent airstrip. As at Alpine, gravel roads might be constructed to link pads within the same field.

If this model were followed, the mileage of roads constructed in the 1002 area would be far smaller than was expected in the 1987 FLEIS (for a given size and location of discovery). Heavy reliance on ice roads could mean high demands for water if the staging area were just to the west of the 1002 area and discoveries were in the eastern portion of the 1002 area – a distance of roughly 100 miles. Alternatively, staging areas could be located farther east, perhaps by off-loading barged equipment at Kaktovik. Water demands might be further reduced, perhaps by developing new technologies, or by placing gravel roads to transport heavy equipment on Native lands. The feasibility of these options would also depend on the extent to which Congress regulated development on Native lands (as opposed to federally-owned land).

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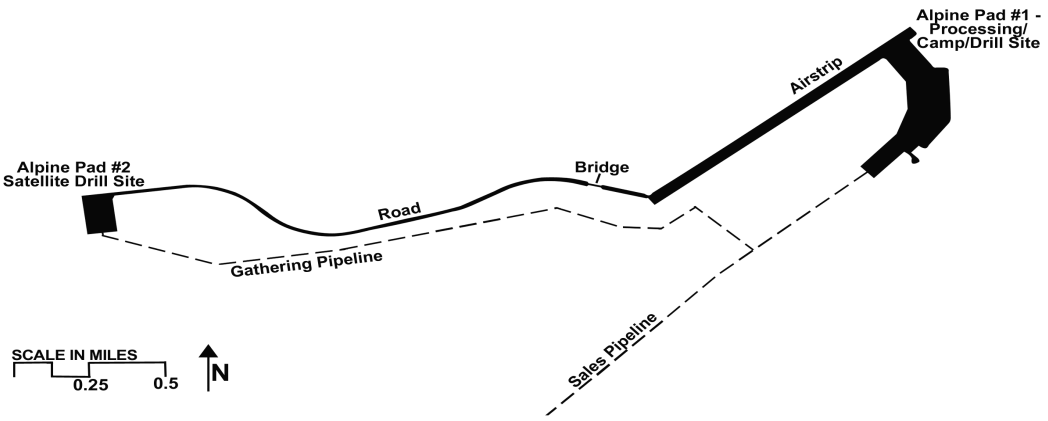
[35]U.S. Army Corps of Engineers Alaska District, Permit Evaluation and Decision Document, Alpine Development Project, Colville River 18 (2-960874), p. 2 (Feb. 13, 1998).

[36]Stephen Taylor, retired director of environmental policy, BP Exploration (Alaska). Cited by Janet Pelley, "Will Drilling for Oil Disrupt the Arctic National Wildlife Refuge?" *Environmental Science and Technology* (June 1, 2001).

Figure 4. Alpine Oil Field.



Source: ARCO Alaska, Incorporated. Permit Application to U.S. Army District Engineer, Alaska, Permit No. 2-960874, Colville River 18. Jan. 22 and 24, 1998. Map somewhat simplified for clarity in monochrome.

The Meaning of Footprints. The *footprint* of development infrastructure is the area within the outline of any structures on the surface of the land as these features might be shown on an ordinary two dimensional map. In the case of arctic energy development, most observers appear to include gravel drill pads, runways, and roads in the total footprint of development. However, in the case of elevated pipelines, some might choose to count only the base of the support arms holding aloft the pipelines (footprint in the narrow sense), rather than the entire length and width of the pipeline (footprint in the broad sense).[37] Some would also count the surface covered by gravel mines, ports, water impoundments, water treatment facilities and the like (footprint in the broadest sense).

Arctic Power (a consortium of development proponents that includes industry) has estimated that the 1.5 million acre 1002 area could be developed with a maximum footprint of 2,000 acres.[38] Some have assumed that the footprint would be a single compact unit of 2,000 acres (equivalent to 3.125 square miles – about 0.13% of the 1002 area). However, full development would be impossible if the footprint were a single compact unit. With advanced drilling technology (extended reach drilling), under favorable circumstances, lateral drilling can reach 5 to 7 miles from a drill site. Thus, if development were confined to a compact box of 3.125 mi^2 (equivalent to a square 1.77 miles by 1.77 miles) and optimum conditions obtained, up to 10.5% of the 1002 area could be developed. In contrast, full development of the 1002 area would require the strategic placement of pads, connector roads (the type of road at Alpine), and pipeline supports to be scattered about the 1002 area in a network.

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[37]The difference could be likened to the choice between counting the actual area touched by the supports of a highway overpass or the outline of the whole overpass, as the footprint.

[38]For example, Arctic Power's website [http://www.anwr.org/features/pdfs/tech-facts.pdf] for January 9, 2002 makes this claim.

Most development advocates do not oppose a surface occupancy, or footprint, limitation to 2,000 acres, apparently feeling that such a limit based on a definition covering pads, airstrips and pipe supports would not hinder full development. Even if the term *footprint* were expanded to include connector roads like that at Alpine (where the road represents about 15% of the gravel surfaces), they do not appear to consider a 2000-acre limit to be overly confining. If, however, gravel mines, water catch basins, water treatment plants, ports, causeways, and other possible features (FLEIS, p. 99), were to be built and included in a 2,000-acre limit on footprint (the broadest definition of the term), and if geology of the fields required more numerous or widespread wells, there appear to be three possible responses to the problem: (1) facilities might be modified (perhaps through improved technology) in order to stay within a 2,000-acre limit; (2) some otherwise economic prospects might be missed; or (3) the footprint limitation might be modified in some way. Finally, if legislation did not apply limitations to Native lands, some additional prospects on federal leases might be developed from pads within these Native lands by using advanced drilling technologies. Support facilities also could be located on the Native lands within the Refuge and as a result avoid an acreage limitation, if legislation did not specifically include such lands in the limitation.

Production Phase

In a production phase, drilling equipment would be removed, and small buildings (housing oil pumps) would be installed and connected to pipelines and, for the 1002 area, ultimately to TAPS. Fewer employees are necessary during the production phase. Production facilities to extract hydrocarbons consist of drilling equipment and rigs, central processing facilities (which include oil and gas separation units, power plants, flowlines, and crew offices and living quarters), access roads, gravel mines, airstrips, and possibly ports and desalination facilities. Should commercial quantities of oil be discovered in ANWR, it is likely that the most advanced production facilities would be used in order to contain costs and minimize physical size and effect on the environment.

With current technologies, permanent drill sites would be constructed of gravel or recycled cuttings from the exploration wells. Compact factory-manufactured production facilities would be transported to the site instead of built on site. Depending upon conditions, slim-hole or coiled tubing drilling would be used.[39] Multilateral wells (wells with additional boreholes branching from a common hole) might be used in restricted spaces and/or to share the same surface facility. When wells not accessible to conventional rigs became old, the life of the reservoir may be extended by using through-tubing rotary drilled wells, which go through existing production tubing. Unmanned production facilities might be installed to exploit accumulations in remote sites, precluding the need for crew facilities at those locations. Together, these techniques reduce the amount of support facilities needed and the amount of waste.

The Alpine development, at the far western edge of North Slope development, uses these technologies, the most advanced currently available. The total Alpine

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[39]See CRS Report RL31022, previously cited, for a description of these technologies.

development, according to the U.S. Army Corps of Engineers, is permitted at 98.4 acres of gravel fill. The permit provides for 1 large drill pad (36.3 acres), 1 satellite pad (10.1 acres), 1 airstrip (35.7 acres), 1 connector road of 3 miles (14.6 acres), and other features (culverts, etc., 1.7 acres).[40]

Reclamation Phase

In the reclamation phase, lessees would remove the traces of their activities to whatever standard was specified. Any authorization to develop the 1002 area could include reclamation provisions.[41] If oil production were to occur, industrial activity would probably last decades, especially if natural gas resources could also be developed, so reclamation would be decades in the future. Removal of gravel pads, roads, and runways; pipelines; support centers; water treatment plants; etc., would come as production (and therefore revenue) was declining. To ensure financial resources to support this final industrial phase, some have suggested that companies be required to post bonds. Even with consistent use of the best available technologies, decades of disturbance could require more decades for the disappearance of human intrusion in the slow-growing environment.[42] It is unclear whether local residents or Refuge managers would even wish to have roads or other facilities removed once energy production ceases.

However, as noted above, new developments in production field facility construction and maintenance and in drilling and production have reduced the size of oil and gas field operations. And, since modern technology attempts to avoid any surface discharge, the technical aspects of reclamation could be somewhat less demanding than for older fields.

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[40]It appears that somewhat less acreage was actually occupied than called for in the permit: the size of the Alpine complex is variously cited as 93, 94, 97, and 98 acres, depending on the source. It is unclear exactly what portion of the development is reduced relative to the permitted size.

[41]If commercial quantities were not found, reclamation would occur after some years of exploration. FWS or BLM (or other agencies given such responsibility) might condition development permits on mitigation, reclamation, or rehabilitation of affected lands. If no commercial quantities of oil were found, cleanup needs might be fairly minimal – although with the slow growth rate of vegetation in the arctic, even minimal disturbance can take decades to recover. See *Reclamation Issues After Development*, below.)

[42]The response of arctic vegetation to disturbance is complex. Factors that tend to lengthen recovery include greater dryness, changes in moisture conditions, and soil compaction. Recovery is hastened by re-planting with native plants and careful, selective use of appropriate fertilizers. Recovery is slower than in temperate habitats. See Jay D. McKendrick, "Vegetative Responses to Disturbance," in *The Natural History of an Arctic Oil Field*, pp. 35-36.

Resources: Status, Current Regulation, and Potential Effects of Development

While much is still unknown regarding both the biological and geological resources of the 1002 area, much has also been learned during 40 years of debate over the Refuge. Among the areas with improved information are estimates of the oil and gas potential of the area and the ecology of several of the species that frequent the area. Some of the specific resources are discussed below.[43] This report will first give background information, and then discuss potential effects of development on Alaska Natives, the economy, and the Refuge.

Energy: Status and Effects

Potential energy resources are the attraction that drives the ANWR question. From a long term and basic perspective, U.S. oil production has been declining for three decades, petroleum consumption has been increasing, and oil imports fill the growing gap. During 2001, the nation's attention was drawn to energy issues by successive jumps in the pump price of gasoline and by California's serious electric power problems.[44] The potential for oil in the 1002 area has been a focus of that attention.

Oil Potential. Parts of Alaska's North Slope (ANS) coastal plain have proved abundant in oil reserves, and its geology holds further promise. The oil-bearing strata extend eastward from structures in the National Petroleum Reserve-Alaska (NPR-A), to the 2 billion barrel Kuparuk River field, past the Prudhoe Bay field (originally 11-13 billion barrels, now down to about 4 billion barrels), and a few smaller fields, and may continue into and through ANWR's 1002 area. Further east in Canada's Mackenzie River delta, once promising structures have not produced significant amounts of oil. These smaller accumulations include some fields that have produced intermittently and others that currently are noncommercial due mainly to lack of transportation infrastructure. The 1002 area contains some of the most promising undrilled onshore geologic structures with petroleum potential known in the United States.

Geology and Potential Petroleum Resources. Estimates of ANWR oil potential, both old and new, depend on limited data and numerous assumptions about geology and economics. New geological data from outside ANWR and reinterpretation (using new techniques) of the limited old FLEIS information have changed estimates of ANWR's oil potential. Another factor affecting resource and recovery estimates is the projected price of oil, which the Bureau of Land Management (BLM) in 1987 assumed would increase steadily (excluding inflation) over coming decades. In actuality, except for short intervals of spiking, the price of

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[43] As noted above, many opponents of Refuge energy development focus less on the specific resources (discussed below) that might be at risk if oil development is allowed, and more on wilderness protection, or integrity of the ecosystem as a whole.

[44] As discussed later, oil and gas development of ANWR essentially would not address these current issues.

oil has not risen to the extent assumed by BLM until recently. A third factor is falling production costs. As technology improves, once unprofitable structures may become profitable; this has occurred repeatedly on the North Slope. (See Box, *What the Numbers Mean*, for discussion of terms used below.) Three major studies are reviewed below; due to changes in methods, assumptions, and goals of the studies, comparisons among them must be done with caution.

1991 and 1995 Studies. In 1991, BLM reviewed its 1987 estimate of ANWR's recoverable petroleum resource, based on reprocessed geophysical data, newly-acquired information on four wells drilled near ANWR, additional seismic data from offshore areas near the coastal plain, and the characteristics of new applicable technology (used in the development of the Endicott and Milne Point fields on the ANS frontier). This review gave BLM a greater level of confidence that ANWR is part of the North Slope oil province, and increased its estimates of the probability of economic success. BLM reduced its estimate of the smallest field that could be developed economically from 440 million to 400 million barrels,[45] thereby increasing the marginal probability of economic success from 19% to 46%; if such a field is found, the mean estimate of economically recoverable oil would be 3.57 billion barrels – 0.37 billion bbl more than in 1987.

In June 1995, the U.S. Geological Survey (USGS) revisited the Bureau of Land Management's 1991 estimates, relying upon several new geologic studies and data from a new well, the Tenneco Aurora, a federal offshore lease north of the 1002 area. The USGS reduced its estimates of technically recoverable oil reserves in the 1002 area to between 148 million and 5.15 billion barrels. (The draft study, which was never finalized, did not give a mean estimate.[46] See Box *What the Numbers Mean*, for the difference between "technically recoverable" and "economically recoverable.")

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[45]The seeming paradox of reduction constituting an improvement is analogous to taking two tests, in which a passing score on the first is 70, while the passing score on the second is 60. The probability of passing the test (finding an economic field) increases if the minimum passing score (minimum economic field) decreases. This particular figure for field size was applicable to western prospects in the 1002 area. The minimum field size for eastern prospects, needing a longer pipeline to hook up with TAPS, was reduced from 600 million to 550 million barrels.

[46]U.S. Dept. of the Interior, Geological Survey. *Implications of U.S. Geological Survey Region Hydrocarbon Assessment of Northern Alaska to Oil Resource Potential of Arctic National Wildlife Refuge 1002 Area.* June 2, 1995. 6 p. (Issued in draft form only; unnumbered report.)

What the Numbers Mean

There are many widely varying estimates of oil quantities in the 1002 area. Here is a guide to these estimates and their meaning.

How much oil might be present? The amount that might be present or "in place" is just a starting point, since it is not possible to extract all of the oil in a field. Estimates are almost always given as a range of numbers. First, petroleum geologists ask "what quantity of oil are we confident of finding?" There is a good change of finding a small amount (or more), and a small chance of finding a large amount (or more). The probability levels used are fixed (by tradition) at 95% (chance of at least a certain small amount), and 5% (chance of at least a certain large amount). The third number is the mean estimate – the average of all of the estimated amounts. The numbers could change with better data or better technology.

How much oil is technically recoverable? This set of estimates does not take into account the cost of recovery and price of oil, and assumes that only current technology is used to recover the oil. Like the previous set of estimates, it states the large (95%) chance that a certain small amount (or more) of oil is present, the small chance (5%) that a large amount (or more) is present, and the mean estimate. These numbers always are smaller than the estimates of oil that might be present. As technology advances, this number also could change.

How much oil is economically recoverable? These numbers are often the most useful. They reflect assumptions about oil prices, cost of production, etc. They also are given as 95%, mean, and 5% estimates (of small or more, mean, and large or more amounts). If technology later advances, costs decrease, or prices rise, then these numbers could increase, and vice-versa. Estimates of economically recoverable oil tend to increase over time.

Minimum field size is the smallest amount of oil that must be present in a prospect for it to be commercial. Embedded in this concept are assumptions about future oil prices, technology development, and costs of production and transportation; if these change, this threshold will change. At ANWR, the minimum field size usually is estimated at a few hundred million barrels. Many smaller fields very close together might serve as well as a larger one in terms of potential profitability.

What area is being measured? Some estimates of oil in ANWR include the inholdings of the Kaktovik Inupiat Corporation and those of the Arctic Slope Regional Corporation, as well as state owned lands offshore. This report refers to estimates on federal lands only, unless otherwise noted.

1998 Study. The most recent government study of oil and natural gas prospects in ANWR, also by the USGS, was completed in 1998.[47] USGS scientists gathered new data from nearby fields both onshore and offshore and examined the reprocessed seismic data collected in the Refuge in 1984-1985. (See Table 1 and Figure 5; more detailed maps of results are given in the report.) The results of this new study are based upon the assumption that at least one commercial-size field is discovered.

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[47]U.S. Dept. of the Interior, Geological Survey. *The Oil and Gas Potential of the Arctic National Wildlife Refuge 1002 Area., Alaska.* U.S.G.S. Open File Report 98-34. (Washington, DC: 1999). Summary, and Table EA4. (Report available on 2-disk CD-ROM.) (Hereafter cited as USGS, *Oil and Gas Potential of ANWR.*)

Table 1. Probability of the Presence of Given Quantities of Oil and the Recoverability of the Oil in the 1002 Area
(billions of barrels)

Crude Oil	95% Chance This Much or More	Mean Estimate	5% Chance This Much or More
In place	11.59	20.73	31.52
Technically recoverable	4.25	7.69	11.80
Economically recoverable at . . . a market price of $30/bbl	2.98	6.30	10.47
. . . a market price of $24/bbl	2.03	5.24	9.37
. . . a market price of $18/bbl	- 0 -	2.40	6.15

Note: All calculations to estimate economically recoverable resources and the prices used are in 1996 dollars.

Source: U.S. Dept. of the Interior, Geological Survey. *The Oil and Gas Potential of the Arctic National Wildlife Refuge 1002 Area, Alaska.* U.S.G.S. Open File Report 98-34 (Washington, DC: 1999) Summary, and Table EA4. (Report available on 2-disk CD-ROM.)

According to USGS, there is an excellent chance (95%) that at least 11.6 billion barrels are present on federal lands in the 1002 area. There also is a small chance (5%) that 31.52 billion barrels or more are present. If cost were no object, USGS estimates there is an excellent chance (95%) that 4.25 billion barrels or more are technically recoverable. And there is a small chance (5%) that 11.80 billion barrels or more are technically recoverable.[48] (If state offshore lands and Native corporation lands are included, these numbers become 5.7 and 16.0 billion barrels, respectively.) It appears that natural gas is likely to be present as well. USGS estimates that there is a 95% chance that 2.28 trillion cubic feet (tcf) associated with crude oil are technically recoverable, and a 5% chance that 5.16 tcf are technically recoverable.

Technically or Economically Recoverable? However, cost inevitably comes into play, whether in the extreme conditions of the North Slope or elsewhere. Thus, the primary question is *how much oil can be extracted profitably*? Each company has its own internal criteria for this. The higher the price of crude oil, the greater the proportion that would be economically recoverable. High prices also could provide incentives to improve extraction technology thereby reducing extraction costs. The USGS estimated that, at $24/barrel (in 1996 dollars), there is a 95% chance that 2.03 billion barrels or more could be recovered, and a 5% chance of 9.37 billion barrels

[48]The USGS technically recoverable figures in the 1998 assessment are based upon the percentage of oil in place that was recoverable by the oil industry in the 1980s. Inasmuch as recovery rates have improved since then, the USGS figures may underestimate recovery rates in ANWR.

or more. For comparison, the spot price of West Texas crude oil ranged from an average of $11.35 per barrel in December 1998, to $34.34 per barrel in November 2000, according to the Energy Information Administration (EIA). It was estimated at $20 in November 2001. (In 1996 dollars, these were $10.95, $32.00, and $18.10, respectively.)

The projected price of oil is only one of many factors entering into the decision on bidding for a lease. Efforts to reduce exploration and production costs through new technologies play a key role, for example. Each prospective bidder would do its own analysis of the economic and physical factors of the areas offered for lease, and company analyses historically have differed from one another and from government analyses. With geological evidence pointing to the presence of recoverable oil and gas, developers may be interested in bidding on ANWR leases.

Possible Production Levels. It is difficult to estimate the development rates or production levels over time that would be associated with given volumes of economically recoverable oil resources. Some of the various factors considered by prospective bidders also would come into play in determining the rate of development and levels of production. Oil prices (current and projected), geologic characteristics such as permeability and porosity, cash flow, and any transportation constraints would be among the most important.

The EIA estimated production "schedules" that would be associated with several different volumes of *technically* recoverable resources at two development rates.[49] (See Table 2.) At the faster development rate, a production peak would occur 15 to 20 years after the start of development, with maximum daily production rates of roughly 0.00015 (0.015%) of the resource. Slower development rates would peak about 25 years after the start of development at a daily production rate of roughly 0.000105 (0.0105%) of the resource. (Peak production associated with a resource of 5.0 billion barrels at the faster development rate would be 750,000 bbl/d.)

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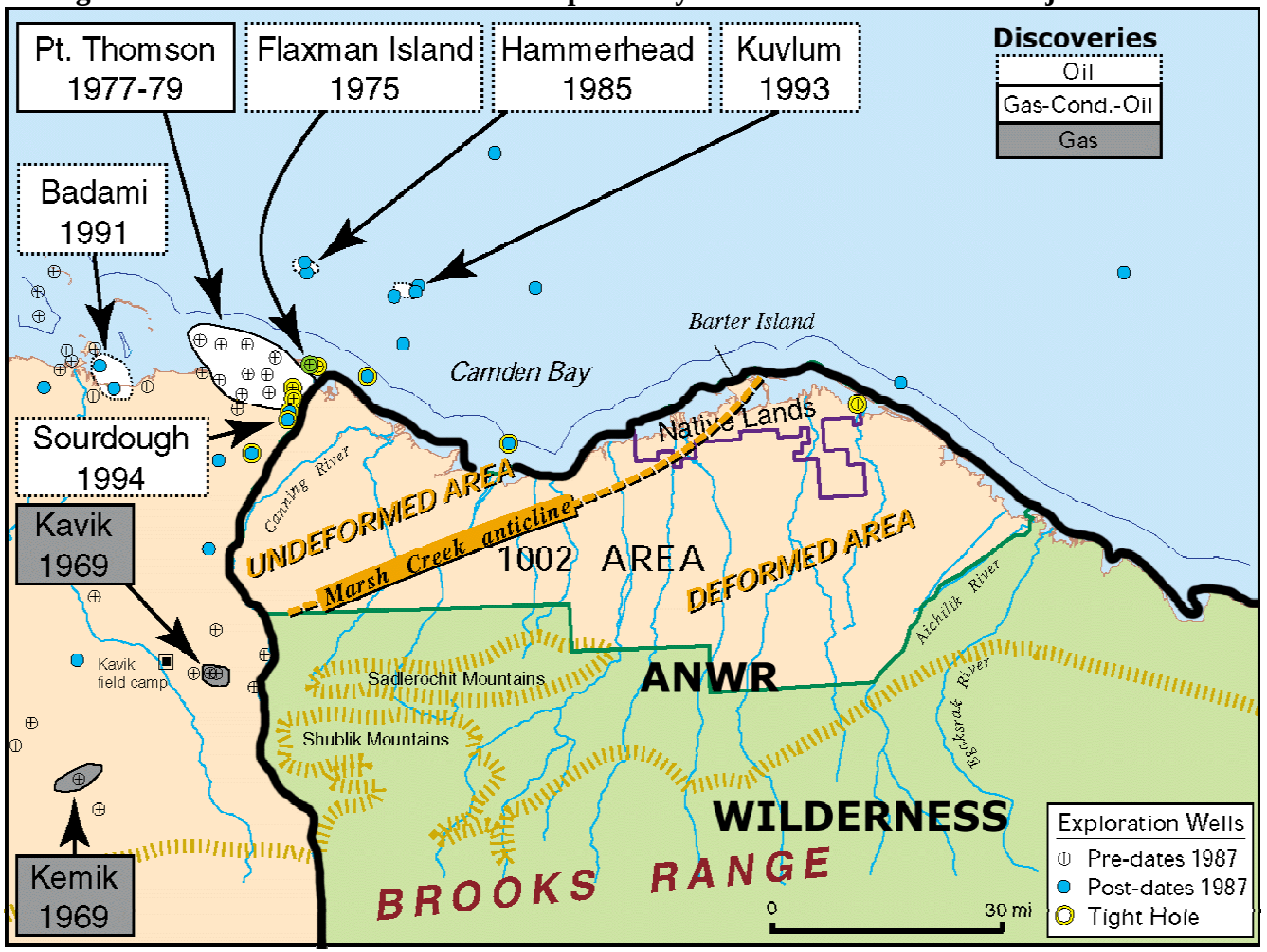
[49]U.S. Dept. of Energy, Energy Information Administration, *Potential Oil Production from the Coastal Plain of the Arctic National Wildlife Refuge: Updated Assessment* (Washington: May 2000). The development rates are postulated with the implicit assumptions of sufficiently high crude oil prices (current and projected) and constant technology.

Figure 5. Petroleum Discoveries and Exploratory Wells of 1002 Area and Adjacent Areas.



Notes: This map shows "petroleum discoveries and status of exploratory wells relative to the 1987 USGS [FLEIS] assessment. ...[D]ashed line marks approximate boundary between undeformed area, where rocks are generally horizontal, and deformed area, where rocks are folded and faulted." Source: Figure AO2 of USGS, *Oil and Gas Potential of ANWR*. Oil was found at Flaxman Island, Hammerhead, Kuvlum, Badami, and Sourdough. Gas was found at Kavik and Kemik, and Point Thomson showed gas condensate and oil.

