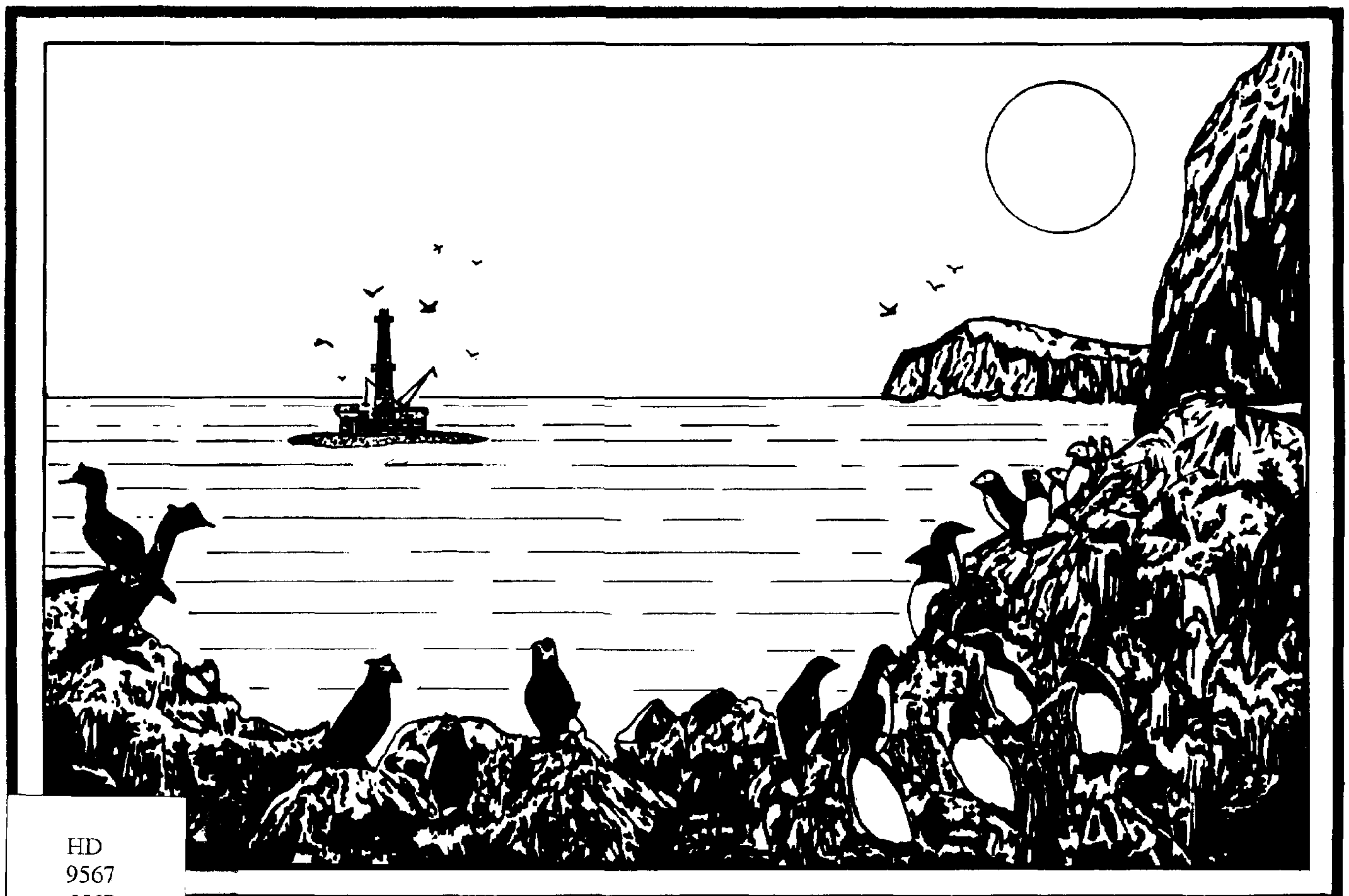
Recommendations for Minimizing the Impacts of Hydrocarbon Development on the Fish, Wildlife, and Aquatic Plant Resources of the Northern Bering Sea and Norton Sound

MITIGATIVE MEASURES



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Mitigative Measures

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INTRODUCTION

As part of a Coastal Energy Impact Program (CEIP) study of the northern Bering Sea-Norton Sound region, mitigating measures were proposed for various impacts which might occur as a result of oil and gas development. These mitigating measures represent an attempt to prevent, minimize, or ameliorate impacts to fish and wildlife populations and their associated habitat, while allowing development to proceed at the most efficient pace commensurate with those concerns. These measures are additionally designed to be utilized as a quick means of reference for future planning or developmental considerations. For further information regarding anticipated impacts of oil and gas development, the reader is referred to the complete report "Recommendations for Minimizing the Impacts of Hydrocarbon Development on the Fish, Wildlife, and Aquatic Plant Resources of the Northern Bering Sea and Norton Sound".