It is not known if the development rates and production schedules developed by EIA would apply to discoveries of *economically* recoverable oil in ANWR. If they did, the peak production level in a scenario with the world price of oil at $24 per barrel could range from 200,000 to 1,400,000 barrels per day depending upon the size of the discovery (Table 2). For simplicity, it is assumed that oil prices do not fluctuate during the lives of the fields being produced.

Table 2. Approximate ANWR Peak Production Levels Under Selected Discovery and Development Scenarios

Oil Price per Barrel (1996 dollars)	Hypothetical Volumes of Economically Recoverable Crude Oil[a] (billions of barrels)			Approximate Peak Production Associated With Respective Volumes and Different Rates of Development[b] (thousands of barrels per day)		
	95%	mean	5%	95%	mean	5%
$18	- 0 -	2.40	6.15	- 0 -	250 – 350	650 – 925
$24	2.03	5.24	9.37	200 – 300	550 – 775	975 – 1,400
$30	2.98	6.30	10.47	300 – 450	650 – 950	1,100 – 1,575

Note: Production levels (and implicit development rates) are based upon the assumption that crude oil prices (current and projected) would be high enough to justify continued development and production. For simplicity, it is assumed that oil prices do not fluctuate during the lives of the fields being produced.

[a]These volumes correspond to those shown in Table 1 as economically recoverable oil at market prices of $18, $24, and $30 per barrel at different degrees of uncertainty.

[b]Production volumes associated with a slower and a faster rate of development; thus at $24/bbl, the mean expectation of economically recoverable oil is 5.24 billion bbl. This would result in a production rate of 550,000 to 775,000 bbl/day in the slower and faster production rates, respectively.

Sources: Energy Information Administration. *Potential Oil Production from the Coastal Plain of the Arctic National Wildlife Refuge: Updated Assessment*. May 2000. Table 1 and CRS estimates.

Natural Gas Potential. Not only crude oil but also large amounts of natural gas are believed to exist in the 1002 area. This expectation together with huge amounts of proven gas reserves in the Prudhoe Bay area may increase the appeal of oil and gas development of ANWR to energy producers.[50] For economic reasons,

[50]See CRS Report RL31165, *Natural Gas Reserves in Alaska: an Overview of Conventional and Non-conventional Development and Transport Options*, by Terry R. Twyman (Oct. 25, (continued...)

natural gas was not emphasized in the 1980s, but has become more important in recent years as demand has grown.

Estimates of Prudhoe Bay Complex. The Alaska Department of Natural Resources estimated the original recoverable gas reserves of Prudhoe Bay at 30.5 trillion cubic feet (tcf), and estimates current overall North Slope reserves at 30.9 tcf (including amounts in oil fields subsequently discovered).[51] On an energy equivalent basis, 30 tcf of natural gas is equivalent to about 5.3 billion barrels of crude oil.[52] The Energy Information Administration originally counted all of the ANS gas volumes noted above as proved reserves. Since 1988, however, the EIA has omitted about 80% of those volumes on the basis that, without a pipeline or near-term prospects of a pipeline, the gas has no market and therefore is not commercially recoverable. EIA counts the remaining portion of the gas reserves because they are used to power oilfield and transport operations. EIA estimates that proved natural gas reserves in the entire state of Alaska totaled 9.7 tcf at the beginning of 2000.[53]

Most of the gas produced so far on the North Slope has been reinjected into the ground by oil field operators to maintain pressure in the reservoir zones. Currently, 80-90% of the 8 to 9 billion cubic feet of natural gas produced per day are reinjected.[54] The remainder is used for lease operations, electric power generation, and for powering oil flow through pipelines.

Estimates of 1002 Area. Natural gas is also estimated to be in the 1002 area, although seemingly not as much as so far discovered in the rest of the North Slope. The USGS 1998 assessment of ANWR gas resources estimated a 5% chance that there are 10.02 tcf or more of technically recoverable gas not associated with oil in the 1002 area, with a mean "expected" amount of 3.48 tcf. The mean "expected" amount of technically recoverable dissolved natural gas (*i.e.*, associated with oil) was 3.56 tcf (Table 3). Non-associated gas probably would not be targeted until after oil field infrastructure was in place.

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[50](...continued)
2001), 23 p. (Hereafter referred to as CRS Report RL31165.)

[51]"Original estimate" figure from Alaska Dept. of Natural Resources, as reported in *Alaska Oil and Gas, Energy Wealth or Vanishing Opportunity? (Final)*. Prepared for the U.S. Dept. of Energy by EG&G Idaho, Inc. January 1991, p. 2-8. Current estimate from *2000 Annual Report*, Alaska Dept. of Natural Resources, Division of Oil and Gas, not dated, p. 12.

[52]There are approximately 1,030 btu per cubic foot of natural gas, and 5.8 million btu per barrel of crude oil. A btu, or British Thermal Unit, is the amount of heat required to raise the temperature of a pound of water one degree Fahrenheit. (30 tcf x 1,030 btu/cf = 30.9 quadrillion btu. 30.9 quadrillion btu ÷ 5.8 million btu/bbl = 5.3 billion bbl.)

[53]U.S. Dept. of Energy, Energy Information Administration, *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1999 Annual Report*, (Washington, DC) p. 28.

[54]Alaska Dept. of Natural Resources. *2000 Annual Report*, p. 8; and T. J. Glauthier, Deputy Secretary, U.S. Dept. of Energy, "Testimony to the Senate Committee on Energy and Natural Resources," September 14, 2000.

Table 3. Mean Estimates of the Amounts of Undiscovered Natural Gas and Natural Gas Liquids in the 1002 Area

Natural Gas Resource	Technically Recoverable	Economically Recoverable at a Market Price of . . .		
		$18 per bbl of oil	$24 per bbl of oil	$30 per bbl of oil
In Oil Fields				
Associated dissolved gas (tcf) (Crude oil equiv. (million bbl))	3.56 (630)	N.A.	N.A.	N.A.
Natural gas liquids from associated dissolved gas (million bbl) (Crude oil equiv. (million bbl))	143 (92)	10 (6)	70 (45)	100 (64)
In Gas Fields				
Non-associated gas (tcf) (Crude oil equiv. (million bbl))	3.48 (616)	N.A.	N.A.	N.A.
Natural gas liquids from non-associated gas (mil. of bbl) (Crude oil equiv. (million bbl))	112 (72)	N.A.	N.A.	N.A.

Notes: Crude oil equivalents are based upon inherent heat content. The mean is the arithmetic average of all the estimated amounts, and is sometimes called the "expected" value, or amount.

bbl – barrel; N.A. – not applicable; tcf – trillion cubic feet.

Source: U.S. Dept. of the Interior, Geological Survey. *The Oil and Gas Potential of Arctic National Refuge: 1002 Area, Alaska*. U.S.G.S. Open File Report 98-34. (Washington, DC: 1999). Tables EA4 and RS14.

In addition, the USGS estimated natural gas liquids extractable from the technically recoverable gas in mean amounts of 143 million barrels from oil fields and 112 million barrels from gas fields. With an energy content of about 3.8 million btu per barrel, the former figure is roughly equivalent to 95 million barrels of crude oil and the latter to about 75 million barrels. The mean amounts of natural gas liquids economically recoverable at $18, $24, and $30 per barrel of oil would be 10 million, 70 million, and 100 million barrels, respectively.

Because, without a pipeline, there presently is no way of transporting natural gas to markets and generating revenue streams with which to compare costs, it is not possible to derive estimates of *economically recoverable* natural gas in the 1002 area.

Native Lands and Adjacent State Waters. Significant amounts of oil also are believed to be under Native lands and lands beneath state waters adjacent to

ANWR – perhaps one third as much as in the federal 1002 area. In a March 2002 "preliminary" report, the USGS presented estimates that there is a 95% chance that there are at least 1.5 billion barrels (bbls) and a 5% chance there are at least 4.2 billion bbls of *technically* recoverable oil in lands under state waters adjacent to the Federal 1002 area and in Native lands, with a mean estimate of 2.7 billion bbls.[55] The USGS estimated that, if the price of crude oil is $24 per barrel (1996 dollars), there is a 95% chance of at least 0.9 billion bbls and a 5% chance of at least 3.7 billion bbls of economically recoverable oil in the non-federal 1002 portion of the study area, with a mean estimate of 2.4 billion bbls.

While significant accumulations may exist under state waters and in Native lands, they will be difficult to develop without access to Federal land. Alaska Natives have various property interests and differing opinions related to the issue of oil drilling in ANWR that may present complex legal issues for refuge management if the coastal plain is opened to oil and gas exploration and development. Regulation of development on these lands could be difficult, as discussed in *Alaska Native Lands and Rights*, below.[56]

Natural Gas Pipeline from North Slope. Construction of a pipeline to transport natural gas to North American markets and/or a warm-water port for shipping liquefied natural gas (LNG) could enhance Prudhoe Bay economics – oil as well as gas. The prospect of producing both oil and gas would also enhance the commercial promise of the 1002 area. Until recently, estimated costs of transporting the gas precluded serious consideration of pipeline construction. However, recent steep increases in the price of natural gas and some projections of continued high prices relative to the average of the past 15 years have suggested some improvement in the relationship between market price and the cost of known gas resources in the North Slope. Economic growth, environmental regulations, and gains in gas-fired electric power generation have increased current and projected demand for natural gas. In addition, the technology of converting gas into a liquid has advanced. As a result, serious consideration is being given to building the means of transporting "proven" gas and the prospective gas of the North Slope to markets.

There appear to be several route options. (See Figure 6.) One is a pipeline that would parallel the existing TAPS from the North Slope to Fairbanks, then veer eastward along the Alaska Highway through the Yukon Territory, northern British Columbia, and into Alberta. This, the Alaska Natural Gas Transportation System (ANGTS), was approved by the U.S. government in the 1970s and by the Canadian

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[55]U.S.G.S. *Frontier areas and resource assessment: the Case of the 1002 Area of the Alaska North Slope.* by Emil D. Attanasi and John D. Scheunemeyer. Open File Report 02-119, March 2002. The report is preliminary and has not been reviewed for conformity to USGS editorial standards and stratigraphic nomenclature. The estimates in the 2002 report were developed as part of the previously cited USGS 1998 study, which assessed and prepared estimates for an area larger than the Federal 1002 area. The study covered adjacent lands beneath Alaska state waters (to the 3-mile line) and Native lands "within the 1002 area," as well as the federal portion of the 1002 area.

[56]For a more detailed discussion of legal complications, see CRS Report RL31115, *Legal Issues Related to Proposed Drilling for Oil and Gas in the Arctic National Wildlife Refuge.*

government shortly after. Phase I of the ANGTS pipeline was completed in the early 1980s and is in operation. Its two legs, extending from a central collecting point in Alberta in the direction of northern California and to the Chicago area, respectively, deliver one-third of Canada's total annual gas exports to the United States. The third leg, connecting Phase I to the North Slope, has never been started. The legal framework and permits are still in force. Another proposed gas pipeline, the TransAlaska Gas System (TAGS), would move the gas via a buried route paralleling TAPS all the way to slightly west of the TAPS terminal at Valdez. The gas would be liquefied there for shipment to Asian markets. Various environmental and other approvals have been obtained.

A northern pipeline route (Northern Gas Pipeline Project) would run eastward from Prudhoe Bay buried under the Beaufort Sea and come ashore in the Mackenzie Delta. It would then link with a pipeline running through the Mackenzie Valley into northern Alberta, or with a pipeline running through the Yukon Territory, which would then link with the ANGTS. It appears that the options have narrowed to the northern route and the unbuilt leg of the ANGTS route.

Various factors would come into play in determining a route or routes.[57] A study prepared for the INGAA Foundation[58] estimated that an overland pipeline route would cost $100,000 per diameter-inch-mile, and an offshore pipeline route would cost $150,000 per diameter-inch-mile in up front capital.[59] According to this estimate, a 30-inch, 500-mile overland pipeline would cost $1.5 billion. The proposed northern pipeline route would be shorter, but the underwater nature may subject it to technical and environmental risks, and whalers from Alaska Native villages object. Environmental impact statements prepared 25 years ago may not be accepted now.

In mid-2003, the economic viability of a natural gas pipeline appears uncertain. But some recent industry engineering studies of prospective pipeline costs suggest insufficient profit potential *vis a vis* the risks.[60]

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[57]For more on transportation options for natural gas, see CRS Report RL31165, previously cited.

[58]INGAA stands for "Interstate Natural Gas Association of America," though the official name of the Foundation uses the acronym.

[59]Houston Energy Group, LLC and URS Corporation, *Future Natural Gas Supplies from the Alaskan and Canadian Frontier*, Prepared for the INGAA Foundation, Inc. (2001), p. 22.

[60]See, for example, "Producers Say Alaska Gas Line Not Feasible," by Mark E. Heckathorn. *The Oil Daily*, May 8, 2002.

Figure 6. Proposed Routes to Transport Alaskan and Canadian Natural Gas to Markets.

Source: T.J. Glauthier, Deputy Secretary, U.S. Department of Energy, "Testimony to the Senate Committee on Energy and Natural Resources," September 14, 2000. Cited in "SPECIAL TOPIC – Alaskan North Slope Gas: From Stranded Asset to a Prize of the Decade: [http://www.eia.doe.gov/emeu/perfpro/chapter4.html]. Figure is slightly modified for clarity in monochrome.

Advances in the technology of converting natural gas into a liquid could provide another transportation option. A gas-to-liquids process (now being developed) chemically converts natural gas into a diesel-like liquid that can be mixed with crude oil for transportation and then refined in the lower 48 states.[61] Converting the gas

[61]Basically, a mixture of oxygen and the methane component of natural gas is passed through a ceramic membrane containing a catalyst, producing a synthetic gas, that is then reacted with another catalyst and converted to high-quality diesel and heavier oil liquids. (continued...)

into a liquid at or near the oil and/or gas fields would eliminate the need for a separate gas pipeline and potentially extend the economic life of the existing oil pipeline. Oil produced from existing North Slope fields is projected to decrease and fall below the minimum economic flow of the TAPS within a decade or two.

Alaskan Position on Northern Route. Alaska has enacted legislation that bans construction of a gas pipeline in northern state waters. The Alaska state legislature strongly supports proposals for a pipeline to the south. While the royalties to the state (for those natural gas resources actually owned by the state) would be higher under the shorter, less costly northern route, thereby making the wellhead prices higher,[62] state officials see a greater gain through the income multiplier effect of construction within the state and greater access by Alaskan communities to the new gas supplies. Also at issue is the fact that a Canadian route would likely serve new Canadian gas fields, which would then compete with Alaska in U.S. markets. This, together with the factors cited above, suggests a potential conflict between maximizing energy company profits and benefits to the state.

Canadian Position on Natural Gas Pipeline. Canada supports a natural gas pipeline that would travel from Alaska through Canada. The Canadian government has not taken a stand on which of the two possible Canadian routes it might prefer; affected provincial governments all support routes through their jurisdictions. The over the top route could make some natural gas deposits in the Yukon and Northwest Territories economically viable. In either case, Prime Minister Chrétien has expressed Canada's interest in selling more oil and natural gas to meet U.S. energy needs. (Some have argued that this interest has intensified Canadian opposition to ANWR development.)

However, the Canadian government has expressed deep concern that price supports to encourage development of the pipeline could damage or even end Canadian natural gas sales to the United States. The Premier of the Northwest Territories, Stephen Kakfwi, fears that price supports might even flood western Canada with sufficient cheap natural gas to shut down the area's own natural gas production.[63] In addition, some Canadian critics reportedly claimed that price supports could interfere with free trade and therefore violate NAFTA. (U.S. domestic producers in the Lower 48 have also expressed reservations about potential distortions in the natural gas market.)

Economic Effects of Development. The U.S. economy as a whole would be affected by development and production of oil in the Arctic National Wildlife

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[61](...continued)
Low levels of sulfur, metals, and nitrogen in either the pure product or the mixture make it attractive in terms of reducing pollution.

[62]The wellhead price of oil or gas obtained by Alaskan producers equals the delivered price (per barrel or thousand cubic feet) less the cost of transportation, which increases according to the length of the pipeline. State royalties and other revenues are proportionally affected.

[63]Carlisle, Tamsin. "The Next U.S.-Canada Trade Spat? Canadian Oil Firms Object to Proposed Tax Credits for Alaska Energy Project." *Wall Street Journal*, May 10, 2002. p. A9.

Refuge through the direct effects of the economic activity constituted by the development and production itself. The economy would also be indirectly affected by any change in oil prices resulting from ANWR production and any effects on the amount spent on imported oil. A major unknown and driving factor is the amount of economically recoverable oil discovered and eventually produced.[64]

Development Stimulus. Oil and gas development in ANWR would generate primarily mining, construction, manufacturing, and transportation activity, but also many types of other supply and support services such as food, fuel, power, and management services. Such demand for goods and services equipment would be felt in the lower 48 states as well as in Alaska.

Major determinants of the cost of developing ANWR, and its direct stimulus, would be the size of any overall discovery of economically recoverable oil resources and the sizes of the individual fields containing such resources. There are high degrees of uncertainty in both areas. (See Table 2.)

The USGS estimates also have very wide ranges with respect to oil field sizes. Among the larger sizes, which oil companies probably would consider first, the estimates show a 95% chance of three or more fields and a 5% chance of six or more fields with 256-512 million bbl of technically recoverable oil; a 95% chance of one or more fields and a 5% chance of four or more fields with 512-1,024 million bbl; and a 95% chance of a field of three-tenths of a field or more and a 5% chance of one and a half fields or more with 1,024-2,048 million bbl.[65] Each company would have data on 1002 area prospects from its preliminary exploration and comparisons with existing information; it would then select the most attractive prospects based upon its own interpretation of geologic data, its own resource assessment, and its own financial criteria. Smaller fields probably would become attractive if and when larger fields were developed and infrastructure was in place.

Thus, if commercial oil fields were discovered, they most likely would be of different sizes and the collective overall quantity of economically recoverable oil could be in a very wide range. And, given that the size of a possible overall discovery is unknown, estimations of the overall cost of developing ANWR are hypothetical.

Advances in arctic oil and gas development technology, equipment, and facility configuration reduce both the extensiveness of facilities and the development cost per barrel of discovery.[66] These advances have made such development more capital intensive onsite and moved more labor offsite, to locations where data analysis is performed. A very crude benchmark to use as a basis for estimating the outlays that

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[64]The economic effects of development are also discussed in CRS Report RS21030, *ANWR Development: Economic Impacts*, by (name redacted), (Dec. 3, 2001). 6 p.

[65]USGS, *Oil and Gas Potential of ANWR*. These are arithmetic means of distributions of estimated field sizes; results can have numbers with fractions. The numbers of fields used in the text are rounded.

[66]For more detailed treatment of ANWR petroleum development technology in the arctic, see CRS Report RL31022, previously cited.

would be entailed is the roughly $1 billion cost of developing the Alpine field, which has about 430 million bbl of reserves.[67] Alpine is a recently developed field on the North Slope of Alaska that employs advanced arctic technologies. However, Alpine is appropriate as a cost benchmark only to the extent that the geological conditions, pristineness, and accessibility of the hypothetically discovered fields at ANWR were similar to those at Alpine.[68]

Two illustrative *hypothetical* cases might be as follows: (1) A discovery of 2.40 billion bbl of economically recoverable oil in four 100-million bbl fields, three 200-million-bbl fields, two 400-million-bbl fields, and one 800-million-bbl field. (2) 5.24 billion bbl of economically recoverable oil in six 200-million-bbl fields, four 400-million-bbl fields, two 800-million-bbl fields, and one 1,200-million-bbl field.[69]

In the first case if, hypothetically, the fields associated with an overall 2.40-billion-bbl discovery of economically recoverable oil are of the same nature and degree of difficulty to develop as Alpine, and if, *as is unlikely*, development costs for ANWR are proportional to field size (using Alpine as the benchmark), total development cost of an ANWR discovery of that size would approximate $6.5 billion. With identical caveats for a 5.24-billion-bbl overall discovery, total development cost of that overall discovery would approximate $14.0 billion.[70] At roughly $2.70 per barrel discovered ($14 billion ÷ 5.24 billion bbl), these hypothetical estimate totals, which may well exclude exploration costs, appear low. In recent years, major oil companies have experienced onshore finding costs of about $5.25 per barrel (with exploration costs accounting for about one-third), based upon Energy Information Administration (EIA) surveys,[71] but such costs have been declining over time.

Oil Market Response. Other things being equal, an increase in production, or supply, would be expected to result in a price decline (or a lower price than would occur otherwise). The size of the decline would depend to some extent on how close world oil output would be in relation to world oil production capacity and upon the reaction of other suppliers to the market.

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[67]Alan Petzet, "Alaska operators start Alpine field, take more leases," *The Oil and Gas Journal*, (December 4, 2000); Phillips Alaska, Inc., *Fact Sheet* (January 1, 2001).

[68]Additional outlays for infrastructure, including the cost of connecting to the TransAlaska Pipeline System, would be required if fields are distant from existing staging areas.

[69]The hypothetical distributions of field sizes are based upon Figure EA2 in: USGS, *Oil and Gas Potential of ANWR,* Chapter EA.

[70]Using a ratio of $1 billion per 400-million-bbl field, the arithmetic is as follows. For the smaller discovery: (4 x $250 million) + (3 x $500 million) + (2 x $1,000 million) + (1 x $2,000) = $6.5 billion. For the larger discovery: (6 x $500 million) + (4 x $1,000 million) + (2 x $2,000 million) + (1 x $3,000 million) = $14.0 billion.

[71]U.S. Dept. of Energy, Energy Information Administration, *Performance Profiles of Major Energy Producers, 1999*. (Washington, DC) Table 20, Table B14.

As noted above, peak production from any economically recoverable volumes of 2.03 billion and 9.37 billion bbl at $24 per barrel[72] probably would be reached in about 2020, and would range from roughly 300,000 to 1,400,000 bbl per day. EIA projects world oil production to total 106.6 million bbl per day in 2015.[73] Thus, ANWR production (from the respective discovery volumes) at their peaks around the years 2013-2015 would range from about 0.3% to 0.9% of world output.

Opponents of ANWR have suggested that potential ANWR resources are equivalent to U.S. daily demand for oil for a matter of just months.[74] This does not consider the role which any incremental source of petroleum plays in markets, which are dynamic. Consequently, the impact of ANWR production on world oil prices is likely to be variable depending upon market and political factors prevailing in the moment. For proponents of development, the oil shocks to the market in 1973-74, 1979-80, 1991, and 2000-2001 tend to loom large.

However, a review of the nearly thirty years since the time of the Arab oil embargo and first oil price shock in 1973 suggests that it is more accurate to see this nearly thirty-year period as one of general price and supply stability that is periodically broken with shorter episodes when price became volatile and supplies of fuel less certain. During any of these episodes, even an additional 100,000 bbl/day of refined product in certain regional markets might have eased prices.[75] In times of uncertainty – and even at the low range of estimates of potential ANWR production – these volumes might help contain a short-term spike in prices. In these moments, it matters little whether the incremental supply comes from a field holding six months' national demand, or sixty years' potential supply, because the price of product at the pump will not discriminate between the two.

Some argue that ANWR production could result in lower world oil prices if supply in the world market were relatively tight in 2015 and the market was reasonably competitive. In a period of general stability and balance in supply and demand, production from ANWR at the lower range of the estimates would probably have a small effect on prices. There is also the prospect that, depending upon market factors and their internal economies, OPEC and other producers could cut their output to offset the supply effect of ANWR, as has occurred before. This would depend upon the commitment of OPEC nations to try to support or defend a price band for crude oil by cutting production, as they did three times in 2001. At the same time, internal revenue needs have sometimes prompted producing nations to sell

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[72]EIA projects the average price of landed oil imports at $21.37 per barrel in 2010 and $21.89 in 2015 (1999 dollars). *International Energy Outlook 2001.* (Washington, DC: March 2001), p.41. EIA's oil price, oil production, and economic growth projections used here are its best-guess "reference case."

[73]*International Energy Outlook 2001*. p. 42.

[74]Actual extraction of the oil would require decades.

[75]Mention should be made that a shortage of refining capacity or configuration, and transportation infrastructure were contributing factors to some of the observed increase in price, and under these circumstances, the effect upon price of incremental crude production will be perhaps more selective and regional.

output above their quotas. Additional oil supply from non-OPEC producers also makes it more difficult for OPEC to affect prices.[76]

Macroeconomic Effects. In general, if energy prices fall, the drop would tend to increase the amount of inputs afforded by businesses, boosting the overall supply of goods and services. Higher aggregate income and lower prices would enable households to buy more goods and services. Economic growth would speed up; and, if the economy is not at full employment, more labor and capital would be employed. Once the adjustment to lower prices is completed, growth would return to its prior rate, but at a higher output level.

However, in analyzing the impact of changes in energy costs on the economy as a whole or on individual sectors, one needs to be aware that the relative price of oil has decreased since the oil price spikes of the 1970s and early 1980s, and energy use per unit of output has fallen as well. The proportions of production costs accounted for by energy have dropped across the economy; and energy costs as a share of Gross Domestic Product (GDP) have declined. Consequently, the relative impacts of energy price changes on the economy in general and on particular sectors can be expected to be smaller than they were 20-25 years ago.

It appears also that any price effect would have to be considerable and sustained for the macroeconomic effects to be reasonably noticeable. For example, the Organization for Economic Cooperation and Development estimated that an increase in oil prices of $10 per barrel above its baseline scenario would result in U.S. GDP being 0.2% lower one year and two years after the shock.[77] In contrast, as noted above, the price effect of a 0.3%–0.9% addition to world oil supply resulting from ANWR production probably would be small, although econometric research findings suggest that the beneficial macroeconomic result of a price drop would not necessarily be proportional.

Oil and gas producers that do not participate in ANWR development, their suppliers, and their local economies in the contiguous 48 States would be *harmed* should oil prices decline. Producers' revenues would decline indirectly as well as directly through reductions in output – both effects leading to cutbacks in employment and in purchases of other goods and services.

With respect to ANWR development, hypothetical outlays of $6.5 billion and $14.0 billion with an income multiplier of two[78] applying to both would come to

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[76]For more on U.S. energy policies, see CRS Issue Brief IB10080, *Energy Policy: Setting the Stage for the Current Debate*. 16 p.

[77]Organization for Economic Cooperation and Development, *Economic Outlook*. (December 1999), p. 9. Macroeconomic simulations by other organizations have had similar results.

[78]Changes in investment spending have a magnified impact on the economy as a result of the ripple effects on the income and spending of other businesses and of households. Income multiplier is the term used to denote the total impact of the initial spending. Such multipliers differ depending upon the sector of the economy in which the investment takes place. A multiplier of two is generally considered reasonable for the type of spending (continued...)

roughly 0.12% and 0.26% of projected GDP for the year 2002 (on the unlikely assumption that all the outlays occur in one year).[79] If the outlays are spread over more than one year, the impact in each year would be less, but the total effect would be about the same. The percentages would be much lower in 2020, when the economy is projected to be about 45% larger.[80] If there is some spare capacity in the oil and gas industry, producers and their suppliers would benefit. However, if the economy is at full employment, the multiplier effect would be transitory.

Employment Effects. Oil and gas development in ANWR would generate *additional* jobs in the national economy to the extent that development resulted directly and indirectly in a *net* economic stimulus. A key factor would be whether the economy is at full employment or less than full employment. The direct effects are clearer than the indirect, given the uncertainty of the effects of ANWR oil on world oil prices and any consequent beneficial effects of lower energy prices on the economy as a whole.

Rough estimates can be made for jobs generated by the hypothetical development outlays by using the national averages of 3.89 jobs directly and indirectly generated per $1 million of sales by oil and gas producers and 16.53 jobs per $1 million of sales by oil and gas field service companies, as estimated by the Bureau of Labor Statistics (BLS).[81] Adjusting for price increases since 1992 and assuming that half of the outlays are attributable to each group, $6.5 billion in outlays would lead to about 60,000 jobs, and $14.0 billion would lead to about 130,000 jobs.[82]

If the economy were at full employment, however, investment in ANWR may crowd out other spending in the economy; moreover, ANWR development may draw oil industry resources (capital and labor) from oil prospects elsewhere in the country. In the long run, the unemployment rate is determined by the structure of the labor market, and, at full employment, any jobs generated by ANWR development would come at the expense of an equal number of jobs lost in the rest of the economy.

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[78](...continued)
discussed here.

[79]DRI-WEFA, *U.S. Economic Outlook*, (August 2001) p. 9. The projection is in current dollars.

[80]EIA, *Annual Energy Outlook 2001*, p. 152.

[81]U.S. Bureau of Labor Statistics. Web site [http://www.bls.gov/emp/empind4.htm]. While in terms of sales in 1992 dollars, the ratios (which BLS calls "employment requirements") are based upon 1998 productivity relationships.

[82]Hypothetical $6.5 billion scenario: ($3.25 billion by oil producing companies ÷ 1.097 (deflator)) x 3.89 (jobs per million $) = 11,525 jobs; ($3.25 billion by oil field service companies ÷ 1.097 (deflator)) x 16.53 (jobs per million $) = 48,975 jobs. Together, the result would be 60,500 jobs.
Hypothetical $14.0 billion scenario: ($7.0 billion by oil producing companies ÷ 1.097 (deflator)) x 3.89 (jobs per million $) = 24,825 jobs; ($7.0 billion by oil field service companies ÷ 1.097 (deflator)) x 16.53 (jobs per million $) = 105,475. Together, the result would be 130,300 jobs.

Because the impact of ANWR oil on world oil prices would be uncertain, and any decrease would have to be considerable and sustained for the macroeconomic effects to be reasonably noticeable, the effects on employment would be highly uncertain. Any gain in employment from beneficial macroeconomic effects of a drop in oil prices, however, may be offset by the harm to oil producers elsewhere in the United States, who may reduce their operations and workforce.

Other Job Impact Estimates. Some proponents of ANWR development assert that such development would result in a gain of more than 700,000 jobs in the economy. This is based upon a 1990 report by The WEFA Group[83] that estimated that the economic impact of oil development in ANWR would result, through direct and indirect effects, in a net gain in employment of 735,000 in the peak year of job creation. The major portion of WEFA's employment gain results from large estimated beneficial macroeconomic effects of lower world oil prices caused by an increase in world oil supply attributable to ANWR oil. WEFA based that increase upon an oil discovery near the high end of the 1987 FLEIS estimates.

The study's estimates of effects on GNP[84] and employment appear large in the context of WEFA's essentially full employment base case. They are large also compared with actual economic consequences of oil price changes, and in view of decreased importance of energy inputs in the economy compared with the 1970s (noted above). It may have been reasonable for WEFA to posit that the world oil supply situation in 2005 would be much tighter than in 1990, and that an injection of an additional 1.7 million barrels per day would tend to lower prices somewhat; and the model used by WEFA allowed for some response by OPEC. The estimated price effect is large nevertheless. In general, the report tended to select the more or most optimistic of underlying scenarios when there was a choice to be made in the sequential analysis required in estimating efforts of this type.[85]

A recent report by Dean Baker of the Center for Economic and Policy Research (CEPR) examined The WEFA Group study and re-estimated the employment effects. It followed WEFA's paradigm but applied different assumptions about some basic data, the degree of response by the market and by OPEC to ANWR oil, and the degree to which the economy responds to an oil price decline. CEPR estimated that oil production in ANWR would result in the creation of 46,300 jobs.[86] The CEPR report, however, does not purport to be a full-fledged estimate of job effects under current oil market, oil industry, and economic conditions.

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[83]The WEFA Group merged with DRI, forming DRI-WEFA. DRI had been a subsidiary of Standard & Poor's.

[84]Before 1991, the main indicator of total economic output used by the U.S. Department of Commerce was Gross National Product, rather than the Gross Domestic Product now used.

[85]A 1992 CRS report, which examines the economic impact question, judged that, overall, the WEFA estimates were generous. See *ANWR Development: Analyzing Its Economic Impact*, Report 92-169 E, by Bernard Gelb (Feb. 12, 1992), 6 p.

[86]Baker, Dean. *Hot Air Over the Arctic? An Assessment of the WEFA Study of the Economic Impact of Oil Drilling in the Arctic National Wildlife Refuge.* Center for Economic and Policy Research. September 4, 2001. 11 pp.

Import Reduction. As any ANWR oil would be the marginal source of petroleum for the United States, net imports (total imports minus exports) probably would be reduced by virtually one barrel for every barrel of ANWR output. This is true regardless of the amount of exports of North Slope oil (now nil), which would affect *gross* imports. The economy would benefit temporarily through a reduction in the income transferred overseas to pay for the oil. Using the EIA's projection of refiners' acquisition cost of foreign crude oil of about $21.50 per barrel in 2015,[87] the oil import bill would be cut by $2.4 billion to $11.0 billion in that year, improving the U.S. merchandise trade balance in the short run.

The relative reduction in dollars flowing abroad, however, could cause the dollar to appreciate. This would tend to reduce other exports and expand other imports to some extent, reversing the initial improvement. A possibly greater increase in demand for imports of other goods and services could result from the higher level of economic activity caused by lower oil prices. Basically, the trade deficit reflects the desire of Americans to borrow abroad versus the desire of foreigners to invest or borrow in the United States. Assuming that oil development of ANWR did not influence this dynamic, it would likely have no permanent effect on the trade balance.

Effects on the Alaskan Economy. The Alaskan economy could be affected substantially by development and production of oil in ANWR through the direct effects of the exploration, development, and production, and indirectly through the ripple effects of the money spent in Alaska by the producing companies and their workers. A major unknown is the amount of oil that might eventually be produced.

Oil and gas production already is a major industry in Alaska, directly accounting for about 4,500 jobs and $425 million in annual payroll,[88] and about 20% of state gross product on average.[89] ANWR development would affect primarily the oil and gas industry, but also construction, telecommunications, manufacturing, transportation, and other mining, as well as employment in these industries. Many types of other supply and support services such as food, fuel, power, and management services would also benefit. A study of the current economic impact of the oil and gas industry on Alaska indicates substantial effects of the industry on individual regions in the state. And it found indirect and "induced" employment impacts equal to six times employment in the industry itself.[90]

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[87]EIA, *Annual Energy Outlook 2000,* p. 133.

[88]Employment and payroll figures are calculated from data in U.S. Dept. of Commerce, Bureau of the Census, *1999 County Business Patterns, Alaska* and Information Insights, Inc. and McDowell Group, *Economic Impact of the Oil and Gas Industry on Alaska,* (Fairbanks, AK: January 15, 2001).

[89]U.S. Dept. of Commerce, Bureau of Economic Analysis at [http://www.bea.doc.gov]. State gross product is the total market value of the goods and services produced in the state. Gross product originating in oil and gas extraction varies widely with crude oil prices and the consequent effects on oil company profits, which are a component of gross product.

[90]*Economic Impact of the Oil and Gas Industry in Alaska. op. cit.* The study is based upon a survey of state oil and gas producers and businesses in the state that sell them goods and services. CRS observes that while there are indirect effects, frequently studies of this type

(continued...)

The direct stimulus of the outlays for exploration, development, and production would be felt more in Alaska than elsewhere in the United States – the amount of economically recoverable oil discovered and eventually produced being a key factor. However, much of the equipment and other goods required would be manufactured in the lower 48 states as well as in Alaska. Working with the hypothetical outlays of $6.5 billion and $14.0 billion for wells, pipeline extension, and other facilities, and making the simplifying assumption that half of these outlays would be spent for goods and services (including labor) in Alaska, they would come to $3.25 billion and $7.0 billion. Again adjusting for price increases since 1992 and assuming that oil producing companies and oil field service companies each accounted for half of the outlays, it would lead to about half of the hypothetical jobs estimated for the United States as a whole – 30,000 and 65,000, respectively.

The ratios used, however, are national averages, and oil and gas industry wages in Alaska are higher than average. While the latter is beneficial in one respect, it may translate into a smaller number of jobs per billion dollars of outlays. Also, advances in oil and gas development technology and facilities since 1990, reducing the size of facilities, may also reduce the number of jobs generated by such development.

Furthermore, if there were some slack in the Alaskan economy if or when ANWR energy development occurs, jobs created by ANWR could result in a reduction in Alaskan unemployment. If the Alaskan economy were at full employment, the job gain could be transitory. Moreover, as noted earlier, any jobs generated by ANWR development could come at the expense of an equal number of jobs lost in the rest of the economy. This could include drawing oil industry resources (capital and labor) from oil prospects elsewhere in the country to some extent.

The Alaskan state government, and ultimately Alaskan citizens, could benefit substantially from ANWR development via its share of potentially billions of dollars of revenues from bonuses, rents, and royalties. Alaskan citizens receive annual distributions from the state's Permanent Fund, which is endowed by revenues from mineral lease rentals, royalties, and bonuses, and the states's share of federal mineral-derived revenues. The distribution in 2000 was $1,963.86 per resident.

Regarding only royalties, a discovery sufficient to produce the modest amount of 750,000 barrels per day with a wellhead price of $20 per barrel and a royalty rate of 12.5% could yield about $700 million per year for Alaska's 627,000 residents. As discussed subsequently in this report, however, it is uncertain at this point what Alaska's share of the various revenue streams might be.

Relationship to Recent U.S. Energy Difficulties. The current interest in oil exploration and development in ANWR was at least partly prompted by the increase in the retail prices for refined petroleum products that began with gasoline in early 1999, and California's electric power problems. Any energy and/or economic benefits that would accrue from oil and gas development of ANWR

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[90](...continued)
use estimating approaches that tend to overstate indirect impacts.

essentially would not address the power difficulties experienced in California – which were related to insufficient generation capacity, natural gas price spikes, and the electric power market deregulation plan adopted by the state.

Similarly, some of the increase in the prices for gasoline, diesel and home heating oil were a function of insufficiently available refining capacity, and a brittle petroleum supply infrastructure. Much of this effect has now been mitigated. Under these circumstances, the effect upon price of incremental crude production from ANWR might have been partly muted, or at least more selective and regional.

Biological Resources: Status and Effects

At a House hearing on July 1, 1959, testimony was provided by Ross L. Leffler, Assistant Secretary of the Interior for Fish and Wildlife, on H.R. 7045 to authorize the establishment of the Arctic National Wildlife Range. Speaking of the entire area of the proposed refuge, he said:

> The great diversity of vegetation and topography . . . in this compact area, together with its relatively undisturbed condition, led to its selection as the most suitable opportunity for protecting a portion of the remaining wildlife and its frontiers. The area included within the proposed range is a major habitat, particularly in summer, for the great herds of Arctic caribou, and the countless lakes, ponds, and marshes found in this area are nesting grounds for large numbers of migratory waterfowl that spend about half of each year in the rest of United States; thus, the production here is of importance to a great many sportsmen.... The proposed range is restricted to the area which contains all of the requisites for year-round use. The coastal area is the only place in the United States where polar bear dens are found.[91]

Twenty-eight years later, the FLEIS echoed these remarks with the following: "The Arctic Refuge is the only conservation system unit that protects, in an undisturbed condition, a complete spectrum of the arctic ecosystems in North America" (p. 46). It also said "The 1002 area is the most biologically productive part of the Arctic Refuge for wildlife and is the center of wildlife activity" (p. 46). The biological value of the 1002 area rests on the very intense productivity in the short arctic summer; many species arrive or awake from dormancy to take advantage of this richness, and leave or become dormant during the remainder of the year. Caribou have long been the center of the debate over the biological impacts of Refuge development, but other species have also been at issue. Among the other species most frequently mentioned are polar bears, musk oxen, and the 135 species of migratory birds that breed or feed there. To some extent, the effects of development on animals in the Refuge can be estimated by examining past effects on the same

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[91]U.S. House of Representatives, Committee on Merchant Marine and Fisheries, *Miscellaneous Fish and Wildlife Legislation*, 86th Congress, First Session, July 1, 1959, (Washington, DC:1959), p. 140.

species as they exist in developed areas on the coastal plain.[92] However, these comparisons must be made with some caution for several reasons:

- The coastal plain in the 1002 area is much narrower (as little as 15 miles) than around Prudhoe (roughly 100 miles) or the NPR-A (as much as 130 miles).
- The form development takes in the 1002 area would likely be quite different from earlier development, with fewer roads and more overflights, for example.
- Conditions have changed since Prudhoe Bay development began nearly 30 years ago: winters tend to be milder; tundra thaws earlier and freezes later; and vegetation patterns have already begun to change in response to these changes.[93] Animal life would be expected to respond to these changes, sooner or later.

This section presents background information on various species as it might relate to energy development in the Refuge and the potential effects of development on these species.

Caribou. In 1987, the Porcupine caribou herd (PCH) was estimated at 180,000 animals, and is now estimated at 129,000 animals.[94] The herd winters south of the Brooks Range in central Alaska and northwestern Canada. Its winter range is centered on the Porcupine River in Canada and Alaska. In the spring, the males and yearlings migrate north first, followed by the cows, who move north with the retreating snow line; the entire herd calves in only a few days. In most years, the cows reach the 1002 area and give birth there, concentrating their activity in areas that are greening most rapidly and that offer the high protein content required by growing calves and lactating cows.[95] If snowfall has been heavy, or if a cool spring delays snowmelt, the cows are delayed, and drop their calves short of the 1002 area. (Maps of the distribution of radio-collared caribou throughout their annual cycle can be found at [http://www.taiga.net/caribou/pch/pc_cycle.html] and annual calving maps at [http://www.r7.fws.gov/nwr/arctic/pchmaps.html].)

Much has been made of the failure of caribou cows to calve in the 1002 area in some years, notably 1986, 1987, 2000, and 2001. In these years, heavy snowfall or cool spring temperatures slowed the northern migration, so that when calving occurred, most cows had not yet crossed large flooding rivers or passed the Brooks

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[92]Development of Native lands may operate under different legal authorities or management goals, depending on existing laws and such changes as Congress might make in legislation to open the 1002 area to development. Such differences could affect not only these lands themselves but also surrounding federal lands.

[93]Margie Mason, "Increased Shrubbery Found in Arctic," *Reuters* (May 30, 2001); Zaz Hollander, "Global climate changes rule Senate hearing," Anchorage *Daily News* (May 30, 2001).

[94]Like many arctic species, caribou (*Rangifer tarandus*) population numbers are highly variable, and the causes of these "boom and crash" cycles are not well-understood. The Central Arctic Herd calves closer to the existing oil fields, and is about 20-25% the size of the PCH. The PCH has shown a sustained decline from its peak in 1989. (USGS Wildlife Research Summaries, 2002. p. 14.)

[95]Gibbs, "The Arctic Oil and Wildlife Refuge,"pp. 62-69.

Range. Many newborn calves died in river crossings or fell prey to the golden eagle, wolf, and grizzly populations in the Brooks Range. For radio collared cows in 2000, the June calf survival rate and the July calf to cow ratio were the lowest ever recorded.[96]

Even if migration is delayed, the cows continue on to the 1002 area, where they continue to forage. As June days lengthen and become warmer, mosquitos, bot flies, and warble flies can reach tremendous numbers on the coastal plain. While the blood-sucking habits of mosquitos are well-known, the flies present major health problems as well. These flies deposit their eggs in the nasal passages of the caribou or in wounds; larvae feed and migrate through the skin, making holes in the skin when ready to emerge. Severely infested animals, or those in weakened condition (*e.g.*, injured or older animals, young calves, lactating cows) have restricted breathing or are otherwise weakened. They may die or fall to predators. When these flies are numerous, herds may appear panicked, seeking relief in areas where flies are less numerous.

Mosquitos become active earlier in the summer and are deterred by cool, windy, humid conditions. When they are numerous, caribou congregate near the coast, where breezes are typically stronger, temperatures lower, and mosquitos consequently rarer. The larger bot and warble flies tolerate somewhat higher winds, but not shade; they too prefer warmer temperatures, and become active later in the summer.[97] Consequently, after calving is over and the herd has reached the 1002 area, the herd generally moves to the coast to escape mosquitos; as mosquito populations decline and fly populations increase, the herd may return to inland areas where patches of snow, gravel bars, or hills offer less favorable conditions for the increasing numbers of bot and warble flies. At this time of year, cows are at their lowest energy levels, and according to the FLEIS, "[a]ccess to insect-relief habitat and forage during this period may be critical to herd productivity" (p. 25).

The effects of exploration, production, and development in the 1002 area on caribou cannot be known with certainty unless such events actually occur, and even then will undoubtedly be debated. When the 1987 FLEIS was released, debate centered on the potential for displacement of the herd from (a) its preferred calving area and (b) the coastal areas needed for relief from clouds of biting insects. These remain the primary concerns. A major point of debate has been the comparison of effects of development on the Central Arctic Herd (CAH), whose range is partly in the developed areas west of the Refuge, and the potential effects of development on the PCH, whose summer range is primarily in the 1002 area. Comparisons of the two herds must be made cautiously, since the PCH is about 5 times larger than the CAH, calves in about 1/5 the area of the CAH, and annually migrates to overwinter south of the Brooks Range, while the CAH generally remains year-round in the much broader coastal plain in and south of the existing oil fields.

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[96]Stephen M. Arthur, "Porcupine Caribou Herd Calving Survey, June 2000," unpublished memorandum, (July 12, 2000), 7 p.

[97]Warren B. Ballard, Matthew A. Cronin, and Heather A. Whitlaw, "Caribou and Oil Fields" in *The Natural History of an Arctic Oil Field*. (New York, NY: Academic Press, 2000), p. 91. (Hereafter cited as *The Natural History of an Arctic Oil Field*.)

Would Caribou Be Displaced from Calving in the 1002 Area? This question can be divided into two parts: *would the PCH likely be displaced from the 1002 area at calving time*? And more importantly, if it were displaced, *would displacement have harmful effects on calving success*? For the first question, the answer for the herd as a whole, based on the Prudhoe Bay experience, appears initially to be a qualified "no." Individual animals, especially adult males, habituate to the disturbance, and sometimes seek out gravel pads and roads, where insect attacks may be less severe. The CAH has grown since development began, from 5,000 to about 27,000. However, warning signs exist. For instance, Brad Griffiths and Ray Cameron and their students at the University of Alaska (Fairbanks) have shown that for the western portion of the CAH, cows have shifted their calving southward, out of the development area, and return to this rich foraging area only after their calves are older. These studies also show that "the greatest incremental impacts are attributable to initial construction of roads and related facilities" and that "the extent of avoidance greatly exceeds the physical 'footprint' of an oilfield complex."[98] Thus, it is possible that habituation could occur, especially with males and yearlings, but some displacement of cows with young calves also seems likely.

The second question is the most crucial, since displacement to another area is inconsequential only if calving success is equally good in the alternative area(s). More precisely, if the herd is significantly less productive in the alternative area(s), the difference serves not to show the availability of alternatives but rather to highlight the importance of the preferred area. For clues, scientists have examined the reproductive success both of displaced cows in the CAH, and of the PCH in years when natural events prevented it from calving in the 1002 area. Griffiths and Cameron have shown a correlation of calf survival in the CAH with the amount of high-protein food in the calving area. In the much narrower coastal plain of the 1002 area, any cows displaced southward would calve in or nearer the Brooks Range, where golden eagles, grizzly bears, and wolves (all calf predators) are more abundant than on the plain. Cows displaced to the east and calving in Canada tend to eat mosses and evergreens there, rather than the more digestible cottongrass and other plants available in the 1002 area.[99] As noted above, in 2000, when snows delayed migrating cows, effects on calf survival were severe.[100]

In sum, calving can – and in some years does – occur in areas other than the preferred 1002 area. However, evidence exists to suggest that calving success will be reduced when this occurs. At present, displacement from areas of the most nutritious forage is a rare event; if it were to become common, reduced fecundity could be expected. Smaller drill pads and fewer roads could combine to reduce displacement, and with directional drilling, pads might be sited to avoid areas of high quality forage. Even then, the naturally cyclic nature of caribou populations might conceal all but large effects for a considerable time.

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[98]C. Nellemann and R. D. Cameron, "Cumulative impacts of an evolving oil-field complex on the distribution of calving caribou," *Canadian Journal of Zoology*, Vol. 76 (1998): p. 1435.

[99]USGS *Wildlife Research Summaries*, 2002. p. 21.

[100]Stephen M. Arthur, "Porcupine Caribou Herd Calving Survey, June 2000," unpublished memorandum (July 12, 2000). 7 p.

Attempting to address this question of calf survival, USGS scientists used existing field data on caribou displacement elsewhere and combined it with five possible development scenarios (described in previously published literature) ranging from development only at the periphery of the northern and western portion of the 1002 up to one scenario that included most of the 1002 area and two full development scenarios. Then they examined the hypothetical outcomes that would have occurred had those areas been developed at that level with the actual data on the distribution of cows from 1980 to 1995. In effect, they asked where would PCH cows have gone in each of those 16 years of data, if that level of development had been in place and if PCH cows responded as other caribou cows do to various kinds of disturbance. With this empirical model, they then predicted PCH calf survival in the areas to which the cows would have been displaced. "The simulations indicated that a substantial reduction in calf survival during June would be expected under full development of the 1002 area."[101]

Would Caribou Be Displaced from Insect Relief Areas? Relief from massive mosquito populations and then fly populations can be critical to the herd. Given the particular aversion of cows with young calves to developed areas, the potential for conflict with development seems likely to be more important early in the calving season. Immediately along the coast, breezes deter mosquitos. Any shore facilities or activities that block access to the coast could be most significant in this potential conflict. Later, when bot and warble fly populations are peaking and calves are older, cows with calves are likely to leave the coast and move inland. In the CAH, they may join the rest of the herd when it rests on drill pads or under pipelines or other structures, where shade discourages fly populations. Studies by Pollard *et al*. have shown that temperatures were lower and wind speeds higher on gravel pads, and mosquitos and flies were less common on gravel pads than on tundra.[102] Thus, gravel drill pads could join other features in providing fly relief to the PCH, once caribou become accustomed to the facilities. However any such benefit is likely to be marginal for the PCH, since the herd tends to leave the 1002 area before the bot and warble fly populations have reached their peaks.[103]

Polar Bears. Polar bears (*Ursus maritimus*) probably rank right after caribou in generating attention in the ANWR debate. The Beaufort Sea population is estimated at about 2000-2500 bears and ranges along the Alaskan and northwestern Canadian coasts. Bears spend most of their adult lives at sea on the ice, feeding primarily on seals. Female bears give birth about once every three years (or less, if previous cubs died young) as they hibernate. While some females den on the ice pack, other adult females come ashore. In either case, they give birth to one to three cubs. In the spring, the females and cubs leave the dens; those with onshore dens return to join the rest of the population on the ice pack. As a result of this pattern, only a small part of the population is on shore at any one time. The Refuge has the highest density of onshore dens of any area along the Alaskan coast. Researchers

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[101]USGS *Wildlife Research Summaries*, 2002. p. 31.

[102]Cited in *The Natural History of an Arctic Oil Field*, p. 91.

[103]USGS *Wildlife Research Summaries*, 2002. p. 29

have shown that female polar bears are very sensitive to disturbance and will abandon their dens and young cubs if sufficiently disturbed (FLEIS, p. 129-130).

The shift to winter for virtually all exploration and certain other activities during development and production benefits many species. However, for polar bears this activity would occur at the times when female bears would be denning. To the west, industry has worked to avoid known den sites, but fewer dens are present in that area than in the 1002 area. Paradoxically, one new technology may present more difficulties. Use of 2-D seismic exploration can be accomplished with crews working at considerable intervals between survey lines. But for finer analysis of geological data, industry may find 3-D seismic exploration to be a cost-effective and preferable supplement. However, 3-D crews must work at much closer spacing than 2-D, thereby increasing the potential for conflict with denning bears. However, more recent studies suggest that denning polar bears may not be as seriously disturbed by human activities as previously thought: certain dens exposed to high levels of activity did not suffer a detectable reduction in productivity.[104]

Other possible conflicts include inhibition of bears coming ashore for denning, and the habituation of polar bears to human presence, and the subsequent risk to human life. Protected under the Marine Mammal Protection Act, and an international agreement (though not under the Endangered Species Act), polar bears are hunted relatively infrequently in Alaska (for subsistence), and some may lose their fear of humans. If human presence increases in the 1002 area as a result of development, conflicts with scavenging bears might become more common in the 1002 area. Polar bears are attracted now to the Kaktovik area (especially on occasions when whale carcasses have been landed). Generally, when such conflicts have occurred on the North Slope, habituated nuisance bears are relocated or destroyed.

The FLEIS suggested buffer zones of at least 0.5 miles around known dens in order to prevent abandonment. It also recommended orienting facilities to permit inland access for pregnant polar bears, relocating problem bears, and as a last resort, humane killing to protect human welfare. These actions continue to be the primary forms of mitigation.

Musk Oxen. Musk oxen were hunted to extinction in the area in the late 1800s, but 64 animals were re-introduced into the 1002 area in 1969-1970, and the population peaked at about 400 animals in 1986.[105] About twice that many are present during spring calving. They survive brutal winters protected by their thick fur, and conserve energy by moving little from their preferred riparian habitats. River corridors are used both for feeding and for travel all through the year, particularly in western portions of the 1002 area. Limited hunting of bulls is permitted by the Alaska Department of Fish and Game.

The high demand for water could create conflicts with the needs of musk oxen. The preferred habitat for musk oxen is riparian areas; if riparian areas are heavily

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[104]USGS *Wildlife Research Summaries,* 2002. p. 69.

[105]USGS *Wildlife Research Summaries,* 2002. p. 54. Some data suggest that the decline from the peak is associated with lower calf production and increased grizzly bear predation.

mined for gravel, or altered for capture of spring runoff, this species could be affected. In addition, the extreme metabolic slowdown that this species undergoes to survive the harsh winter could be threatened if herds are forced to flee frequent disturbances. The latter seems more easily mitigated than habitat alteration, since knowledge of the specific whereabouts of herds through radio collars could permit workers to avoid them.

Migratory Birds. A variety of bird species nest or forage in the 1002 area, taking advantage of the explosion of insect life and rapid plant growth that occurs in the short summer. Compared to birds breeding in temperate areas, these species cycle from spring arrival, to nesting, to southern migration at a furious pace. A large variety of birds, both familiar and rare in the lower 48 states, breed or fatten for migration in the Refuge. (See FWS web site: [http://www.r7.fws.gov/nwr/arctic/wildlife.html].) Among these are many popular game species: snow geese, Canada geese, white-fronted geese, brant, pintails, widgeons, and others. A wealth of shorebirds (plovers, dunlin, sandpipers, turnstones, phalaropes, and others) also frequent the area. Population data on most ANS bird species come from studies done in or near developed areas around Prudhoe Bay. The populations of many species oscillate, as is common in the arctic. Among shorebirds, only dunlin have shown long term declines, though this trend is shown in other arctic areas, and may be due to losses in their wintering habitat in east Asia.[106] Only 6 bird species are regularly found in the 1002 area in winter: snowy owls, gyrfalcons, rock and willow ptarmigans, common ravens, and American dippers.[107]

The spectacled eider, a large sea duck, is a rare to uncommon breeder along the coast of ANWR. It is listed as threatened under the Endangered Species Act (ESA). (See FWS fact sheet, including distribution map, at http://alaska.fws.gov/es/spei.pdf.) Reasons for the decline are unclear and may vary in different parts of the bird's range, but increased lead poisoning from ingested lead shot, hunting, and increased predation due to augmented predator populations near human development and garbage dumps are thought to play a role.

Steller's eider is a casual visitor along the coast of the Refuge. It too is listed as threatened under ESA. (See FWS fact sheet, including distribution map, at http://www.r7.fws.gov/es/steller/stei.pdf.) Reasons for the decline of this species are also unclear, but may be similar to those for the spectacled eider.

In comparing likely environmental effects of potential energy development on the birds of the 1002 area under a modern scenario and under that envisioned in 1987, only one feature seems to have changed markedly: much greater reliance on

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[106]Declan M. Troy, "Shorebirds" in *The Natural History of an Arctic Oil Field*, p. 283.

[107]Additional species may come to frequent the North Slope as the area shares in the warming trend that is now observed in much of the rest of the high arctic region. (See "Habitat Trends During the Study Period", p. 11-13 in USGS *Wildlife Research Summaries*, 2002.) In northern Canada even a robin (a bird for which there is no name in Inuit) was recently seen in the high arctic, boldly going where no robin apparently had gone before. (DeNeen L. Brown, "Signs of Thaw in a Desert of Snow," *Washington Post*, May 28, 2002. p. A1.

aircraft. Many more airstrips are now likely to be built, and many more flights made, especially in summer when more birds are present, than seemed likely in 1987. The species most likely to be affected by these flights is the snow goose, since their huge feeding flocks are highly sensitive to overflights, and are easily startled away from foraging sites. Mitigation measures suggested in the FLEIS were "careful facilities siting and controls on surface activities, air transportation, and hunting" (p. 133). These remain important, and it seems likely that a reduced number of facilities could make siting easier, but controls on air traffic seem more likely to be difficult than was assumed then. Protection of eiders, which were not listed under ESA at that time, could also be an issue in the western part of the Refuge where these rare birds are more likely to occur. Measures to protect both species of eiders could include restrictions on certain activities such as vehicular traffic, noise, construction within about 200 meters (660 feet) of active nests, and habitat alteration.

Other Species. Arctic fox populations and brown (grizzly) bear populations on the coastal plain have increased from development due to increased scavenging. The FLEIS noted that the increased population of foxes had damaging effects on their normal prey species, such as young birds, on which they continue to feed. Scavenging arctic grizzlies can become habituated to humans, as they do elsewhere, and become dangerous to human life. As noted in the FLEIS, careful control of trash can mitigate both problems.

Special Areas. If Congress opened ANWR, it could choose to afford special protections to special areas. Four areas within the coastal plain are commonly considered to have exceptional ecological value and were identified as such in the FLEIS.

- By far the most frequently mentioned is *Sadlerochit Spring* in the southernmost part of the 1002 area. The spring maintains a flow of water at 50°-58°F year-round, and keeps the river open for nearly 5 miles, even in winter. It represents the extreme northern range of some plants and birds, and provides wintering habitat for fish; muskoxen frequent the area. During the research leading up to the Section 1002 study, 4,000 acres around the spring were closed to exploration. There are individual Native allotments in the Sadlerochit area, which could complicate attempts to set it aside.
- The *Kongakut River* lies between the 1002 area and the Canadian border, and flows into the Beaufort Lagoon. Because of the unusual and diverse offshore ecosystem, and the presence of some of the North Slope's very rare trees in the upper part of the watershed, the area is considered ecologically valuable. About 25,000 acres of this system are included in the extreme northeastern part of the 1002 area.
- The *Angun Plains* are in the eastern part of the 1002 area, where evidence of Pleistocene glaciation is considered special. It comprises 36 square miles (23,040 acres).
- Parts of the *Jago River* drainage were identified in the FLEIS as nominees for "a system of 'Ecological Reserves.'" The river flows from the Brooks Range, into the 1002 area, and to the sea east of Kaktovik. The report notes that the drainage "contains a complete array of tundra and flood-plain vegetation types and provides habitat for a cross-section of all Arctic Slope wildlife species"

(p. 20). The particular areas suitable for such ecological reserves were not named by proponents of the idea, and the FLEIS gave no acreage figure for it.

Physical Environment: Status and Effects

Much of the attention and controversy over exploration and development of the 1002 area have focused on potential impacts on biological resources in the area. However, if development occurs, there also will be impacts on the physical environment and resources of the area – land, air, and water – as a result of construction, operations, and human habitation. Currently, because the area is largely uninhabited, the condition of the physical environment is almost pristine (although rugged and challenging for man's use) and essentially unaffected by human activity. Especially in terms of land and water, the dominant physical characteristic is permafrost, the permanently frozen layer which starts between 1 and 2 feet below the surface and has been found at a depth of 2,000 feet, that impedes drainage and creates saturated soil conditions in most areas of the entire North Slope. Permafrost and the surface layer on top of it are fragile, and special construction techniques (such as ice roads and structures built on pilings) have been devised to protect them.

It is undisputed that exploration and development activities will alter the existing physical environment. Oil field operations will result in air pollution emissions. There will be a need for large amounts of water for drilling and ancillary activities, including construction of roads, drill pads, and airstrips. Some amount of gravel will be mined as part of some of these activities, and there likely will be impacts from both the mining and use of gravel. Exploration and development activities will result in the generation of several types of waste streams, both wastes from industrial operations and domestic wastes, requiring disposal technologies. At issue are the individual and cumulative effects of such alterations and the ability of the natural environment to recover and be reclaimed when oil-related activities have ceased.

The industry strongly believes that the 1002 area can be explored and developed in an environmentally sensitive manner. Industry points out that companies use improved technology (compared with that used in the past for development of existing sites in the arctic region) which greatly reduces the "footprint" of operations and relies on practices that minimize and provide for better disposal of wastes. The result is less direct and indirect impact in terms of habitat loss and environmental contamination. Moreover, there are numerous environmental protection requirements administered by federal and state authorities that are intended to govern and regulate activities that might take place. Critics, however, are concerned about effects of routine operations in the fragile 1002 environment, as well as the possibility of leaks and spills of various contaminating substances, and whether adequate safeguards will be included in legislative proposals, and adopted and enforced by regulators.

Air Quality. Air quality on the North Slope of Alaska, including that in ANWR, currently meets all National Ambient Air Quality Standards (NAAQS) and would likely continue to do so even with ANWR development. Areas such as ANWR (i.e., those that meet the NAAQS) are regulated under the Prevention of Significant Deterioration (PSD) requirements of the Clean Air Act. The PSD

program requires pre-construction review and permitting of major new sources of pollution to determine the impact of projected emissions, and the imposition of Best Available Control Technology on emission sources.

Emissions and Expected Air Quality. Oil field operations – and the natural-gas-fired turbines and heaters associated with them in Alaska – generate significant amounts of air pollution. The power facilities needed to support operations on the North Slope are quite large: according to BPAlaska, the Central Compression Plant at Prudhoe Bay has turbines capable of generating the equivalent of 429 megawatts of electric power – enough power for a city of 150,000 people.[108] Even though it burns relatively clean fuel (natural gas), the North Slope complex emits an estimated 63,786 tons of air pollution per year.[109] Nitrogen oxide emissions, which account for more than two-thirds of the total, are "2-3 times the amount emitted by Washington, DC."[110]

Despite these emissions, as noted, air quality on the North Slope of Alaska, including that in ANWR, currently meets all National Ambient Air Quality Standards. Annual concentrations of nitrogen dioxide, measured at three monitoring stations in the Prudhoe Bay field, were, in fact, 70% to 90% below the NAAQS in each of the years 1996-2000. Emissions of other criteria pollutants were also within limits.[111]

Potential emissions from ANWR sources were discussed in the Final Legislative Environmental Impact Statement (completed in 1987, and not subsequently updated). The FLEIS concluded that the likely effect on air quality of the full leasing and development alternative would be minor.[112] It also noted that while "it is difficult to predict the impacts on air quality in the 1002 area without knowing the scope, timing, and location of oil development," which is impossible to predict without further exploratory activity, "The maximum annual emissions from the 1002 area would probably be analogous with present North Slope operations."[113]

PSD Regulatory Structure. Facilities in the 1002 area would be subject to the Clean Air Act's Prevention of Significant Deterioration rules. The PSD program is designed to protect air quality where ambient concentrations of pollutants are better than required by National Ambient Air Quality Standards. Pollutants subject to PSD requirements are particulate matter, sulfur oxides, and nitrogen oxides. Of

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[108]*BP Environmental Performance Report, 2001*, Part 3, Status of Environmental Protection, p. 3-19, available at [http://www.bp.com/alaska/index_envperf.htm].

[109]Personal communication, Don Bodron, Alaska Department of Environmental Conservation, January 9, 2002.

[110]Steven Brooks, atmospheric scientist, National Oceanic and Atmospheric Administration, Oak Ridge, TN, as cited in Janet Pelley, "Will Drilling for Oil Disrupt the Arctic National Wildlife Refuge?" *Environmental Science & Technology*, June 1, 2001, p. 244A.

[111]*BP Environmental Performance Report, 2001*, previously cited.

[112]U.S. Department of the Interior, *ANWR FLEIS*, previously cited, p. 166.

[113]Ibid., pp. 198, 112.

these, only the nitrogen oxide increment[114] is expected to pose any challenge to the development of the 1002 area.

Under the PSD program, the type of area affected by a proposed facility's emissions determines the amount of air quality degradation to be allowed. All international parks, national parks larger than 6,000 acres, and most wilderness areas larger than 5,000 acres are mandatory Class I areas – those for which the least increment of pollution is allowed. Facilities affecting Class I areas may increase annual ambient concentrations of NOx by only 2.5 $\mu g/m^3$ – 2.5% of the NAAQS.

ANWR, and specifically the 1002 area, are not Class I areas, however: the 1002 area has not been designated wilderness, and the remainder of ANWR, while it is officially wilderness, was not designated so until after the statute establishing the PSD program was enacted. Thus, like most other areas of the United States, ANWR is a Class II area. In such areas, new facilities may increase concentrations of NOx by 25 $\mu g/m^3$, 25% of the NAAQS – 10 times the amount allowed if the area were designated Class I.

Even this allowed increment could pose constraints for full ANWR development. In establishing the PSD increments for nitrogen oxides in 1988, the Environmental Protection Agency (EPA) made specific note of their potential impact on the North Slope, stating that "certain Class II areas such as Prudhoe Bay, Alaska, have ambient concentrations as much as 40 $\mu g/m^3$ higher than in 1980,"[115] which exceeds the 25 $\mu g/m^3$ increment adopted. If the FLEIS is accurate in projecting NOx emissions from full development of ANWR as analogous to levels observed at Prudhoe Bay, emissions might exceed allowed levels unless additional pollution control measures are adopted.

Major new sources of air pollution in PSD areas must undergo preconstruction review and must install Best Available Control Technology (BACT). State permitting agencies (in this case, the Alaska Department of Environmental Conservation) determine BACT on a case-by-case basis, taking into account energy, environmental, and economic impacts. More stringent controls can be required if modeling indicates that BACT is insufficient to avoid violating an allowable PSD increment or the NAAQS itself. Thus, the permitting process should ensure that ambient concentrations of NOx increase no more than 25% of the NAAQS level.

Arctic Haze. Another air quality concern that was much discussed when ANWR development was first considered in the 1980s is a phenomenon known as arctic haze. Beginning in the 1950s, arctic observers have noted the presence in late winter and early spring of persistent bands of haze that reduce visibility and change the color of clear skies from deep blue to a pale blue or hazy gray. The haze consists of suspended particles, primarily sulfates, that originate in Europe and the former

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[114]Allowed levels of pollution in the PSD program are termed "increments" because the standards specify maximum incremental concentrations of pollution to be allowed. The specific increments for NOx are discussed later in this section.

[115]Prevention of Significant Deterioration for Nitrogen Oxides, Proposed Rule, 53 Federal Register 3706, February 8, 1988.

Soviet Union.[116] The arctic's cold, dry air, with little precipitation and weak sunlight, produces remarkably stable air masses in winter and early spring, allowing the particles to remain airborne for weeks at a time and to spread thousands of miles from their point of origin.

Arctic haze appears to be less of a concern at present than it was in the 1980s. With the breakup of the former Soviet Union and the closure of many of the most heavily emitting industrial facilities in Eastern Europe and Russia, the haze has declined by as much as 50% since the mid-1980s.[117] Emissions from Alaska's North Slope appear to contribute relatively little to the problem.

Water Resources and Wetlands. Issues of concern for potential oil exploration and development in the 1002 area are the availability of water supplies and the impacts of production activities on the water and wetland resources of the area. Large amounts of water are needed for drilling and ancillary activities, such as ice roads and airstrip construction, as well as domestic use.

Description of the Resource. According to the 1987 FLEIS, free water is limited in the 1002 area and is confined to the surface and the shallow zone of soil located above the impermeable permafrost layer. The refuge receives an average of 6 inches of precipitation annually. A study done in 1989 found 255 lakes, ponds, and puddles within the 1002 area. Most lakes are shallow and freeze solid in winter. Less than 25% were deeper than 7 feet, and only 8 contained enough unfrozen water to build a mile or more of ice road.[118] A number of rivers and streams exist in the 1002 area, most draining to the coast and the Beaufort Sea; these too are also usually shallow.

According to the FLEIS, 99% of the 1002 area is classified as wetlands, which are transitional lands found between terrestrial and aquatic systems where the water table usually is at or near the surface, or the land is covered by shallow water. Arctic wetlands are different from those in the Lower 48 states, however. In warmer areas outside of Alaska, wetlands play a significant role in floodwater storage, lateral water movement, groundwater recharge, and sediment and erosion control. But in the arctic area, the permafrost layer impedes drainage and prevents many of the processes normally attributed to wetlands from occurring, because most arctic wetlands are not hydrologically linked to underground aquifers. However, this thin surface layer of soil and rock, located above the permanently frozen layer, is the area where the processes that sustain life in the arctic occur, including the cycle of freezing in winter and thawing in the brief summer and where biological activity of micro-organisms

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[116]Leonard A. Barrie and Jan W. Bottenheim, "Sulphur and Nitrogen Pollution in the Arctic Atmosphere," in W.T. Sturges (ed.), *Pollution of the Arctic Atmosphere* (New York: Elsevier Science Publishers, 1991), p. 173, 177.

[117]John Ogren, NOAA Climate Monitoring and Diagnostics Laboratory, Boulder, CO, "Measurements of the Climate-forcing Properties of Atmospheric Aerosols," Slide 18, at [http://www.cmdl.noaa.gov/aero/pubs/sem/ogren/Mexico_980123/sld018.htm].

[118]Gibbs, "The Arctic Oil and Wildlife Refuge," p. 68.

and growth of plant roots take place.[119] Plants that grow in the perpetually saturated soils of the area include sedges, grasses in flat areas, and tiny shrubs and dwarf trees in the foothills and uplands.

Water availability is cyclical during the year. In the spring, rapid snowmelt occurs throughout the area, and melting snow flows to rivers because it does not penetrate the permafrost. Rivers run full, riverbanks are severely eroded by ice and snow, and there is extensive spring flooding. Turbidity from suspended sediments is high, which impairs water quality. In summer and fall, rain follows, which can also lead to flooding. But at the time of freezeup in the fall, low water supply conditions prevail. Most rivers go dry or freeze to the bottom, and streamflow ceases during winter except below a few warm springs.

Currently, water quality conditions in the 1002 area are not affected by human activity. While the state does not have extensive information about water quality in the vast majority of Alaska's watersheds, because they are not actively monitored, most are presumed to be in relatively pristine condition – including the 1002 area – due to the state's size, sparse population, and general remoteness. As of 1987, no data were available on water quality below the permafrost in the 1002 area, but the water beneath it is probably brackish, according to the FLEIS.

Effects of Oil Exploration and Development. The 1987 FLEIS identified the use of limited fresh water sources for industrial purposes as having the potential for major adverse effects, if exploration and development of the 1002 area occur. It estimated that one exploratory well could require 15 million gallons of water: 7 to 8 million gallons for construction and maintenance of an airstrip; 1.2 to 1.5 million gallons per mile for road construction and maintenance; and 1.7 to 2 million gallons for drilling operations and domestic use. Despite technological improvements and a smaller "footprint" for oil and gas operations in the arctic today (discussed below), estimates of water requirements are generally the same as presented in the FLEIS.

These water supply needs result from the fact that ice is the construction material of choice for the winter exploration season to make temporary roads, winter airstrips, and drill pads, in preference to mining of gravel (discussed below). This is done by spreading 6 inches of chipped ice from rivers and lakes, then spraying the area with fresh water to make temporary roads and pads that melt in the spring. When they melt, they leave no significant damage to the tundra. Road construction techniques have evolved since early days of oil activity in the arctic. Temporary ice roads now allow construction of oil field pipelines during the winter months, thus largely eliminating the need for permanent gravel roads adjacent to pipelines.[120]

A source of water for ice roads, airstrips, and drill pads would need to be located, but there is little evidence on whether North Slope rivers and lakes can support the amount of water used by oil fields. One FWS hydrologist suggests that

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[119]British Petroleum Corp. "Exploring Alaska: Alaska's Terrestrial Environment." [http://www.bp.com/alaska/environment/env.htm]

[120]British Petroleum Corp. "Exploring Alaska: Ice Roads and Pads." [http://www.bp.com/alaska/bpamoco/env_record/10.htm].

drawing too heavily from deep lakes would diminish the aquatic species that are food for migratory waterfowl; heavy withdrawals from the Canning River, which flows freely in winter for many miles below warm springs, could harm overwintering fish.[121] The deepest river basins are near the mouths of the Canning and Jago Rivers; if the brackish water from these basins were used for ice roads, the result could be harm to tundra vegetation when the ice melts in the spring.

Because the Refuge has few deep lakes or lakes that do not freeze solid in winter, it is believed that there is only enough water in the 1002 area for less than 50 miles of ice roads.[122] To meet water needs, alternatives that might be considered include creating water reservoirs by excavating deep pools in conjunction with gravel removal. Overflow during spring runoff would fill the basins, and the accumulated water could be used for construction. With sufficiently deep basins, habitat could be created for overwintering fish. If economic quantities of oil were not found, basins might be left in place, or it would be necessary to find clean gravel to fill in the basins. Riparian habitat is heavily used by musk oxen in winter, and siting of facilities in riparian areas (with or without oil discovery) would likely to be an issue.

Companies might also melt lake and river ice and snow, or desalinate marine water. Oil companies also might consider transporting water by truck from existing developed areas, such as Prudhoe Bay, although the economics of doing so for long distances could be impractical. Another possibility is that oil companies might revert to building gravel roads for exploration and production, as in the past elsewhere on the North Slope.

On the North Slope today, most wastes associated with drilling, as well as sewage and garbage, are injected in dedicated disposal wells, rather than in waste pits, which greatly reduces surface impacts and water pollution incidents. The oil industry has improved both technology and practices to prevent and clean up accidental releases that could harm the surface layer and water. However, critics are concerned about the possibility of spills of various substances, including waste oil, acid, ethylene glycol, and drilling fluids, especially given the relatively few lakes and streams in the 1002 area. Even small spills, if not cleaned up, can affect lakes and streams, for example if a spill on an ice pad melts in the spring. The primary impact of contaminated water is its potential to reduce oxygen availability in receiving waters, plus possible toxicity of the waste.[123] Critics also are concerned that leaks and spills of oil, fuel, chemicals, or brine could contaminate soils, thus killing vegetation and resulting in scattered small habitat loss. In addition, they are concerned about the environmental standards which would have to be met for development on these federal lands.

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[121]ANWR chief hydrologist Steve Lyons, cited in Gibbs, "The Arctic Oil and Wildlife Refuge," p. 68.

[122]Pelley, Janet. "Will Drilling for Oil Disrupt the Arctic National Wildlife Refuge?" *Environmental Science & Technology*, June 1, 2001: 244A. (Hereafter referred to as Pelley, "Will Drilling for Oil Disrupt ANWR?")

[123]British Petroleum Corp. "Water."
[http://www.bp.com/corp_reporting/hse_perform/env/water/index.asp]

Regulatory Setting. If oil exploration and development were to occur in the 1002 area under current law, a regulatory regime that is carried out both by federal and state agencies would apply to water quality protection. Federal laws applicable to activities taking place in the 1002 area include the Clean Water Act, Safe Drinking Water Act, Rivers and Harbors Act, Coastal Zone Management Act, and the Ocean Dumping Act. In Alaska, permits required by federal laws are issued by federal agencies, especially the Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (Corps).

The state of Alaska has limited separate regulatory authorities and requirements. One important role that the state plays is in establishing water quality standards to protect waters within its jurisdiction, as required by the federal Clean Water Act (CWA). Alaska's statewide standards apply to surface waters and to groundwater, at the state's discretion, and include specification of designated uses (such as use for water supply or recreational purposes), numeric and narrative criteria, and general policies to ensure protection of the designated uses. State standards do currently apply to waters throughout the state, including the 1002 area. Any permits written by federal or state agencies must provide that state water quality standards will not be violated. In addition, the state requires development of oil discharge prevention and contingency plans for exploration or production facilities and proof of financial responsibility to ensure that owners and operators maintain adequate financial resources to respond to any spill and mitigate environmental damages. The state's Department of Fish and Game also would conduct a review of any proposed project for possible impacts on anadromous fish.

There is little public information available concerning oil industry compliance with state water quality standards, permits, and other environmental requirements. The industry believes that as a result of improved technology and operating practices – especially in recent years – its environmental performance in the arctic is good. Critics, however, point out that data compiled by the Alaska Department of Environmental Conservation demonstrate that on average several hundred spills of hazardous substances, refined oil products, and crude oil occur each year at existing North Slope operations, and some argue that the oil industry should not be allowed into the 1002 area until it fixes chronic problems with leaky and poorly maintained physical structures.[124]

The Clean Water Act requires that facilities must obtain permits which authorize discharge of processed wastewater. These permits, issued in Alaska by EPA, establish specific limitations on pollutants in industrial waste or sewage that may be discharged from any facility to waters of the United States, as well as general requirements such as monitoring and reporting. CWA permits for oil and gas operations in the arctic typically require Best Management Practices (BMP) plans which focus on pollution prevention rather than end-of-pipe discharge limits through specification of structural and operational controls, maintenance, and inspections. Outside of the 1002 area, EPA has issued a general permit for onshore and offshore

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[124]Pelley, "Will Drilling for Oil Disrupt ANWR?" p. 43A. Reports and data on spills can be found at:
[http://www.state.ak.us/local/akpages/ENV.CONSERV/dspar/perp/datanews.html]

oil and gas extraction in Alaska that covers rest of the North Slope Borough. It provides general authorization to different facilities having similar discharges for such activities as discharges from ice roads constructed of gravel pit water, discharges of sanitary and/or domestic wastewater from covered facilities, and construction dewatering. The general permit application process is streamlined, because individual sources covered by a general permit do not need to apply to EPA for a source-specific permit; if they file a Notice of Intent and meet certain other qualifications, they can be covered by the general permit. The current general permit was issued in 1997 and extends to April 10, 2002. It is possible that EPA would also choose to issue a general permit for any activities in the 1002 area.

EPA also issues CWA permits for stormwater discharges of uncontaminated rainwater and snowmelt. Arctic drilling and production pads do not have conventional storm drains, as in other parts of the country, so stormwater discharges are in the form of surface runoff during the spring thaw season. Stormwater permits focus on plans to prevent releases of contaminated runoff to waters of the United States.

The Safe Drinking Water Act (SDWA) authorizes a program to protect underground sources of drinking water (USDWs) from contamination by injection through wells. In Alaska, primary responsibility for regulation of injection wells through this program is split between EPA and the Alaska Oil and Gas Conservation Commission (AOGCC). EPA issues permits authorizing subsurface injection of non-hazardous industrial wastes associated with oil exploration and development, while the AOGCC issues permits for wells used for injection of fluids brought to the surface from oil and gas production operations or liquid hydrocarbons which are stored underground. Injection of fluid wastes which cannot be recycled is preferred to the discharge to surface disposal pits or ponds. Underground injection is to be conducted so as to protect USDWs. However, in existing oil production areas on the North Slope, EPA has determined that there are most likely not any aquifers beneath the permafrost which are fresh enough to qualify for protection as USDWs. Thus, the agency has granted several waiver requests from oil companies authorizing underground injection with less stringent requirements than normal. This could be a precedent for ANWR, as well.

Separate from the CWA discharge permit program administered by EPA, §404 of the CWA also contains a permit program administered by the U.S. Army Corps of Engineers under which advance approval must be obtained for discharges from any project that involves dredging or filling of the nation's waters, including adjacent wetlands. Because of the extent of wetlands in the 1002 area, these requirements are likely to apply to nearly all oil exploration and development activities that might occur onshore. In addition, the Rivers and Harbors Act of 1899 requires permits from the Corps for construction of any dam or dike in a navigable waterway or any structure in or over any navigable waterway, if the structure affects the course, location, or condition of the waterbody.[125] If docks or offshore navigational components of facilities to transport people and materials to and from the 1002 area

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[125]Given the rapid snowmelt and high streamflow in rivers that occurs in the spring, constructing bridges could present significant challenges.

were constructed, permits under this authority as well as the CWA would likely be required.

Another permit provision that could arise is contained in the Marine Protection Research and Sanctuaries Act (Title I known as the Ocean Dumping Act), which requires a permit from the Corps for the disposal of dredged material in the territorial seas, for example, for disposal of material dredged in the construction of channels in open seas needed to get to shore facilities. In carrying out its regulatory responsibilities, the Corps evaluates projects through a public interest balancing process, considering the public benefits and detriments of all relevant factors including conservation, economics, aesthetics, wetlands, cultural values, fish and wildlife values, and navigation. Further, the Corps shares jurisdiction with other agencies. For example, the Corps uses environmental guidelines issued by EPA to evaluate impacts of a proposed discharge and consults with other federal and state agencies before issuing permits.

The Coastal Zone Management Act (CZMA) requires certification by states that projects to be located in a state's coastal zone are consistent with the state's coastal zone management program. The CWA requires a similar state certification concerning compliance with state water quality standards. Both would presumably apply to oil exploration and development activities. According to EPA officials, however, in part because of resource limitations, the state of Alaska frequently waives CZMA and CWA certification, rather than using that authority to impose environmental conditions on projects.[126]

Waste Disposal. Oil exploration and drilling result in the generation of several waste streams. There are also small quantities of solid and hazardous wastes associated with daily living activities and with running an industrial complex. The Resource Conservation and Recovery Act (RCRA) governs the generation, storage, transportation and disposal of hazardous wastes, and in Alaska the program is carried out by the U.S. EPA. Nonhazardous and RCRA-exempt solid wastes are regulated by the Alaska Department of Environmental Conservation (ADEC).

The hazardous wastes come from maintenance shops, laboratories, and other support activities. The largest categories are paint wastes, solvents, miscellaneous chemicals (particularly from laboratories), crushed light bulbs and bases, and rags, sorbents, and filters. There are no commercial facilities in the state for disposal of hazardous wastes, and they must be stored in secure areas before shipment to RCRA-permitted facilities in the lower 48 states.

RCRA-Exempt Wastes. EPA has determined that oil and natural gas exploration and production wastes constitute a high-volume, low-toxicity waste stream that would be better managed outside the RCRA hazardous waste regime. The ADEC regulates these drilling fluids, produced waters, and other wastes.

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[126]Personal communication with Ted Rockwell, U.S. EPA, Anchorage, Alaska, Dec. 19, 2001.

In the past, drilling wastes were placed in surface impoundments called "reserve pits," but they have several disadvantages: they take up a great deal of space, making the well pad's footprint larger; they require continuous fluid management, maintenance, and monitoring to prevent releases of metals, salts, and other contaminants into the environment; and, when closed down, may require years of environmental monitoring. Today these wastes are ground up and injected into dedicated disposal wells 5,000 - 8,000 feet deep.[127] The ADEC regulates underground injection wells, as discussed above in *Water Resources and Wetlands*. The wells are only allowed in areas where there is no underground source of drinking water, or where aquifers are too deep or briny for development. Grind and inject technology has ended the use of reserve pits for permanent disposal.

Minimization and Recycling. The companies on the North Slope employ waste minimization and recycling programs to reduce the volume of solid waste.[128] One of the waste streams is drilling muds – mixtures of natural clays and weighting materials with small amounts of specialized additives that serve to lubricate the drill bit, remove cuttings from the well bore, and control the pressure in the well. As the mud circulates back to the surface, cuttings and other solids are removed, and the muds are reused; this recycling can reduce mud requirements by 50 % or more. During drilling operations, each well can generate up to 8,000 barrels of muds and cuttings. Cuttings from the upper strata are washed and used as gravel for construction of roads and pads. The remaining cuttings are ground fine and injected in a slurry in a permitted disposal well along with other production wastes.

Surface discharges of sanitary and domestic wastewater (black and gray water) have been eliminated at some facilities by injecting them in disposal wells or using them for enhanced oil recovery (EOR). Other nonhazardous and RCRA-exempt liquids that might otherwise be discarded may also be used for EOR. Used oil from vehicles and equipment is collected at several North Slope facilities. It is blended into the crude oil and sent to refineries.

In conjunction with the Federal Trade Commission's approval of the sale of ARCO Alaska to the Phillips Petroleum Company in 2000, an agreement between the State of Alaska and the companies operating on the North Slope was reached. Called the "Charter for the Development of the Alaskan North Slope," it contained, among other things, several environmental provisions committing British Petroleum and Phillips Petroleum to clean up selected existing and abandoned sites, retrieve and dispose of abandoned empty barrels, and close inactive reserve pits.[129]

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[127]Pelley, "Will Drilling for Oil Disrupt ANWR?" p. 243A.

[128]British Petroleum Corp. "BP and the Environment on Alaska's North Slope." [http://www.bp.com/alaska].

[129]"Alaska at Peace with BP Amoco Concessions," *Gas Daily*, December 3, 1999; Mary Pemberton, "DEC: BP and Phillips Keeping Environmental Promises on North Slope," Associated Press State & Local Wire, March 28, 2001; and Alaska. DEC. *Alaska Department of Environmental Conservation's Report on the Charter for Development of the Alaskan North Slope.* March 2001. 8 p. Available at: http://www.state.ak.us/local/akpages/ENV.CONSERV/pubs/charter7web.pdf

These cleanup activities are testament to the uneven environmental record of the past. And as recently as the year 2000 British Petroleum (BP) paid $7 million in civil and criminal penalties and agreed to spend $15 million to carry out a nationwide environmental management system as a result of a contractor's illegally disposing hazardous waste for at least 3 years, and of BP's failing to report it immediately on discovery.[130] Technical advances and heightened sensitivity on the part of the operators to the need for careful operation in the arctic environment offer an optimistic outlook, but the possibility of an accident or deliberate violation of a waste disposal permit or regulation always exists.

Land and Gravel Use. Gravel is a necessary component of exploration and development activities on the North Slope, and gravel suitable for these activities is a relatively valuable resource there.[131] However, with the higher velocities of rivers in the narrow coastal plain of the 1002 area, gravel is more abundant than in the broader, developed portion of the coast plain to the west. Gravel roads and pads are constructed by piling gravel on top of tundra to provide a base for aboveground structures and to insulate the permafrost that lies just below the surface. The mining of gravel from streambeds and floodplains for such purposes can alter natural river drainage and cause increased erosion and sedimentation. Vegetation covered with layers of gravel dies, subtracting its resources from the food web of the ecosystem. In addition, dust blown from the gravel structure may affect freezing and thawing of nearby vegetation, as may any material washed from the gravel surface. The blown dust might convey some unexpected benefits: dust kicked up from gravel structures may cause earlier snow melt. Early melting stimulates plant growth, and could provide earlier foraging areas for waterfowl. Possible contamination of the dust with wastes might counter benefits, however.

The need for gravel for activities in the 1002 area, if development occurs, is likely to be much less than that for earlier years of oil development in existing areas for several reasons. First, gravel previously was used as the base for nearly all road and pad construction, but today it is likely to be used only for *permanent* roads and pads because ice is the preferred construction material for *temporary* roads and pads (although the availability of adequate supplies of water is an issue for development of the 1002 area; see *Water Resources and Wetlands*, above). Second, gravel previously was mined to create reserve pits that held drilling muds and other produced wastes. Today, however, nearly all wastes are recycled, reused or disposed by underground injection, thus greatly reducing the need for reserve pits. Third, even where used for drilling pads, the amount of gravel needed will be less because of the smaller overall footprint of sites.

If development in the 1002 area followed the pattern at Alpine, it would be, if not entirely roadless, then road-reduced, compared to older developments. Alpine is not connected by road to older facilities, but the development includes a 3-mile

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[130]U.S. Environmental Protection Agency. "British Petroleum (BP) Exploration Alaska Sentenced in Hazardous Waste Case." February 10, 2000. See: http://yosemite.epa.gov/R10/OWCM.NSF/28100b370f14993688256500005dcdf2/1eff2f7433b0da66882568b000745a01?OpenDocument.

[131]*BP Environmental Performance Report, 2001*, previously cited: 3-39.

road (14.6 acres) and a 36.3-acre airstrip. (See Figure 4.) The latter forms part of the road connecting the 2 pads.[132] The road and airstrip constitute about 52% of the total permitted acreage. If anything like this pattern holds in a modern scenario, it would represent a very substantial reduction in the miles of roads relative to earlier development.

However, it is not clear whether roadless development along the Alpine model would be economic in ANWR. According to a recent report, current leaseholders at the Badami oil field (25 miles further east than the current easternmost permanent road on the North Slope, and about 25 miles west of the 1002 area) are seeking a permanent road to field.[133] The leaseholders argue that the leases are not economic without a year-round road. They seek state funding for the creation of this road. If such a road were built, the Badami area would represent the nearest staging area to the 1002 area. Thus depending on whether the Badami road is built, development in the 1002 area would require either construction of an additional 25 or 50 miles of gravel road up to the refuge boundary, plus ice roads into the 1002 exploration sites. Proponents of state construction of the Badami road estimate that it would cost $50-60 million. Similarly, the three most extensive of 5 development scenarios in one recent model assume the presence of a road, parallel to a pipeline, as well as a connector road to Kaktovik, in the 1002 area.[134] The absence of a gravel road linked to currently developed areas would add to the cost of development of ANWR, potentially making some prospects uneconomic or adding to pressure to build gravel roads outside or inside the 1002 area. (On the other hand, a variety of factors, including higher oil prices, could mean that such costs would not be prohibitive.)

Caribou cows in existing oil fields with calves younger than a few weeks old (roughly, during June in most years) are known to avoid roads, pads, and other areas around human activity; avoidance during this early period extends well beyond the footprint of facilities, especially in early years of oil development.[135] (See also *Caribou*, above.) If road mileage were reduced, impacts on calves at this sensitive time could be lowered. In ANWR, as calving ends in early June, and as the Porcupine Caribou Herd (PCH) tends to move to the coast and the western portion of the 1002 area for insect relief, roads or runways oriented across the path of travel could be expected to disrupt the cows' movement more than those oriented roughly parallel to it. If calving were displaced to the foothills, greater predation would apparently result; if foraging is displaced from prime areas, weight loss in cows could

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[132]U.S. Army Corps of Engineers, Alaska District, Permit Evaluation and Decision Document, Alpine Development Project, Colville River 18 (2-960874) p. 2 (February 13, 1998).

[133]Cashman, Kay. "Winstar wants year-round road to Badami; ice roads too costly", *Petroleum News Alaska*. April 7, 2002. p. 1.

[134]Tussing, Arlon R. and Sharman Haley. "Drainage pierces ANWR in Alaska study scenario." *Oil and Gas Journal*, July 5, 1999. p. 71-85.

[135]C. Nelleman and R. D. Cameron, "Cumulative impacts of an evolving oil-field complex on the distribution of calving caribou," *Canadian Journal of Zoology*, Vol. 76 (1998): p. 1425-1430.

result in reduced survival rates in calves.[136] On the other hand even in June, some animals (primarily males and yearlings) use pads, roads, and runways for insect relief, and so may congregate in these areas. Later in the summer, when calves are older, some cow-calf pairs may join them.

Consequently, interpretations of impacts based on the CAH must be made cautiously, due to the differing concentrations of the herds and the differing availability of similar calving areas.[137] If road mileage were limited, impacts would probably be lowered. Conversely, if roads were not limited, or if economic necessity later resulted in a change in this restriction, impacts on the PCH or other species, such as tundra swans (which tend to avoid nesting within 200 meters (about 650 feet) of roads), could be greater. (See also *Biological Resources: Status and Effects*, above.)

Changing Footprint Estimate: 1987 vs. 2001. There has been considerable focus in recent years on the reduced footprint that seems likely in any 1002 development, given advances in exploration, development, and production technologies, as well as the possibility of added congressional restrictions on environmental impacts. It may be useful to compare those features considered in the footprint as described in the 1987 FLEIS, and how that might differ from a scenario predicated on modern technologies. In 1987, the FLEIS described the assumptions built into its full development scenario:

> For the sake of maintaining data confidentiality, [the full development scenario] shows a highly generalized placement of production and transportation facilities based on typical North Slope prospect characteristics for three localities within the 1002 area. This assumes successful exploration in all three localities. Actual placement of oil production facilities and marine facilities on the 1002 area, or location of the trunk pipeline from producing fields to TAPS Pump Station 1, depends upon site-specific geotechnical, engineering, environmental, and economic data that can be determined only after a specific prospect has been drilled, and a discovery made and confirmed.[138]

The features considered in the FLEIS (on p. 99) are shown in Table 4, along with the estimate given at that time for the space or miles that would be occupied by the feature in a full development as hypothesized by the FLEIS. The third column shows, in qualitative terms, how modern technology would probably change the estimate provided in 1987, assuming the same full development scenario. The highlights of the comparison are as follows.

Some features would very likely or probably be reduced in total acreage or mileage; a few might even be eliminated. These are:

- spur roads with collecting lines, connecting (fewer) pads in a given oil field,

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[136]Gibbs, "The Arctic Oil and Wildlife Refuge", p. 69.

[137]Gibbs, "The Arctic Oil and Wildlife Refuge", p. 69.

[138]FLEIS, p. 98. The full set of assumptions is given on pp. 97-98.

- large permanent airfields (supporting an entire area, as at Deadhorse or Kuparuk),
- permanent drill pads,
- pits for gravel mines (borrow pits),
- major river or stream crossings (given fewer roads),
- main road paralleling main pipeline (possibly *no* such road), and
- large central processing facility, as at Deadhorse or Kuparuk (possibly no such facility).

In other instances, new technology might actually increase the demand for acreage devoted to some features:

- marine and saltwater treatment facilities, due to greater modern demand for water (but possibly substituted with smaller plants for fields near coast), and
- small permanent airfields, enough for each cluster of pads not supplied by a permanent road.

Assuming the same full development scenario as the FLEIS, some features would probably remain the same:

- main oil pipeline within the 1002 area, and
- collecting lines from drill pads to main oil pipeline.

Finally, in some instances, it is simply unclear whether some features would be built:

- marine port facilities, to off-load barges and other heavy equipment,
- main road from marine facility.

In 1987, the FLEIS, in its hypothetical full development scenario, estimated that the total acreage covered would be 5,330 to 5,980 acres. A comparison with a scenario using modern technology suggests that the footprint (as defined by the FLEIS in its table) would be smaller, but perhaps not markedly so. If, as suggested by Arctic Power (a pro-development group cited earlier), full development of the 1002 area could be accomplished by building no more than 2,000 acres of facilities (scattered appropriately around developed oil fields, and assuming the same oil fields as the FLEIS), then either its definition of "footprint" is different from that used in the FLEIS, or additional technological improvements may be required. It is the pads, airstrips, pad supports, and connector roads that are typically considered when development proponents have recently referred to limiting surface impacts to 2,000 acres; other features, such as pipelines, gravel mines and the like typically are not.[139]

While the technologies used would be affected by economics, direction by Congress could specify higher or lower standards than those assumed in the table. Moreover, development on Native lands is not considered in the table, since different

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[139]Some development advocates do not include roads connecting the pads. For example, Rep. Sununu, in an editorial discussing his amendment to H.R. 4 (adopted Aug. 1, 2001), to limit total surface occupancy in future development of the 1002 area to 2,000 acres, said his language did not include roads, saying that most roads in the 1002 area would be made of ice (*Manchester Union Leader*, Aug. 20, 2001).

standards could apply. (For legal issues related to Native lands, see *Alaska Native Lands and Rights,* below.)

Table 4. Comparison of the Estimated Number and Area of In-place Oil-related Facilities: 1987 FLEIS and Modern Technologies

Facility	FLEIS Full Leasing Scenario (p. 99)	Same finds, assuming Alpine-like technologies
Main oil pipeline within 1002 area	100 mi (610 acres)	probably similar for similar locations of oil
Main road paralleling main pipeline (see note below)	120 mi (730 acres)	possibly 0 miles (0 acres)[a]
Main road from marine facilities	(Included in above row, no separate figure given)	Unclear if marine facilities would be built[a]
Spur roads with collecting lines within production fields	160 mi (980 acres)	Uncertain – fewer pads in a production field, therefore probably fewer in-field spur roads for similar locations of oil[a]; collecting lines probably similar
Marine and salt-water treatment facilities	2 facilities (200 acres)	Unclear how many would be built, but demands on fresh water sources possibly greater than assumed in 1987
Large central production facilities	7 facilities (630 acres)	0? (facilities incorporated into one pad in each production field)[b]
Small central production facilities	4 facilities (160 acres)	0? (facilities incorporated into one pad in each production field)[b]
Large permanent airfields	2 airfields (260 acres)	0?[b]
Small permanent airfields	2 airfields (60 acres)	Many more – probably one for each production field[b]

Permanent drilling pads	50-60 pads (1,200-1,600 acres) [average size: 20-32 acres]	Probably fewer per production area, given greater reach of modern wells[b]; most recent 2 pads (at Alpine) were 10 acres and 36 acres each.
Borrow sites (*i.e.*, gravel mine pits)	10-15 pits (500-750 acres)	Uncertain, but probably fewer, given fewer roads and fewer pads[c]
Gravel for construction, operation, and maintenance	40 - 50 million cu yds	Uncertain, but probably less
Major river or stream crossings	Maximum 25	Uncertain, but likely fewer, due to fewer roads
Total acres of surface occupancy	**5,330 - 5,980 acres**	**Probably less**

Notes: Columns 1 and 2 are reproduced from the FLEIS with the modifications noted. Column 3 assumes the same hypothetical oil fields as the FLEIS, and the use of modern, Alpine-like technologies or better. The FLEIS table gave one figure for all main roads; this number is broken into two parts here, since an Alpine-like scenario is assumed not to have a main road for a pipeline, but such technology may not necessarily preclude a marine facility or roads associated with it.

[a] Facilities which at least some observers would likely count in current proposals to restrict development to 2,000 acres (see text); unclear in some of the marked cases whether any such structure would actually be built. Some argue that economics (cost of long-distance transportation of heavy equipment or cost of repeated construction of ice roads) could force eventual construction of a main road, especially if world oil prices do not increase.

[b] Facilities which most observers would likely count in proposals to restrict development to 2,000 acres (see text); unclear in some of the marked cases whether any such structure would actually be built.

[c] In association with the Alpine development, the Corps of Engineers issued a permit to Nuiqsut Contractors for a 150-acre gravel pit, though some portion of the gravel met needs in the village of Nuiqsut, and the size of the permitted pit may have been designed to allow expansion of the Alpine development to 2 additional satellite pads and associated connector roads. It is unclear precisely what size of gravel mine would have been required to construct only the current facilities at Alpine. Consolidation of gravel pits might occur, by digging fewer, deeper pits, but no information was found on this possibility.

Sources: U.S. Dept. of the Interior, Fish and Wildlife Service, Geological Survey, and Bureau of Land Management. *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment.* Report and Recommendation to the Congress of the United States and Final Legislative Environmental Impact Statement. Washington, DC, 1987. p. 99.
U.S. Army Corps of Engineers, Alaska District, Permit Evaluation and Decision Document, Alpine Development Project, Colville River 18 (2-960874). February 13, 1998. p. 2.
U.S. Army Corps of Engineers, Alaska District, Colville River 17 (2-960869). Alpine Gravel Pit, Nuiqsut Contractors. June 23, 1997.

Effects on Tundra Surfaces. The 1002 area has a higher proportion of rolling terrain than the flat, pond-rich Prudhoe Bay area. Vegetation may be exposed by the wind and damaged as it is run over, especially where more hilly terrain could make rolligon use difficult. In a more temperate environment, vegetation might recover fairly quickly, but the intense cold and the freezing and thawing cycles of the arctic environment can make recovery rates much slower. However, there is no research to show whether this type of vegetational damage would affect foraging animals.[140]

The vegetation under ice roads and ice pads may be damaged, partly by compaction, but also by being delayed in its spurt of growth in the brief summer. Where all debris is removed and no spills have occurred, little effect has been observed.[141] Where insulation is used to maintain an ice pad over a single summer, damage appeared to be confined to areas around the edges of the pad, where some thawing had occurred but no sunlight had reached the plants; evidence of recolonization began to appear in two growing seasons.[142]

Port and Offshore Activity. The FLEIS assumed that 2 ports would be built to support development in the 1002 area. It is unclear whether that assumption is still likely. If water for ice roads is at a premium, port development could reduce the need for long ice roads from the west. If port facilities were carefully sited and built offshore, and connected to shore via causeways, and in turn to ice roads, they may prove attractive for the staging and movement of heavy equipment. Offshore facilities may also be considered for placement of heavy equipment such as water treatment plants, since such placement could put them outside any 2,000 acre limit on surface occupancy (if Congress were to impose such a limit). The reduction in surface impacts would be traded for potential offshore impacts; in the FLEIS, the focus of impacts from causeways was on fish migration. If ports were to be located on Native lands, their regulation is unclear.

Aircraft Use. At Alpine, 6 to 8 aircraft, including large cargo planes, arrive daily.[143] Reliance on aircraft for summer transport is essential if connecting roads are to be eliminated. Effects on bird populations vary. Tundra swans appear to be affected only minimally by aircraft.[144] According to the FLEIS (p. 132), snow geese are "highly sensitive to aircraft disturbance" from flights at 100 ft to 10,000 ft, and at 0.5 to 9 miles away. The geese appeared to habituate after several passes by helicopters or fixed wing aircraft. The report also noted evidence that snow geese are disturbed by traffic, noise, or other human activities and respond by taking flight *en masse*. Regardless of source, sufficient disturbance would reduce available feeding time, weight gain, and resulting vigor for the fall migration. The FLEIS cited control

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[140]Gibbs, "The Arctic Oil and Wildlife Refuge."

[141]Jay D. McKendrick, "Vegetative Responses to Disturbance", in *The Natural History of an Arctic Oil Field.* p. 43.

[142]*Ibid*. p. 43.

[143]Gibbs, "The Arctic Oil and Wildlife Refuge", p. 68.

[144]Robert J. Ritchie and James G. King, "Tundra Swans," in *The Natural History of an Arctic Oil Field*, pp. 197-220.

of aircraft traffic as potential mitigation, but the development design examined in the FLEIS did not contemplate the heavy reliance on aircraft (and assumed that only 2 large permanent airfields would be built under full development) that would be essential if road mileage were substantially reduced.

Use of Resources by Non-Natives: Status and Effects[145]

The village of Kaktovik on Barter Island (see Figures 1 and 4) is the only currently occupied human settlement in the coastal plain of ANWR. Aside from Barter Island, topographic maps of the area[146] show that it also contains 5 cabins, 2 ruins, 2 landing strips, 2 towers, 1 grave site, and 6 tractor trails. Of these 18 features, all are within 5 miles of the coast, except for one trail. Some of these sites are the remains of facilities run by the Defense Department as part of the Distant Early Warning Line (DEWLine; see below). In addition, as discussed below, the remains of the drill pad and a protruding pipe mark the site of a closed exploratory well on lands of the Kaktovik Inupiat Corporation (KIC well; see *Alaska Native Lands and Rights*, below).

DEWLine and Kaktovik. Starting in the 1950s, the Defense Department constructed a system along the arctic coasts of Alaska and Canada to provide early warning of a Soviet attack.[147] Barrow served as a base for construction. Kaktovik was designated as the site of a major installation, resulting in three relocations of the village to accommodate the military facility, and concentration of the previously more scattered Inupiat seeking job opportunities. Intermediate stations along the coast in what is now the ANWR 1002 area were constructed (from west to east) at Brownlow Point on the Staines River; Camden Bay, about 30 miles west-southwest of Kaktovik; and Beaufort Lagoon, about 30 miles southeast of Kaktovik.[148] Only the station at Kaktovik remained open in 1986. USGS maps (cited above) indicate one tower, one landing strip, and both a landing strip and tower at these three sites respectively. According to a 1986 report, "[a]bandoned materials include numerous rusting steel fuel drums located primarily at Camden Bay and Beaufort Lagoon, but also scattered along the coast and inland within the boundaries of ANWR."[149]

Recreation Visits. There have never been large numbers of recreational visits to this very remote Refuge. The peak was 886 visiting the entire Refuge in 1990,

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[145]In addition, see *Use of Resources by Alaska Natives*, below.

[146]U.S. Dept. of the Interior, Geological Survey, maps for Demarcation Point, Mt. Michelson, Beechey Point, and Flaxman Island. Scale: 1:250,000.

[147]The following history is condensed from U.S. Dept. of the Interior, Fish and Wildlife Service, *Final Report Baseline Study of the Fish, Wildlife, and Their Habitats*, Vol. II (Washington, DC: December, 1986), pp. 436-437.

[148]A fifth site in ANWR, Demarcation Point, lies between the 1002 area and the Canadian border.

[149]U.S. Dept. of the Interior, Fish and Wildlife Service, *Final Report Baseline Study of the Fish, Wildlife, and Their Habitats*, Vol. II (Washington, DC: December, 1986), p. 437, citing a 1979 memo by A. S. Thayer.

when development of the 1002 area was most recently broadly debated; visitor numbers for 2001 are also high.[150] Trips, starting from Fairbanks, usually cost $2,000-$3,000, and may last 1 or 2 weeks. Usually, small groups of visitors are ferried in light planes to a river bank where they are dropped off, traveling with or without professional guides. Either way, they walk along or raft one of the many rivers flowing northward to the coast where another plane picks them up, often followed by a stop in Kaktovik before returning south to Fairbanks. In the right season, the migrating caribou are part of the attraction and, in all seasons, so is the solitude. One outfitter stated, "Where else can you spend 10 days floating a river, and not see anyone at all?"[151] In 2001, with the increase in controversy over the Refuge's coastal plain, the number of visitors has increased, but statistics are not yet available. Under current conditions, given the remoteness of the Refuge's coastal plain, the solitude seems likely to remain one of the principal attractions for visitors, while migrating caribou and other species will attract others.

Migratory Birds: Hunting and Birdwatching. As noted below, birds are used by Inupiat subsistence hunters. Beyond the immediate ANWR area, use falls into 2 additional categories: direct taking by hunters in many states of a number of species, and "use" by birdwatchers in other states. It is difficult to assess the economic impact of such uses and tie them to populations breeding or staging for migration in the 1002 area specifically, since these species breed and stage in other places as well. The tremendous number of snow geese breeding elsewhere, but staging in the 1002 area, make the Refuge especially important to hunters of this species. (A map showing annual migration routes of some birds nesting in ANWR is at http://www.r7.fws.gov/nwr/arctic/birdpost.html.)

Use of Resources by Alaska Natives

Alaska Natives are both participants in and subjects of the debate over ANWR. Alaska Natives include Eskimos (Inuit and Yupik), Aleuts, and American Indians, and make up over 15% of Alaska's population. Alaska Natives participate in the debate through many different groups and organizations. They are members of the state's 229 federally-recognized Indian[152] tribes, which are political entities; they are also citizens of the state and of their boroughs and municipalities (where organized); and they are shareholders in Native village and regional corporations, which in some villages and regions may include both non-profit and for-profit corporations. (See box: *Corporations and Boroughs*, for a discussion of their origins.)

Among and within these groups and organizations, there is disagreement over whether to open ANWR and the 1002 area to oil and gas exploration and development.

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[150]FWS statistics, cited by Sam Howe Verhovek, "Mention Drilling, and Tourists Rush to Alaska," *New York Times* (June 10, 2001), pp. 1 and 24.

[151]*Ibid.* Carol Kasza, co-owner, Arctic Treks; quoted on p. 24.

[152]The federal government generally considers the terms *Indian* and *Indian tribe* to include Alaska Natives.

One set of Alaska Native groups and organizations favors oil and gas development in the 1002 area. This set is centered around North Slope Inupiat, who are Alaskan Inuit. In northern Alaska, this pro-development set includes (1) Kaktovik, the only Native village in ANWR, and its municipal government; (2) Kaktovik Inupiat Corporation (KIC), the Native village corporation; (3) Arctic Slope Regional Corporation (ASRC), the Native regional for-profit corporation for North Slope Inupiat; and (4) the North Slope Borough government, the organized borough within which Kaktovik is located.

Another set of Alaska Native groups and organizations opposes oil and gas development in the 1002 area. This set is centered around a group of Gwich'in Indian villages. The Gwich'in (also known as Kutchin) are Athabaskan Indians and are situated in east-central Alaska and neighboring areas of northwestern Canada. The anti-development set includes (1) two Gwich'in villages, Venetie and Arctic Village, which are located in the Doyon region (an Athabaskan Indian Native region, which overlaps the southern portion of ANWR), and the two villages' tribal government, called the Native Village of Venetie Tribal Government; (2) the Gwich'in Steering Committee, composed of Venetie, Arctic Village, and 13 other Gwich'in villages of Alaska and Canada; and (3) the Native regional *non*-profit corporation for the Doyon region, the Tanana Chiefs Conference, Inc. However, the Native regional *for*-profit corporation, Doyon, Ltd., favors oil and gas development of the 1002 area.[153] Unlike Kaktovik, the Gwich'in villages are not within an organized borough.

The pro- and anti-development sets of Alaska Natives are of course not monolithic. Not all Inupiat or North Slope Borough residents support oil and gas development in ANWR or the 1002 area, and not all Gwich'in or Athabaskans oppose it. Other local, regional, statewide, and national Native and Indian groups and organizations support the position of one set or the other. The Alaska Federation of Natives (AFN), the major statewide Alaska Native organization, favors oil and gas development in ANWR and the 1002 area. Some Native critics of the AFN position claim that the organization tends to represent the position of the for-profit Native corporations, who are generally more supportive of 1002 development. The National Congress of American Indians (NCAI), a major nationwide organization representing Indian tribes, opposes oil and gas development in ANWR, but many Alaska Native entities are not NCAI members.

The disagreement between the two sets of Alaska Natives often centers on the effects of energy development on subsistence resources, especially the Porcupine caribou herd. Both Kaktovik and the two Gwich'in villages make significant use of the PCH. (See also *Biological Resources: Status and Effects: Caribou*, above.) In both Inupiat and Gwich'in cultures, the millennia of dependence on subsistence animals have created a complex set of practices and beliefs linking well-being and identity to subsistence in general and to certain animals in particular. Threats to these animals may thus be seen as threats to the very basis of Inupiat and Gwich'in cultures.

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[153]See [http://www.ANWR.org/people/akgroups.html], Nov. 1, 2001.

The disagreement is also greatly affected by ANILCA, which had several provisions that ultimately allowed KIC to acquire surface lands – and ASRC to acquire subsurface rights under these KIC lands – in the 1002 area and elsewhere on the coastal plain within ANWR. (For fuller discussions, see *Alaska National Interest Lands Conservation Act*, above, and *Alaska Native Lands and Rights*, below.) An oil or gas discovery under KIC/ASRC land would enormously increase ASRC revenues and hence the material benefits to Inupiats.

Corporations and Boroughs

The existence of Alaska Native corporations and boroughs, and their role in the Native debate, is the result of the intersection of the Alaska Native Claims Settlement Act of 1971 (ANCSA, P.L. 92-203, 85 Stat. 688, 42 Stat. 1601 *et seq*.) and Alaska state law. ANCSA was enacted to settle Alaska Natives' aboriginal land claims. The act established 12 for-profit Native regional corporations and several hundred for-profit or non-profit Native village corporations. Natives were to own shares in both regional and village corporations. The regions were to be "composed as far as practicable of Natives having a common heritage and sharing common interests" and especially were to follow the regions represented by 12 existing Native associations. (Many of these 12 Native associations became today's non-profit regional corporations. At least one – the Inupiat Community of the Arctic Slope – became a federally recognized tribe. Other regional non-profits have been established since 1971.)

Both regional and village corporations were to own *surface* lands selected under ANCSA. Only regional corporations, however, could own *subsurface* interests in regional or village lands. Seventy percent of revenues flowing to regional corporations from subsurface rights (and timber) were to be shared with other regional corporations. ANCSA also abolished all but one of the few reservations that then existed in Alaska, but village corporations on these few reservations could opt to forego regional shareholdings and instead take direct fee title to the surface and subsurface of their former reservations.

Today, many regional Native corporations have subsidiaries in the oil supplies and services industries, as well as in other industries. Successful Native corporations have been able to pass benefits on to their members in the form of employment and dividends.

Boroughs are county-like political units that originated from Alaska's state constitution and the state's Borough Acts of 1961 and 1963. These laws required that Alaska be divided into boroughs, which could be either "organized," with varying levels of powers, or "unorganized." In 1972, a year after the passage of ANCSA, the North Slope Borough was organized, with the power to levy property taxes. The North Slope Borough's subsequent tax income from oil and gas property has enabled it to carry out a borough-wide capital improvement program, constructing schools, utilities, housing, public buildings, and other facilities, and has also allowed it to provide extensive services and to become one of the largest employers on the North Slope. Since the Arctic Slope Native region nearly corresponds with the North Slope Borough, most Inupiat have benefitted from North Slope Borough activities, and the Borough has been perhaps the major conduit for oil development benefits flowing to the Inupiat. The Gwich'in, however, have had no parallel source of benefits. Much of the Doyon Native region, including the Gwich'in area, is not in an organized borough; the unorganized borough has no taxing power and gets its services and public investment chiefly from the state.

Inupiat Use of ANWR and the 1002 Area. Kaktovik, the only Native village in ANWR, depends greatly for subsistence resources directly on the 1002 area, the coastal plain in general, and other parts of ANWR, as well as on marine resources off the coast of ANWR. Residents of the Inupiat village of Nuiqsut, about 175 miles west of ANWR, also make some subsistence use of the 1002 area. Nonetheless, Kaktovik is the only Alaska Native village whose residents depend so much on subsistence resources taken on the 1002 area. The FLEIS, citing studies from the late 1970s and early 1980s, found that most Kaktovik households depended on hunting, fishing, and gathering in ANWR for food, and that caribou, Dall sheep, and bowhead whales (taken off the coast of ANWR) were their chief sources of meat, although they also hunted numerous other types of mammals, birds, and fish. Whaling has such great cultural and subsistence importance among Inupiat – especially Kaktovik, which, under special rules for subsistence, is allowed to take one to three endangered bowhead whales a year – that they oppose offshore oil and gas exploration because they fear it may endanger their whaling. Kaktovik's take of caribou was estimated in the FLEIS to be about 100 caribou a year, 50-80% from the PCH and the rest from the Central Arctic Herd (CAH) to the west. Most Kaktovik caribou harvesting occurs in summer, during the PCH postcalving time, and much of the harvest is in the 1002 area.

Some recent observers have suggested that Kaktovik has become somewhat less dependent on subsistence hunting, even though the activity is still significant. They suggest that paid employment has become so important that it restricts time for subsistence hunting.[154] Statistics from the 1990 census show that 72% of Kaktovik's adults were in the labor force.[155] Like other Arctic Slope villages, Kaktovik has benefitted from the North Slope Borough's programs, which has funded a modern high school, housing, street lighting, a community hall, a power plant, and other capital improvements.[156] Kaktovik also benefits from state government activities funded by North Slope oil development.

Many Kaktovik residents worry that a reduction in oil and gas development and production will reduce their present standard of living, and most of them favor oil

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[154]See, *e.g.*, Impact Assessment, Inc., *Subsistence Resource Harvest Patterns: Kaktovik: Final Special Report* (Anchorage, AK: U.S. Dept. of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region, 1990); and Norman A. Chance, *The Iñupiat and Arctic Alaska: An Ethnography of Development* (Fort Worth: Holt, Rinehart and Winston, 1990).

[155]Go to [http://factfinder.census.gov/servlet/BasicFactsTable?_lang=en&_vt_name=DEC_1990_STF3_DP3&_geo_id=16000US021560] for these statistics. The Census Bureau classifies persons who are either employed or unemployed but seeking work as being "in the labor force." Census respondents who list their occupation as "subsistence hunter" may be classified by the Bureau in its "hunters and trappers" occupational classification, but no persons were counted in this occupation in the Kaktovik data.

[156]Earl Lane, "Living in the Cold: Two Native Villages Differ on Oil Drilling; Both Share a Harsh Existence," *Seattle Times*, (May 21, 2001), p. A3; and David Foster, "Mixing Oil and Wilderness," *Alaska* (August 2001), pp. 30-37.

exploration and development in the 1002 area.[157] Moreover, because they are shareholders in KIC and ASRC, because they would be the closest Native village to oil development in the 1002 area, and because exploration of the 1002 area may even reveal oil in lands where ASRC owns the subsurface rights, Kaktovik residents might be expected to benefit more than any other Alaska Natives from 1002 oil and gas development. Moreover, through the actions by which ASRC acquired subsurface rights to KIC lands in ANWR (see *Alaska Native Lands and Rights*, below), ASRC was found by arbitration to be exempted from ANCSA's requirement to share subsurface revenues with other regional corporations, so dividends to ASRC shareholders, including Kaktovik, might be even greater.

Kaktovik residents and other Inupiat supporting oil and gas development in the 1002 area argue that they are as concerned about the dangers to subsistence as the opponents, but that they are experienced in caring for wildlife and the environment and believe that development can be carried out without endangering subsistence animals, including especially the PCH. Alaskan Inupiat who support ANWR leasing have in their turn opposed or remained cool to offshore leasing on the grounds that it might harm or drive off the bowhead whales on which they depend for cultural and subsistence reasons.[158] That is, both sets of Natives have opposed leasing in areas commonly used by the resources on which they depend.

Gwich'in Use of ANWR and the 1002 Area. The Gwich'in do not hunt within the 1002 area. They take caribou from the Porcupine herd in areas south of the Brooks Range, inside and outside ANWR, during the fall, winter, and spring. According to the FLEIS, Arctic Village in Alaska and Old Crow in Canada are the two Gwich'in villages most involved in caribou harvesting (recent information suggests Fort McPherson in Canada may now have a larger harvest than Old Crow[159]). Other Alaska Gwich'in villages hunting PCH caribou are Venetie, Fort Yukon, and Chalkyitsik; some of these also trade for much of their caribou meat. These Gwich'in villages harvest more caribou than does Kaktovik. Caribou is the main food source for Arctic Village, Venetie, and other Gwich'in villages. Arctic Village, according to the FLEIS, harvested 200-1,000 caribou per year in the 1970s, as did Old Crow, while the other Alaskan Gwich'in villages together took 300-400 a year and the other Canadian villages 100-2,100 a year. The Gwich'in also harvest other animals as well as fish and birds. For the Gwich'in, caribou are by far the most culturally important subsistence animal. They speak of themselves as "people of the deer," and traditionally the Gwich'in believed that people and caribou each had a bit of the other's heart in theirs.[160]

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[157]Foster, *ibid.*

[158]Yereth Rosen, "Alaska Natives sue to block Phillips oil project." Reuters (Dec. 19, 2000) at [http://www.enn.com/news/wire-stories/2000/12/12192000/reu_oil_40893.asp].

[159][http://www.taiga.net/caribou/pch/slides/pch6.html].

[160]Richard Slobodin, "Kutchin," in *Handbook of North American Indians, Vol. 6, Subarctic*, June Helm, vol. ed.; William C. Sturtevant, genl. ed. (Washington: Smithsonian Institution, 1981), pp. 514-532.

Arctic Village and Venetie have benefitted from Alaska's oil and gas development, but to a much lesser extent than Kaktovik. Arctic Village and Venetie elected, under ANCSA, to forego regional corporation shareholdings and take private fee title to their 1.8-million-acre reservation. After 1971, the reservation was first held in joint ownership by the two villages' village corporations, but in 1979 the corporations transferred title to the villages' tribal government, the Native Village of Venetie Tribal Government (the land was not, however, restored thereby to the status of an Indian reservation). Hence, because they had no shareholdings in Doyon, Ltd., the regional for-profit corporation, Arctic Village and Venetie residents have not shared in any dividends flowing to Doyon shareholders. Moreover, the Alaskan Gwich'in villages are not in an organized borough, so their benefits from North Slope development have come chiefly through state government activities. Their community facilities are less prosperous and extensive than those of North Slope Borough villages.[161] Paid employment in Arctic Village and Venetie is not as widespread as it is in Kaktovik. Census statistics for 1990 show that 54% of Arctic Village's adults and 48% of Venetie's adults were in the labor force.[162]

The Gwich'in argue that oil and gas development in the 1002 area will endanger the PCH by threatening the herd's calving areas, and that because of their dependence on the PCH they will suffer subsistence loss and harm to their culture. When critics from the pro-development set of Alaska Natives argue that Arctic Village and Venetie in the 1980s sold oil development leases (ultimately unsuccessful) on their lands, and that the villages seemed unconcerned about endangering the PCH then, the Gwich'in respond that the lease areas were not calving or postcalving areas and thus were not as sensitive for the herd's survival.

Alaska Native Lands and Rights. Alaska Natives have various property interests related to the issue of oil drilling in ANWR that may present complex legal issues for refuge management if the coastal plain is opened to oil development.[163] In 1971, Congress enacted ANCSA to resolve all Native aboriginal land claims against the United States. ANCSA provided for monetary payments and also created village corporations that received the surface estate to approximately 22 million acres of lands. Village selection rights included the right to choose the surface estate in a certain amount of lands within the National Wildlife Refuge System, in which case, under §22(g) of ANCSA, the lands were to remain subject to the laws and regulations

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[161]Lane, "Living in the Cold," *op. cit.*

[162]For these census statistics, go to [http://factfinder.census.gov/servlet/BasicFactsTable?_lang=en&_vt_name=DEC_1990_STF3_DP3&_geo_id=16000US020200] for Arctic Village and [http://factfinder.census.gov/servlet/BasicFactsTable?_lang=en&_vt_name=DEC_1990_STF3_DP3&_geo_id=16000US023480] for Venetie. As was the case with Kaktovik, no persons were counted in the "hunters and trappers" occupation in the Arctic Village and Venetie data.

[163]See CRS Report RL31115, *Legal Issues Related to Proposed Drilling for Oil and Gas in the Arctic National Wildlife Refuge*.

governing use and development of the Refuge.[164] KIC received rights to three townships[165] along the coast of ANWR.

ANCSA also created regional corporations which could select subsurface rights to some lands and full title to others. Subsurface rights in National Wildlife Refuges were not available, but in-lieu selections to substitute for such lands were provided.

Section 1431 of ANILCA (1980) followed up on the previously enacted ANCSA and gave KIC rights to make certain selections and to enter into certain exchanges. ANILCA (§1002(b)) also defined the 1002 area by reference to a map dated August 1980, which has been interpreted as excluding the KIC lands. As a result, Kaktovik has its previous surface rights to three townships along the coast that are outside the 1002 area and one township inside that area. *Geographically*, the KIC lands are all on the coastal plain and are indistinguishable from surrounding lands in their importance to wildlife. However, *all* of the Kaktovik lands are within the Refuge as a whole and hence are subject to the restrictions on oil and gas development of §1003 of ANILCA and, under §22(g) of ANCSA and §1431(g) of ANILCA, they are subject to the laws and regulations governing the Refuge.

Section 1431(o) of ANILCA also authorized the Arctic Slope Regional Corporation (ASRC), whose shareholders are Inupiat, to obtain rights in the Refuge through exchanges, if lands in the National Petroleum Reserve-Alaska (NPR-A) or ANWR within a certain proximity to village lands were ever opened for commercial oil and gas development within 40 years of the date of ANILCA. However, under a different ANILCA exchange authority (§1302(h)), an exchange was executed on August 9, 1983, between then Secretary of the Interior James Watt and ASRC. Under this "Chandler Lake Agreement" the United States received certain ASRC lands in the Gates of the Arctic National Park and ASRC received the subsurface rights to the KIC lands – which, it will be recalled, are three townships within the Refuge on the coastal plain but outside the 1002 area, and one township within the 1002 area. Congress appears to have ratified the Agreement in later legislation (P.L. 98-366, §5; 98 Stat. 468, 470-471).

Also as part of the Chandler Lake Agreement, ASRC was given the contractual right to drill up to three exploratory wells on the KIC lands that are outside the 1002 area within a certain window of time. One test well was drilled, but the results of that well have been kept confidential.

In addition to the KIC and ASRC Native lands, there are also some individual Native "allotments" within the coastal plain. These typically are surface rights belonging to a particular individual. The conveyance of some lands has been completed; other lands have been applied for, but final rulings have not been made. BLM currently is compiling the exact locations and acreage of these allotments, but preliminary data indicate that these allotments and applications appear to be clustered along the coast and near Sadlerochit Spring, both of which are important wildlife areas. (See *Special Areas*, below.) Allotments already conveyed total over 10,000

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[164]See 50 C.F.R. Parts 25 and 26.

[165]A *township* is about 36 square miles - roughly 23,000 acres.

acres. Use of allotments appears not to be subject to §22(g) ANCSA controls, nor to other restrictions or regulations unless Congress enacts same.

The 1983 Agreement and its appendices address oil exploration and development on the KIC/ASRC lands and their terms will govern the development and oil production on those lands unless they are superseded by statutory provisions. Appendix 2, part 9 of the 1983 Agreement states that development and production activities undertaken on ASRC lands "shall be in accordance with the substantive statutory and regulatory requirements governing oil and gas exploration, including exploratory drilling, and development and production that are designed to protect the wildlife, its habitat, and the environment of the coastal plain, or the ASRC Lands, or both." Other provisions in the Agreement purport to survive subsequent legislation (which is to say they likely would unless Congress acts to expressly negate them), and would affect the applicability of any environmental controls Congress might otherwise enact. If Congress repeals the current prohibition against oil development in the Refuge, development could occur on the more than 100,000 acres of Native lands that are comprised of KIC/ASRC lands and individual Native allotments.

Canadian Interests in Traditional Native Rights. The Canadian government has consistently opposed development in the 1002 area, citing risks to the PCH and consequently to the Gwich'in people found on both sides of the international border.[166] It also points to a 1987 U.S.-Canada "Agreement on the Conservation of the Porcupine Caribou Herd" under which each nation agreed to protect the PCH and its habitat. If one country plans to carry out an activity that may result in significant long term adverse impacts on the PCH, the other is to be notified, and given the opportunity to consult before any final decision. Canada cites evidence of its commitment to the herd in its creation of Ivvavik and Vuntuk National Parks on the Canadian side, which prevent development in important calving and migration areas on its side of the border. The embassy website notes: "... the 1002 Area of ANWR contains the core of the critically important calving area for the Porcupine Caribou Herd, and Canada is convinced that only permanent protection of the plain will assure the herd's long-term sustainability."[167]

Development proponents often claim that the Canadian position borders on hypocrisy, since a significant portion of the PCH range in Canada was leased for oil and gas development in decades past. But commercial quantities of hydrocarbons were not found, and leases have been allowed to lapse. Thus, this argument goes, Canadian opposition arose only after it became clear that commercial quantities of oil were not found in the PCH range in Canada. In response, Canadians (and Gwich'in on both sides of the border) argue that the portion of the calving area on the

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[166]Canada could also be affected by a proposed natural gas pipeline route from the North Slope (whether the gas was from the 1002 area or not). Two of the three main options for the route would pass through Canada before reaching U.S. markets. Canada has generally supported a gas pipeline through its territory. (See Figure 6 and *Natural Gas Pipeline from North Slope*, above.)

[167]From Statement by Canadian Environment Minister David Anderson on Arctic National Wildlife Refuge on August 3, 2001; cited on [http://www.ec.gc.ca/Press/2001/010803_s_e.htm].

U.S. side is the most frequently used, and that at the time the Canadian leases were offered, the importance of the proposed leasing areas to caribou was unclear. Indeed, some Canadian industry officials now complain of government hostility to development in the northern areas of the country, based on what they perceive as overzealous environmental concerns.

Reclamation Issues After Development

If the 1002 area were opened to exploration, and if energy development did occur, then even under the most stringent requirements for environmental protection, a major question would remain: what should be done after the oil and/or natural gas are depleted? The FLEIS seemed to be of two minds. It speaks of "rehabilitation"[168] and says that effects on wildlife could be "very long-term [but] would not be considered irreversible once the life of the producing fields in the 1002 area was over."[169] Yet it also speaks of "the long-term commitment of this area to industrial use based on oil and gas development"[170] and of "long-term changes in the wilderness environment, wildlife habitats, and native community activities currently existing, resulting instead in an area governed by industrial activities."[171] And it notes that "complete restoration [of disturbed sites] may not be possible, inasmuch as construction activities dramatically alter surface features which determine plant species composition in the natural habitat."[172] These comments raise the question as to whether the 1002 area, upon initiation of development, remains an integral part of a wildlife refuge with a temporary (albeit long) interlude of industrial activity, or an area whose fundamental purpose has changed, but continues to lie within the boundaries of a national wildlife refuge.

Whatever development might be permitted, should it be seen as essentially *temporary* – serving immediate energy needs and then being removed, followed by restoring the 1002 area habitat to a condition as near as possible to its pre-development state? The answers to questions about rehabilitation of the 1002 area, and the confidence in the response, will crucially affect not only any development of the area, but also will likely affect views on whether the 1002 area should be opened to exploration and production in the first place.

Conditions for Rehabilitation. Total rehabilitation after development could be defined as restoration to a state which a trained ecologist could not distinguish from the original ecosystem. So defined, total rehabilitation of the 1002 area might require centuries and could be impossible, since it might be confounded by other long-term changes: global warming, changes in sea level, expansion or contraction of the polar ice cap, changes in the northern polar hole in the ozone layer or in CO_2 levels, etc. On the other hand, if "substantial" rehabilitation were defined as

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[168]For example, pp. 86, 114, 116, and 139.

[169]FLEIS, p, 164.

[170]FLEIS, p. 165.

[171]FLEIS, p. 165.

[172]FLEIS, p. 116.

restoration of the area to a state approximating the original, with a full complement of pre-development species (if not all at pre-development population levels), so that at least untrained observers could not easily or frequently detect human influences, then such a level might be an achievable but very difficult goal. Such a goal would probably require not merely the removal of structures and equipment and stringent pollution control, including the safe disposal of hazardous and other wastes, but also the return to pre-development human population levels, the removal of gravel roads, and the restoration of native vegetation.

As yet no major operating oil fields anywhere are known to have been shut down permanently, and many have kept producing long beyond initial expectations, due to enhanced recovery techniques. Thus there is little relevant experience to guide a total closure of potential 1002 area development. Interestingly, in 1988 ARCO Alaska said with respect to Prudhoe Bay that "Large scale rehabilitation/restoration is neither currently practical nor required by Federal or State regulations."[173] Thus, rehabilitation and restoration could be an important feature in congressional debate concerning the 1002 area.

Human Population Levels. In an oil field, human population levels reach a peak during the construction phase, once a producible field has been confirmed. In 1987, the FLEIS estimated 1,500 workers at the peak of construction.[174] After major construction projects are completed, personnel levels drop to those needed for operations – perhaps a few hundred workers – or for smaller construction projects such as the addition of new drill pads.

Once energy production ceases, it is hard to imagine what incentives would hold workers in the 1002 area, since few other industries seem likely to seek the high cost of North Slope operations. An important exception would be Alaska Natives, presumably those in Kaktovik especially. With an increasing reliance on a monetary economy, both for personal and local government income, there may be pressure to maintain development to support (possibly subsidized) alternative local industries, including tourism. The North Slope Borough has stated that its support for 1002 development stems partly from a concern over declining Prudhoe Bay revenues, which are used for schools, fire stations, and other facilities. Over the years, little debate has focused on the post-development status of permanent human populations – a reflection, in part, of a lack of debate on the long-term fate of the 1002 area in general.

Removal of Roads and Gravel Structures. There is a striking distinction between the access policies around development areas in the North Slope versus those in the 1002 area as it is currently managed. In the former, a road network provides relatively easy transportation, but its use is largely restricted to authorized

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[173]ARCO Alaska, Inc. *NRDC/Trustees for Alaska/National Wildlife Federation Report "Oil in the Arctic: The Environmental Record of Oil Development on Alaska's North Slope" – Comments and Critique*. 1988. p. 21.

[174]FLEIS, p. 85. Considerable advances in technology have occurred since then, so this number should probably be considered a maximum; no newer local employment figures are known.

persons. In the latter, the lack of roads requires aircraft for most travel, but the journey is relatively unrestricted. If Congress decides to authorize 1002 area development, the fate of roads could have far-reaching environmental effects.[175]

Under the scenario for development based on current technologies, fewer roads would be built than with older technology. However, if oil prices fall, or operating costs rise, the cost of reliance on expensive aircraft might make construction of haul roads seem attractive, especially for movement of heavy equipment. In addition, it is unclear whether any restrictions on road construction would apply to Native lands, and still less whether requirements for road removal would apply on Native lands. In any event, under all current scenarios, it is likely that at least some roads would be built. If these are in unconnected small segments, as at Alpine, their effects on human access would probably be quite small. Experience in national parks, national forests, and national wildlife refuges has shown that reducing human access can benefit sensitive species, in such matters as preventing illegal hunting, or reducing disturbance of nesting sites, calving areas, or spawning streams.

Removing millions of tons of gravel from roads (and pads) – some of it contaminated with oil or other toxins – would be expensive, but so would continued gravel maintenance to preserve culverts and other flow control measures. Costs would likely prevent either the total removal of roads once production ceased, or the indefinite maintenance of the full network. Unless otherwise specified or required, rehabilitation of gravel structures would likely include removal of culverts and bridges to ensure natural drainage, grading and scoring of the road or pad surfaces, and seeding of grasses and forbs. Care would be required to minimize erosion, sedimentation, and ponding. Probably, only if there were a need for gravel elsewhere would some portion of the gravel be removed from abandoned roadbeds.

Thus, if leasing is allowed and production is achieved, there appear to be several options, depending on the gravel structure and congressional policy. First, some may wish to see certain useful structures retained even if all production ceases. Examples of such structures are water treatment plants and some airfields. Others, such as drill pads, seem unlikely to be useful in a post-production setting, and would likely be priority candidates for removal. Finally, for roads, there appear to be two basic options: maintain some roads while rehabilitating rights of way for the rest; or abandon all of the roads and rehabilitate the rights of way in an effort to return to pre-development conditions. If development were to result in increased tourism (*e.g.*, visitor centers or visitor cabins), there might be considerable pressure to keep at least some roads open, especially if tourism were seen as a continuing source of income for Natives after development ceased. Continuing access could be expected to prolong habitat disturbance and delay rehabilitation.

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[175]Under ANILCA (Title XI), an applicant for a permanent structure affixed to the ground (e.g., a gravel road or pad) has to apply for a right of way to cross federal land. The re-use of the structure after development would have to be compatible with the purposes of the refuge. If Congress authorizes development, it could choose a different procedure, more or less strict than the standard process, for applicants in the 1002 area.

Restoration of Native Vegetation. Once production ceased, restoration of the correct species and adequate numbers of native plants would be a key factor in restoration of animal populations. There is a key distinction between the 1002 area and the developed areas to the west: the rolling hills of much of the 1002 area support more shrubby, woody vegetation, while the wetlands of the developed areas are dominated by herbaceous vegetation. Thus, restoration experience around Prudhoe Bay and environs may provide useful techniques for only part of the 1002 area. Moreover, recent research has shown that "none but the smallest and wettest patches on level ground ... recovered unassisted to something approaching their original state in the medium term (20-75 years)."[176] In larger, drier, or more sloping sites, revegetation (where it occurred) often resulted in a species composition that differed from the original state. "A wide range of small disturbances resulted in alternative vegetation states with reduced species diversity."[177] If roads and other gravel structures were not removed, revegetation on these structures would be particularly difficult, due to drying, loss of seeds, and erosion. On the other hand, revegetation at the edges of the pads would be less difficult, due to wetter conditions and protection from wind.

Site Phase-Out. The requirement to remove all facilities and to rehabilitate the site is generally a term or condition of a lease sale. Thus far, there is relatively limited experience in the arctic from which to judge the effectiveness of this requirement. North Slope fields that have been developed are still active and only a relatively small number of drilling sites have been abandoned. These abandoned sites include a few artificial drilling islands in the Beaufort Sea and a number of onshore sites, several of which are in the NPR-A. At the abandoned island sites, facilities and slope protection have been removed and the artificial islands were left to erode away. The NPR-A example is particularly relevant to ANWR development.

Site Cleanup in the NPR-A. Before the recent return to NPR-A prospects, there were two rounds of drilling in the NPR-A. The most recent was between 1974 and 1981, when 28 wells were drilled in a federal program under the supervision of USGS. In that round, each exploratory site included a drill pad, airstrip, and source of water supply. Buildings and equipment were located on the drilling pad, often on pilings to prevent thawing of the permafrost. The pad design included a fuel storage pit, a reserve pit for drilling fluids and cuttings, and a flare pit.

Cleanup included removing miscellaneous debris, cutting off pilings below ground level, and filling the pits by grading off and contouring the gravel pads. Then revegetation of the sites was attempted using grass seed mixtures and fertilizer. The program for revegetating the pads met with mixed success. Generally, the least success was found at some coastal sites where pads were constructed of relatively brine-rich clay silts excavated from the reserve pits. Considering the somewhat experimental nature of the revegetation program and the variability of individual

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[176]Bruce C. Forbes, James J. Ebersole, and Beate Strandberg, "Anthropogenic Disturbance and Patch Dynamics in Circumpolar Arctic Ecosystems", *Conservation Biology*, Vol. 15 (August, 2001), p. 966. (Hereafter referred to as "Forbes, *et al*.")

[177]Forbes, *et al*., p. 966.

sites, revegetation was thought to progress at reasonable to excellent rates by 1986.[178] In the interim, pad construction techniques elsewhere on the North Slope have evolved, and exploration pads such as those in the USGS program at NPR-A would be built of ice.

However, as with roads, the return of vegetation is not identical to recovery of the tundra to its previous condition. Even if organic matter is left intact after a disturbance, "significant and essentially permanent change [in] both vegetation and soils" may still occur.[179] Nonetheless, a manager may be satisfied if a site simply returns to a plant-covered, stable surface.[180]

Site Development and Facility Removal. Facility removal really begins as soon as drilling a well is finished. At that point, the drill rig is removed, leaving only pipe valves and gages for each well and any operational facilities on the pad. When a field is depleted or a well is abandoned, the well is plugged with cement plugs at various points and at the surface. Surface facilities are removed, and the pad would be graded and revegetated. The FLEIS full development scenario estimated that 5,650 acres scattered around the 1.5 million acre 1002 area would be physically covered with gravel (less than 0.4%). As noted previously (see *Land and Gravel Use*, above), somewhat less would probably be covered with the use of modern technologies, though these features would still be scattered in various spots around the 1002 area. Until the affected areas were restored and revegetated, the impacts would remain visible (at least as long as they were not concealed by snow and darkness). As different requirements for rehabilitation might apply to Native lands, their inholdings might retain various structures or pads might remain for a considerably longer period.

Retention of Facilities: the Other Option. The alternative to removing all drilling pads, roads, buildings, airstrips, and other facilities would be a judgment that some of the development may be of longer term and/or broader benefit than the oil and gas development in the immediate area. In remote regions of a hostile environment, emergency shelters can be life-savers. A building or other recognizable structure, such as a road or airstrip, in a featureless region can serve as a visual aid to navigation, which can also save lives. In addition, if it were necessary to re-develop a location, it would likely be less disruptive to the environment to reopen a closed facility than to construct a new one. In any event, carrying out the actual restoration requirements in ANWR would probably not arise for many years; thus a tension might exist between those preferring that a goal of restoration be made a condition of development and those preferring that the decisions on some facilities be considered on a case-by-case basis later. In the later case, it could be difficult to

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[178]Phillip D. J. Smith, "Final Wellsite Cleanup on National Petroleum Reserve – Alaska." U.S. Geological Survey Contract no. 14-08-001-21787. Anchorage Alaska: Nuera Reclamation Company, 1986. Vol. 1, p. 43.

[179]Forbes, *et al.*, p. 965.

[180]"[I]f a manager simply wants a green, stable surface, then a measure of vascular cover – usually provided by graminoids [grass-like plants] – may be all that is feasible under the most severe conditions." Forbes, *et al*., p. 960, citing 1999 work by Forbes and Jeffries.

enforce a cleanup measure that was not originally specified as regulation, or a term or condition of the lease.

Legislative Issues

The ANWR debate has continued for such a long time that most issues have a long history of debate. Some of the issues that have been raised most frequently are described briefly below. (For specific legislative provisions of current bills, see CRS Issue Brief IB10111.)

Alternatives to Developing 1002 Area

Opponents of energy development in ANWR argue that a variety of other options could provide the energy equivalent of most projections of ANWR oil production, especially if one assumes the high energy prices necessary to reach the most generous assumptions regarding Refuge resources. More succinctly, the high energy prices that would make Refuge oil economic would make a variety of other energy options attractive as well. Recognizing the great importance of oil in the transportation market, opponents most frequently mention increases in fuel economy for cars and light trucks, and production of ethanol from cellulose.[181] Increases in efficiency in other sectors (heating and cooling especially) are also mentioned. Others have argued that developing ANWR oil, thereby continuing a national reliance on TAPS, is harmful to U.S. energy security, especially with respect to terrorist attacks. One author called TAPS "among the gravest threats to U.S. energy security," due to the vulnerability of the pipeline, lack of alternatives if it were seriously damaged, and the difficulty of repairing the aging pipeline.[182] Addition of any ANWR oil would continue that risk, in this line of reasoning.

Consequently, for not only environmental, but also economic and security reasons, opponents of ANWR oil development believe that other options (especially in the transportation sector) are preferable to development of the Refuge. Proponents downplay the economic rationale and practicality of the alternatives, but have only recently begun to focus on continued reliance on TAPS as a security argument.

Exploration Only

Some have argued that the 1002 area should be opened to exploration first, before a decision is made on whether to proceed to leasing. Those with this view hold that with greater certainty about the presence or absence of energy resources, a better decision could be made about whether to open the coastal plain for full leasing. This idea has had relatively little support over the years. For those opposed to energy development, the reasons are fairly clear: if there were economic discoveries, support for further development might be unstoppable. And even if exploration resulted in

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[181]For an analysis of energy alternatives, see CRS Report RL31033. *Energy Efficiency and Renewable Energy Fuel Equivalents to Potential Oil Production from the Arctic National Wildlife Refuge (ANWR)*, by (name redacted).

[182]Amory B Lovins and L. Hunter Lovins, "Frozen Assets? Alaskan Oil's Threat to National Energy Security", RMI Solutions, Spring, 2001. [http://www.rmi.org/sitepages/art1051.php].

no or insufficient economic discoveries, any damage from exploration (*e.g.*, soil compaction, erosion, or altered drainage patterns) would remain.

Those who support leasing see unacceptable risks in such a proposal. First, who would be charged with carrying out exploration, who would pay for it, and to whom would the results be available? Second, if no economic discoveries were made, would that be because the "best" places (in the eyes of whatever observer) were not examined? Third, might any small discoveries become economic in the future? Fourth, if discoveries did occur, could industry still be foreclosed from developing the area, or might sparse but promising data elevate bidding competition to unreasonable levels? Fifth, if exploration were authorized, what provisions should pertain to Alaska Native lands? In short, various advocates see insufficient gain from such a proposal. In the 108th Congress, no bill supporting exploration only has been introduced.

Compatibility with Refuge Purposes

As a general rule, activities may be allowed in federal wildlife refuges if they are compatible with the *major* purposes of the National Wildlife Refuge System and with the purposes of any particular unit of that System.[183] Long-term uses of a refuge may be allowed if compatible with all of the purposes of the particular refuge and the System.[184] The mineral leasing laws apply to lands within the System to the same extent they applied prior to October 15, 1966 (the date of the first general refuge management statute), unless lands are subsequently withdrawn.[185]

A new compatibility policy and new regulations were published on October 18, 2000, effective November 17, 2000.[186] "Compatible use" is defined as "a proposed or existing wildlife-dependent recreational use or any other use of a national wildlife refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purpose(s) of the national wildlife refuge." Lands within Alaska refuges are subject to the regulations on compatibility.

More specifically as to mineral leasing, Public Land Order 2214, which withdrew lands to create the original Range, withdrew the lands from operation of the mining laws, but not the mineral leasing laws. Congress, of course, in §1003 of ANILCA reserved to itself the decision of whether to lease the coastal plain area. Any legislation that ultimately permitted oil and gas leasing in that area would answer the question of compatibility by authorizing leasing, and probably would expressly address the compatibility of that leasing, and might set limits on such activities.

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[183]16 U.S.C. 668dd(d)(1)(A) (emphasis added).

[184]16 U.S.C. 668dd(d)(1)(B).

[185]16 U.S.C. 668dd(c).

[186]65 Federal Register 62484 and 65 Federal Register 62458, respectively. See 50 C.F.R. §§25 and 26 for compatibility materials.

Compliance with NEPA

Some question whether the existing FLEIS, prepared in 1987 in compliance with the National Environmental Policy Act (NEPA), is adequate to support development, or whether an updated or new EIS needs to be prepared. A court in a declaratory judgment action in 1991[187] held that the Department of the Interior should have prepared a Supplemental Environmental Impact Statement (SEIS) at that time to encompass new information about the 1002 area in connection with the Department's recommendation that Congress legislate to permit development. Therefore, it is likely that either an SEIS or a new EIS would have to be prepared before development, unless Congress changed or waived this requirement.

Environmental Direction

Congress could choose to leave environmental matters to administrative agencies under existing laws. Alternatively, Congress could impose a higher standard of environmental protection because the area is in a national wildlife refuge or because of the fragility of the arctic environment, or it could legislate a lower standard to facilitate development. One issue would be the use of gravel and water resources essential for oil exploration and development. Other potential legislative issues include extent and regulation of gravel structures, gravel mines, or other development; limitations on miles of roads or other surface occupancy; the adequacy of existing air and water pollution standards; research needs; monitoring; prevention and treatment of spills; the adequacy of current waste disposal requirements; prohibitions on landfills; aircraft overflights; reclamation; and concerns over shared liability that can make consolidation of facilities unattractive to oil companies.

Of the various bills introduced over the years, few had provisions that mandated specific technologies. Rather, the focus was on requirements to use "best available" or "best practicable" technologies or similar phrases. In recent debates on the issue, limitations on surface occupancy have been also considered. These limitations are generally focused on those features covered by gravel structures (*e.g.*, drill pads, runways, and connector roads). Debates over surface occupancy have tended to omit features that require no laying of gravel or could be built offshore, *e.g.*, gravel mines, pipelines (as opposed to pipeline pier supports), culverts, altered drainage patterns, water treatment plants, ports, causeways, and the like.

Special Areas

Congress could decide to set aside certain special areas for their ecological or cultural values. This could be done either by designating the areas specifically, in legislation, or by authorizing the Interior Secretary to set aside areas to be selected after enactment. A few bills have named specific areas (especially Sadlerochit Spring) within the 1002 area for set-asides. A number of bills in the past have chosen the latter course, with a cap of around 45,000 acres in which surface occupancy (a term not usually defined) could be limited. Depending on the meaning of "surface occupancy," such areas might be open to seismic exploration (which

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[187]NRDC v. Lujan, 768 F. Supp. 870 (D.D.C. 1991)

requires no roads of any type) or to (temporary) ice roads. Such areas could also still be accessible for leasing, if developed from drill pads outside these areas. The four special areas named in the FLEIS together total more than 52,000 acres, so some choices would be necessary if the set-aside acreage available to the Secretary were too low to accommodate the identified areas.

Expedited Judicial Review

Leasing proponents urge that any ANWR leasing program be put in place promptly; expediting judicial review may be one means to that goal. Judicial review can be expedited through procedural changes such as time limits within which suits must be filed, or by avoiding some level of review. The scope of the review also could be curtailed, or the burden imposed on a challenger could be increased. Bills before Congress have combined all of these elements.

Project Labor Agreements

A continuing issue in federal and federally-funded projects is whether project owners or contractors effectively should be required, by "agreement," to use union workers. In the past 10 years, President George Bush, President Bill Clinton, and President George W. Bush have issued executive orders pertaining to the question, with President Clinton favoring their use and Presidents Bush opposing their use. Members of Congress have become involved when they objected to a presidential action. In the 108th Congress, the issue has come up in the context of proposed oil and gas development of ANWR.

Project labor agreements (PLAs) are agreements between a project owner or main contractor and the union(s) representing the craft workers for a particular project. PLAs establish the terms and conditions of work that will apply for the particular project. The agreement may also specify a source (such as a union hiring hall) to supply the craft workers for the project. Typically, the agreement is binding on all contractors and subcontractors working on the project, and specifies wage rates and benefits, discusses procedures for resolving labor and jurisdictional disputes, and includes a no-strike clause.

Proponents of PLAs argue that they ensure a reliable, efficient labor source and help keep costs down. Opponents contend that PLAs inflate project costs and decrease competition. There is little independent information and data to sort out these conflicting assertions and demonstrate whether PLAs contribute to lower or higher project costs. Construction and other unions and their supporters strongly favor PLAs because they believe that PLAs help ensure access for union members to federal and federally funded projects. Nonunion firms and their supporters believe that PLAs unfairly restrict their access to federal and federally-funded projects.[188]

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[188]For discussion of PLAs, see CRS Report 98-965 E, *Project Labor Agreements in Federal Construction Contracts: An Overview and Analysis of Issues*, by (name redacted) (Aug. 24, 1999). 8 p.

Revenue Disposition

A recurring issue in the ANWR debate is that of disposition of possible revenues, not only from oil but also from sale of gravel or water resources. There are two parts to the disposition question: (a) how would revenues be split between the federal government and the state; and (b) how would the federal portion be used?

Federal/State Split. The Mineral Leasing Act (MLA)[189] governs the leasing of oil and gas and certain other minerals from federal public lands. Under §35 of the MLA, certain western states receive directly 50% of revenues received. An additional 40% goes to those states indirectly through the construction and maintenance of irrigation projects under the Reclamation Act of 1902.[190] Before 1976, these percentages were 37½% and 52½% respectively. Because the territory of Alaska did not benefit from the Reclamation Act, it received only a 37½% share of federal leasing revenues. Before enactment of the Alaska Statehood Act, Congress amended the MLA to provide that the territory would receive an additional 52½% share, thereby putting Alaska on the same footing as the other states.[191] Section 28(b) of the Alaska Statehood Act again amended the MLA to change the references from territory to State of Alaska.[192] Section 317 of the Federal Land Policy Management Act of 1976 amended the revenues section of MLA to direct payment of 90% to Alaska, rather than the separate percentages previously stated.[193] The committee report accompanying the 1976 change states that the action was intended to clarify that Alaska was to continue to receive 90% of the mineral revenues taken in from federal lands in Alaska.[194]

Alaska has asserted that the 90% total referenced in the Statehood Act cannot be changed and must always be paid to the state because the Statehood Act is a compact between the prospective state and the federal government. Others assert that the Statehood Act provision was a technical one, meant to recognize that Alaska should receive a share comparable to that of other states *under the MLA*, but does not preclude the Congress from changing the MLA or at times making special provision for leasing certain areas under a different regimen.

Alaska sued in the U.S. Court of Federal Claims, asserting that because the United States had an obligation under the Statehood Act both to maximize mineral leasing in Alaska and to always pay a 90% share of gross receipts to Alaska, the

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[189]Act of February 25, 1920, ch. 85, 41 Stat. 450, 30 U.S.C. 191.

[190]This money is available only if Congress subsequently appropriates it from the Reclamation Fund – it is not permanently appropriated.

[191]P.L. 85-88, 71 Stat. 282 (1957). The 37½% was to be spent for the construction and maintenance of public roads or for the support of public schools or other public educational institutions as the legislature of the territory may direct. The 57½% was to be paid to the territory to be disposed of as the legislature directed in general.

[192]P.L. 85-508, 71 Stat. 339, 351.

[193]P.L. 94-579, 90 Stat. 2743, 2770-2771.

[194]H.Rept. 94-1724, p.62 (1976).

United States had either breached the contract established by the Statehood Act, or "taken" property of Alaska by withdrawing some lands in Alaska from leasing (notably ANWR) and by deducting administrative costs prior to the disbursement of the 90% revenues to the State. The court found that the Statehood Act and the previous statute providing the territory of Alaska with the same shares as the other states "simply plugged [Alaska] into the MLA, along with the other States."[195] Therefore, Congress could amend the MLA, *e.g.*, to provide a different way of calculating receipts, and the changes would lawfully pertain to Alaska. Furthermore, the court concluded that the United States did not promise in the Statehood Act to make federal mineral lands produce royalty revenues for the State, and that the United States therefore retained discretion over leasing decisions.[196] Because of these findings, the court also granted the government's motion for summary judgment on the takings claim, dismissing Alaska's claim.

If the Statehood Act simply means that Alaska will be treated like other states under the MLA, the question may be asked whether Congress may legislate specially as to ANWR and prescribe different revenue-sharing provisions. Congress has done so in the past, *e.g.*, with respect to the National Petroleum Reserves, in which situation all of the revenues go into the federal Treasury,[197] except for the National Petroleum Reserve in Alaska, in which instance the revenue sharing is 50/50.[198] Therefore, arguably Congress has flexibility in legislating regarding oil and gas leasing in the Refuge, including providing for the disposition of revenues from any such leasing.

Uses for Federal Share of Revenues. Proponents of opening ANWR for oil production point out that the federal share of any revenues could be made available for various conservation purposes, including ameliorating impacts, providing funds for research on renewable energy sources, or assisting other refuges and conservation areas. While additional funding for these purposes would undoubtedly cheer many environmental groups, it is difficult to name any such group whose views on ANWR development have been swayed by such proposals.

Wilderness Designation

In each Congress since 1980, bills have been introduced in both House and Senate statutorily to designate the coastal plain of the Refuge as wilderness. Energy development is not permitted in wilderness areas, unless there are pre-existing rights or unless Congress specifically allows it or later reverses the designation. Development of the surface and subsurface holdings of Native corporations would be precluded inside wilderness boundaries (although compensation might be owed). This choice would preserve existing recreational opportunities and jobs, as well as the existing level of protection of subsistence resources, including the Porcupine

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[195] Alaska v. United States, 35 Fed. Cl. 685, 701 (1996).

[196] *Ibid.*, at 706.

[197] 10 U.S.C. 7433.

[198] P.L. 96-514, 94 Stat. 2964.

Caribou Herd, while of course foregoing any energy resources that might be available.

No Action Alternative

Because current law prohibits development unless Congress acts, this option also prevents energy development. Those supporting delay often argue that not enough is known about either the probability of discoveries or about the environmental impact if development is permitted. Others argue that oil deposits should be saved for an unspecified "right time."

Glossary

Key Features, Terms, Acronyms, and Abbreviations

1002 area –
A portion of the coastal plain of ANWR north of the Brooks Range along the Beaufort Sea. Section 1002 of ANILCA defined the area with respect to a "map dated August 1980" but the area was later defined by a published description.

1002 report –
See *FLEIS*.

ADEC –
Alaska Department of Environmental Conservation; regulates nonhazardous and RCRA-exempt solid wastes and underground injection wells.

ADF&G –
Alaska Department of Fish and Game.

ADNR –
Alaska Department of Natural Resources.

AFN –
Alaska Federation of Natives; the major statewide Alaska Native organization.

Alaska Natives –
Eskimos (Inuit and Yupik), Aleuts, and American Indians in Alaska, who together make up over 15% of Alaska's population. Included by the federal government in the terms *Indians* and *Indian tribe*.

Alpine Corporation Oil Field –
A 40,000 acre oil field originally owned by ARCO Alaska, Inc., and now owned by Phillips Petroleum Co. Originally permitted at 98 acres for development, its current footprint is slightly smaller. It is situated west of the Kuparuk Oil Field, and is accessible only by aircraft or winter ice road. Oil development facilities here are considered state-of-the-art arctic (energy) technology.

ANCSA –
Alaska Native Claims Settlement Act of 1971 (P.L. 92-203). Provides for selection and conveyance of property title and monetary award to Alaska Natives in settlement of their aboriginal claims; authorizes establishment of native regional and village corporations; also contains various provisions regarding federal land management in Alaska.

ANGTS –
Alaska Natural Gas Transportation System (surface pipeline).

Angun Plains –
One of several "special areas" in ANWR defined in the FLEIS, where evidence of Pleistocene glaciation is considered special. It comprises about 36 square miles.

ANILCA –
Alaska National Interest Lands Conservation Act of 1980 (P.L. 96-487): Among other things, it expanded the boundaries of ANWR, designated the 1002 area, prohibited energy development in the Refuge unless authorized by Congress, and established numerous federal conservation system units (National Parks, Wildlife Refuges, etc.) on federal lands in Alaska; amended several provisions of ANCSA and included various provisions regarding federal land and resource management in Alaska.

ANWR –
Arctic National Wildlife Refuge; also called "the Refuge."

AOGCC –
Alaska Oil and Gas Conservation Commission. The state agency regulates extraction of oil and gas on non-federal lands. It also has primary responsibility for regulation of subsurface injection of fluids brought to the surface from oil and gas production operations or liquid hydrocarbons which are stored underground through a permit program under the Safe Drinking Water Act (SDWA). AOGCC's responsibilities under the SDWA are split with EPA. (See SDWA.)

ARCO Alaska –
Formerly a subsidiary of Atlantic Richfield Company; operated the eastern half of the Prudhoe Bay field until April 2000, when the company's Alaska businesses were bought by Phillips Petroleum Co. ARCO Alaska was the original developer of the Alpine field near the border of the NPR-A; like other ARCO Alaska holdings, Alpine is now owned by Phillips Petroleum.

Arctic Power –
A consortium of proponents of energy development in ANWR, whose members include, among others, petroleum industry representatives, the State of Alaska, and various Native corporations.

ASRC –
Arctic Slope Regional Corporation. Established under ANCSA, a Native regional corporation for essentially all of the Alaskan North Slope. ASRC owns the subsurface rights beneath the lands within the coastal plain of ANWR owned by the Kaktovik Inupiat Corporation.

BACT –
Best Available Control Technology, required to be imposed on major sources of specified pollutants in areas subject to the Prevention of

Significant Deterioration Program of the Clean Air Act. BACT requirements would apply to ANWR.

Barter Island –
A coastal island within ANWR; the site of the Native Village of Kaktovik and a DEWLine station. Currently, only occupied human habitation on the coastal plain of the Refuge.

bbl –
Barrel; barrels (of oil); 42 gallons.

BEA –
Bureau of Economic Analysis; part of the U.S. Department of Labor.

Beaufort Lagoon –
A small lagoon on the eastern edge of the 1002 area.

Beaufort Sea –
Portion of the Arctic Ocean adjacent to central and eastern Alaska (including ANWR), as well as northwestern Canada.

BLS –
Bureau of Labor Statistics; part of the U.S. Department of Labor.

BLM –
Bureau of Land Management in DOI. Among other responsibilities, BLM administers the federal mineral estate, including oil leases, on federal lands.

BMP –
Best Management Practices. In petroleum energy development, those development plans which focus on pollution prevention rather than end-of-pipe discharge limits through specification of structural and operational controls, maintenance, and inspections.

Bonus bids –
The up-front payment made by a successful bidder to the federal government for tract of federal land on which to explore, and if any energy reserves are found, to produce it. The size of this payment is the vehicle by which companies compete to obtain a federal energy lease.

BPAlaska –
Formerly a division of British Petroleum Company, it became a major North Slope operator in 1968. BPAlaska was sold to Standard Oil Co. (Ohio) in 1978. In 1987, British Petroleum Company acquired complete control of Standard Oil Co., its U.S. associate. British Petroleum Company became BP Amoco p.l.c. after 1998, and then became BP p.l.c. in May 2001, and it currently operates in the western half of the Prudhoe Bay field, as well as other parts of the North Slope, and it is vested in the Trans-Alaska Pipeline.

Brooks Range –

An east-west trending mountain range in northern Alaska, running from the Chukchi Sea eastward into northwestern Canada; north of this Range, water drains to the Arctic Ocean; southward, to the Yukon River in Central Alaska.

btu –

British Thermal Unit. The amount of heat required to raise the temperature of a pound of water one degree Fahrenheit.

CAH –

Central Arctic Herd; caribou whose range is partly in the developed areas, including Prudhoe Bay, west of the Refuge; they occupy an area about one-fifth the size of the Porcupine Caribou Herd (PCH).

CEPR –

Center for Economic and Policy Research. An economic and social welfare policy research organization, aimed at promoting debate on economic and social issues through conducting research and presenting the findings of its own and others' studies. (In September 2001, CEPR reanalyzed the 1990 WEFA study of the economic impact of the possible development of ANWR.)

Chandler Lake Agreement –

The 1983 land exchange agreement between DOI and ASRC, under which the U.S. received lands in Gates of the Arctic National Park and ASRC received subsurface rights to KIC lands in ANWR in return.

Coastal Plain –

When used in lower case, the relatively flat area between the foothills of the Brooks Range and the north coast of Alaska; much of it is wetland, especially around Prudhoe Bay. When used with upper case ("Coastal Plain"), the term is used as defined pursuant to §1002 of ANILCA and excludes Native lands in the coastal area.

COE –

U.S. Army Corps of Engineers. Approves permits affecting wetlands, subject to EPA guidelines.

Compatible Use –

Defined as "A proposed or existing wildlife-dependent recreational use or any other use of a National Wildlife Refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purpose(s) of the National Wildlife Refuge." (50 C.F.R. §25.12). Lands within Alaska refuges are subject to the regulations on compatibility in 50 C.F.R. §§25 and 26.

Corps –

See COE.

CWA –

Clean Water Act; among other things, the CWA requires permits for oil and gas operations in the arctic that typically require the use of best management practices to protect water resources. The CWA also requires a state certification that energy development activities requiring federal permits or licenses will comply with state water quality standards.

CZMA –

Coastal Zone Management Act. Among other things, requires certification by states that projects to be located in a state's coastal zone are consistent with the state's coastal zone management program. For ANWR, this would apply to oil exploration and development activities on the coastal plain (ANILCA §1002).

Deadhorse –

The oldest support center for oil exploration in the Prudhoe Bay field; includes offices, depots, repair and service facilities, and housing for employees.

Denning –

The act of a wild, usually predatory animal taking to its lair or taking shelter. Often associated with bears and other animals which hibernate during the winter, and with females of the species when they are giving birth.

DEWLine –

Distant Early Warning Line. Series of stations used by U.S. and Canadian military for detection of possible national security threats from the former Soviet Union; usually a surveillance post and telecommunications relay at each station. In the case of ANWR, one is situated on Barter Island just off the north coast of Alaska, adjacent to the village of Kaktovik.

DOI –

U.S. Department of the Interior.

Doyon, Ltd. –

Regional for-profit Native corporation for central Alaska Natives (chiefly Athabascan Indian), established under ANCSA.

Economically Recoverable Oil –

Estimated amount of oil that could be feasibly extracted under the assumption of a particular level of crude oil prices. If Congress were to allow for energy development in ANWR, the price of oil would come into play in the decision to explore for and develop resources in the extreme conditions of the North Slope. (See *technically recoverable oil* and *oil in place*.)

EIA –

The Energy Information Administration in DOE. Responsible for inventorying and forecasting U.S. Energy Resources.

Endicott –

Small oil field located offshore from Prudhoe Bay; contains 375,000 barrels of recoverable oil. Formerly operated by Standard Alaska Production Company; acquired as part of Standard Oil Co. (Ohio) holdings by British Petroleum Company in 1987; now belongs to BP p.l.c..

EOR –

Enhanced Oil Recovery. A technique used to increase petroleum recovery from known deposits, e.g., permeability of rocks may be increased by deliberate fracturing, using explosives or water under very high pressure; carbon dioxide gas under pressure can be used to force out more oil; and hot water or steam may be pumped underground to warm thick, viscous oils so that they flow more easily and be extracted more completely.

EPA –

Environmental Protection Agency. Independent U.S. agency which conducts environmental research, promulgates national environmental criteria and standards, regulates a wide variety of activities which may affect the environment, assists states in administering environmental programs and funding municipal water infrastructure projects, remediates and cleans up hazardous waste and enforces most environmental protection laws. EPA has commented on DOI's proposed leasing of ANWR and the adequacy of mitigation measures.

ESA –

Endangered Species Act; 16 U.S.C. 1531ff.

Exxon-Mobil –

A major oil company with substantial North Slope holdings, including oil fields in Prudhoe Bay. Exxon Corporation and Mobil Corporation merged in 1998.

FLEIS –

Final Legislative Environmental Impact Statement; in the ANWR context, the final report published under §1002 of ANILCA on April 1987 by FWS/DOI on alternatives for preserving, managing, and/or developing the 1002 area. Also called *1002 report*.

Footprint –

The area within the outline of any structures on the surface of the land as these features might be shown on an ordinary two dimensional map. In the case of arctic energy development, there is debate over exactly what features might be counted in assessing the total size of the footprint.

FWS –

Fish and Wildlife Service in DOI. Among other things, manages federal wildlife refuges, including ANWR.

GDP –
Gross Domestic Product. Main indicator of total output in the economy used by the U.S. Department of Commerce; before 1991, GNP was used.

GNP –
Gross National Product. Before 1991, the main indicator of total output in the economy used by the U.S. Department of Commerce.

Gwich'in –
Athabaskan Indians, situated in east-central Alaska and neighboring areas of northwestern Canada.

Infrastructure –
Physical facilities. In oil development, these include roads, pipelines, drilling pads and structures associated with wells, pumps, facilities for handling the oil and gas, housing and offices, gravel mines, airports, docks, waste disposal facilities, support services, and others.

INGAA Foundation –
A Foundation of the Interstate Natural Gas Association of America; the official name of this foundation uses the acronym. It reported original cost estimates of developing a natural gas pipeline for Alaska (the Trans-Alaska Pipeline).

Inholdings –
Non-federal lands within a federal area. For ANWR, inholdings include Native lands such as those owned by such Native corporations as the Kaktovik Inupiat Corporation and the Arctic Slope Regional Corporation.

Inupiat –
Eskimo (specifically, Inuit) people of the Alaska North Slope and bordering areas.

Jago River –
Large north-flowing river in the eastern third of the 1002 area.

Kaktovik –
Native village (population between 200 and 300) located in ANWR on Barter Island; part of the North Slope Borough. Also the site of a U.S. DEWLine station.

Kaktovik Inupiat Corporation –
Native Village Corporation of Kaktovik. (KIC.)

KIC–
Kaktovik Inupiat Corporation.

Kongakut River –
River that lies between the 1002 area and the Canadian Border in the ANS frontier, and flows into the Beaufort Lagoon.

Kuparuk –
Large oil field located west of Prudhoe Bay. Field formerly operated by ARCO, now by Phillips Petroleum. Also, Kuparuk Oil Industrial Center.

LNG –
Liquefied natural gas.

Milne Point –
Oil field located northwest of Prudhoe Bay, operated by BP Exploration (Alaska) Inc., a subsidiary of BP p.l.c.. Drilled and operated briefly by Conoco, Inc; once shut-in because of low world oil prices, and now re-opened.

MLA –
Mineral Leasing Act. Federal law that generally governs the leasing of oil and gas and certain other minerals from federal public lands and revenue sharing from these resources. However, Congress has authorized leasing some federal lands under other statutory provisions.

NAAQS –
National Ambient Air Quality Standards. Health-based standards established by EPA for concentrations of ozone, sulfur dioxide, nitrogen oxides, particulate matter, carbon monoxide, and lead in outdoor air.

National Petroleum Reserve-Alaska (NPR-A) –
Reserve of approximately 37,000 square miles located on the North Slope, west of Prudhoe Bay, and originally set aside to provide oil for federal military use. Early exploration did not reveal any potential commercial oil resources, and exploration sites were abandoned. Recently reopened to leasing with most recent lease sale held May 1999, and 130 bids totaling $105 million accepted. This name replaced the earlier "Naval Petroleum Reserve No. 4."

National Wildlife Refuge System –
A network of lands and waters managed by the Fish and Wildlife Service in all 50 states and most territories. As of Sept. 30, 2000, it consisted of 93.96 million acres in 530 refuges, 201 waterfowl production areas, and 50 wildlife coordination areas. Of these, 76.99 million acres were in Alaska.

Native –
When capitalized, used synonymously with "Alaska Native."

Native Corporation –
Any regional, village, urban, or group corporation established under ANCSA. (See also Regional and Village Corporation.)

Native Village –
Any tribe, band, clan, group, village, community, or association in Alaska composed of Alaska Natives. (Here, also includes "Native Groups", defined in ANCSA as having less than 25 Natives.) The Bureau of Indian

Affairs in DOI recognizes over 220 such Native villages, irrespective of population.

NCAI –
National Congress of American Indians; major nationwide organization representing Indian tribes.

NEPA –
National Environmental Policy Act. Requires that certain analyses of possible environmental effects of proposed federal actions be completed. Preparation of an updated version of the FLEIS or Supplemental Environmental Impact Statement under NEPA might be necessary before energy development in ANWR could proceed, unless Congress specified otherwise.

North Slope –
A geographic area of Alaska on the north side of the Brooks Range, exceeding 100,000 square miles (64,000,000 acres) and including foothills and the relatively flat coastal plain, where the waters drain to the Chukchi and Beaufort Seas. Reaches from roughly Point Lisburne on the Chukchi Sea across NPR-A, oil development areas, the 1002 area, and east into Canada.

North Slope Borough –
Local North Slope government established in 1972 under Alaska state law; boundaries are roughly similar to those of the North Slope itself. Equivalent to a county, it has power to tax property.

NO_x –
Nitrogen oxides, one of the principal air pollutants likely to be emitted by oil field operations in ANWR.

Ocean Dumping Act –
Title I of the Marine Protection Research and Sanctuaries Act (also known as the Ocean Dumping Act). Requires the COE to issue a permit for the disposal of dredged material at designated sites in any ocean waters including the (U.S.) territorial seas, *e.g.*, for disposal of material dredged in the construction of channels in open seas needed to get oil/gas tankers to shore facilities.

OECD –
Organization for Economic Cooperation and Development.

OPEC–
Organization of Petroleum Exporting Countries.

Oil in place –
The amount that might be present or "in place" in a given field or area. This figure is just a starting point, since it is not possible to extract all of the oil in a field. Estimates are almost always given as a range of numbers

and probabilities. (See *economically recoverable oil* and *technically recoverable oil*.)

PCH –

Porcupine (River) Caribou Herd. Herd of caribou (variable population levels – from about 120,000 to over 180,000) that winters in central Alaska and Canada and migrates to ANWR in spring and summer; in most years PCH calving is concentrated in the 1002 area; foothills, plain, and coast of 1002 area are used for feeding and insect relief. The PCH herd is estimated to be about five times as large as the Central Arctic (caribou) Herd (CAH).

Phillips Petroleum –

Major operator on North Slope (in addition to BP). Operates the eastern half of the Prudhoe Bay field as well as other North Slope fields (*e.g.*, Alpine).

PLAs –

Project labor agreements. Agreements between a project owner or main contractor and the union(s) representing the craft workers for a particular project that establish the terms and conditions of work that will apply for the particular project.

PLO –

Public Land Order. An administrative action relating to public lands taken by the Secretary of the Interior. PLO 2214 withdrew federal lands in the territory of Alaska to create the original Arctic National Wildlife *Range*. Although it withdrew the lands from operation of the mining laws, it did not withdraw the lands from mineral leasing.

Prospect –

In petroleum exploration, a site which is believed to have the potential for containing a petroleum accumulation of sufficient size to be of commercial interest.

Prudhoe Bay –

Bay on the north coast of Alaska, between the 1002 area and the NPR-A. Also, the adjacent on-shore site of the largest oil field ever found in the U.S. Originally estimated to contain 9.6 billion bbl of proven reserves, then revised upward to 13 billion bbl; an estimated 3 billion bbl of reserves are thought to remain. This field is operated by Phillips Petroleum and BP. (The term often is used loosely to refer to all developed areas on the North Slope.)

PSD –

Prevention of Significant Deterioration: a regulatory program established by the Clean Air Act to protect air quality in areas that meet National Ambient Air Quality Standards.

RCRA –

Resource Conservation and Recovery Act. Governs the generation, storage, transportation and disposal of hazardous wastes; in Alaska the program is carried out by the U.S. EPA.

Regional Corporations –

Alaska Native Regional Corporation established under ANCSA and the laws of the State of Alaska. After 1971, the DOI Secretary divided Alaska into 12 geographic regions, as defined in §1606 of ANCSA, with each region composed as far as practicable of Natives having a common heritage and sharing common interests.

Reinjection –

Process by which most of the natural gas produced so far on the North Slope has been put back into the ground by oil field operators to maintain pressure in the oil reservoir zones.

Rent –

The annual payment made by a lessee to the federal government for the right to a tract obtained for energy production under the Mineral Leasing Act of 1920. Rates are $1.50 per acre per year for the first 5 years and $2.00 per acre per year thereafter.

Riparian –

Areas alongside streams and rivers; in the 1002 area these are often vegetated with low brush that is attractive habitat to a number of species. Frequently serve as corridors for wildlife movement.

Rolligon –

Large vehicles with enormous soft tires that spread their weight evenly across the surface.

Royalty –

A payment by a lessee to the federal government under the Mineral Leasing Act of 1920 for oil or gas produced on federal land. Currently, the royalty rate is set at 12.5%.

Sadlerochit Spring –

A "special area" in the southernmost part of the 1002 area. During the section 1002 study, 4,000 acres around the spring were closed to exploration. The spring maintains a flow of water at 50°-58°F year-round, and keeps the river open for nearly 5 miles downstream, even in winter. It represents the extreme northern range of some plants and birds, and provides wintering habitat for fish; muskoxen frequent the area.

SDWA –

Safe Drinking Water Act. Manages a permit program to protect underground sources of drinking water (USDWs) from contamination by injection through wells. In Alaska, U.S. EPA has primary responsibility to issue permits authorizing subsurface injection of nonhazardous

industrial wastes associated with oil exploration and development. The Alaska Oil and Gas Conservation Commission shares regulatory authority over underground injection wells. (See AOGCC).

SEIS –

Supplemental Environmental Impact Statement; in a declaratory judgment action in 1991, a judge held that DOI should have prepared a SEIS at that time to encompass new information about the 1002 area in connection with the Department's recommendation that Congress legislate to permit development.

Special Area –

Areas of natural beauty or prolific wildlife areas, habitats, and ecosystems in the 1002 area. Five special areas were specifically named in the FLEIS as potential set-asides; these total more than 52,000 acres.

TAGS –

TransAlaska Gas System. Proposed subsurface pipeline delivery system to supply natural gas to LNG processing facilities on the North coast of Alaska.

TAPS –

Trans-Alaska Pipeline System. Transports oil Prudhoe Bay to Valdez, a port on Alaska's south coast. The pipeline was completed and opened in 1977.

tcf –

Trillions of cubic feet, *e.g.*, of natural gas.

Technically recoverable oil –

Oil which has been successfully prospected and may be extracted given the scientific and technological knowhow, resources, infrastructure, etc.; however, its extraction is limited by such factors as the market price of oil, which is related to its supply and demand. (See *economically recoverable oil* and *oil in place*.)

Trans-Alaska Pipeline Authorization Act –

Federal law which authorized construction of TAPS and by granting a right of way over federal lands (P.L. 93-153, 87 stat. 584, 43 U.S.C. 1651 *et seq*.). In addition, federal law had generally prohibited the export of oil transported through pipelines which had been granted a right of way over federal lands (30 U.S.C.§185(u)). However, an amendment enacted in 1996 permits oil shipped through the pipeline to be exported though only under certain very restrictive conditions (30 U.S.C.§185(s)).

Tundra –

Major ecological community of the arctic and high elevation alpine areas, characterized by usually waterlogged soil sitting on permafrost, and by low growing plants such as mosses, lichens, and dwarf forms of woody plants.

USDW –
Underground source of drinking water.

USGS –
U.S. Geological Survey. A DOI agency that, among other things, conducts mineral and energy resource assessments of the U.S. and the world; advises on prospecting and extraction of petroleum and mineral resources on federal lands; evaluates national water resources.

Village Corporation –
Alaska Native Village Corporation organized under ANCSA and the laws of the State of Alaska as a business corporation (for profit or non-profit) to hold, invest, and/or distribute lands, property, funds, and other rights and assets on behalf of a Native village (as defined in ANCSA).

WEFA Group, The –
Economic consulting group, now merged with "DRI" (not an acronym), forming DRI-WEFA. In 1990, published a study of the economic impact of the possible development of ANWR (See also *CEPR.)*

Wellhead Price –
The price paid a producer in the producing field. It is often calculated based on the delivered or first sale price, less the cost of associated transport. Transport tariffs are generally related to pipeline length. In the case of North Slope oil (or gas) – where there pipeline cost is (or would be) substantial, the implied price at the wellhead would be commensurately low.

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