A

SITE PREPARATION

SITE PREPARATION

Extensive site alteration (clearing, grading, filling and gravel pad construction) is often necessary to prepare an area for the construction of buildings, the building of access roads, the laying of pipelines and the establishment of utility right-of-ways.

During site preparation, habitats of local organisms are often altered or destroyed. Species of wildlife that are sensitive to disturbance will be displaced from the area. The impacts on fish and wildlife will be most severe if site preparation occurs in vital fish and wildlife habitats where breeding, nesting, pupping, rearing, staging, wintering, denning, or calving occurs. In addition to destroying habitat, site preparation leads to other environmental problems. Natural drainage systems may be altered. The removal or compaction of ground vegetation exposes soils to erosion and permafrost degradation. Runoff containing eroded soils and contaminants from a construction site can be carried into coastal waters, thereby degrading water quality, blocking light penetration, and inhibiting the growth of algae and aquatic plants.

Recommended Mitigative Measures

General Measures

1. Vital fish and wildlife habitats should be avoided as sites for oil and gas facilities.

2. Before site preparation begins the environmental, geologic and hydrologic aspects of the construction site should be studied. Facilities should be sited where the impacts of the facility on the environment and the environment on the facility are minimized.

3. Site preparation activities should be scheduled at times when the impacts on critical fish and wildlife life processes such as nesting or pupping will be minimal.

4. Development plans should include procedures for controlling erosion, runoff, and sedimentation, for preserving natural water drainage systems, and for protecting permafrost.

5. Wetlands, tideflats, and wet tundra areas should not be drained, filled, or polluted.

6. The destruction of native vegetation cover should be avoided.

7. Size of facilities should be minimized, and facilities should be consolidated where possible.

8. Dust should be controlled at construction sites. Dust accumulation around roads and construction sites can cause early snow melt and vegetation changes. These changes can lead to changes in drainage patterns. Dust should be controlled by watering, not oiling. Runoff from oiled surfaces can pollute local waters and the hard surface created by oiling lengthens deterioration time following project abandonment.

Non-Permafrost Soils - Erosion, Runoff and Sedimentation.

1. Clear only the minimum area needed for construction of facilities. Other parts of the site should not be disturbed. Any remaining vegetation will reduce erosion and runoff in adjacent areas.

2. Finish grades so that the flow of water is directed along natural drainage courses and through natural terrain.

3. Vegetative buffers should be left along all shorelines, sloughs, bays, rivers, streams, and other surface waters in order to trap sedimentation and pollutants and to control stormwater flow. The width of the buffer should be determined by slope of land, severity of erosion, and vegetation type.

4. Cleared areas should be revegetated as rapidly as possible after site preparation activities in order to stabilize exposed soils.

5. Where possible natural vegetation should be used to revegetate cleared areas. It is adapted to local climatic conditions and it reduces the loss of wildlife habitat because birds and mammals are adapted to it. Nurseries should be established to provide arctic adapted species for revegetation.

6. On a site that has been cleared but on which construction will be delayed, temporary vegetation (i.e., rapidly growing grains and grasses) may be planted on exposed soils to prevent erosion. Newly seeded areas can be protected until vegetation becomes established by laying down netting, preferably jute or other biodegradable material.

7. Stormwater runoff may be diverted away from exposed soils by cutting parallel troughs across slopes to intercept the downward flow of surface waters. On steep slopes, bench terraces can be constructed to achieve the same purpose. Both of these methods are used to divert stormwaters into sediment basins or into vegetated buffer strips so that sediments can be removed.

8. Sediment basins or detention ponds may need to be constructed in order to detain runoff and trap sediment thus decreasing the siltation and contamination of coastal waters.

9. Vegetated waterways (swales) should be used to carry stormwaters away from construction sites instead of concrete storm drains.

10. Erosion in waterways (e.g., channels, ditches) may be reduced by planting grasses along their courses. The establishment of grasses is an effective way of removing sediments from the water.

11. Structures sited on slopes of unstable materials should be built on fill or supported on piles.

12. Riprap material used to stabilize river banks and prevent erosion should be of sufficient size so that it cannot be carried into the stream by normal or flood currents.

Non-Permafrost Soils - Preserving Natural Water Drainage Systems.

1. Areas that have high water tables should not be drained. Excavation in these areas should be limited to such structures as ponds, artificial lakes, or other containment projects which preserve the natural water system. These artificial basins should be designed to function as natural systems, which means they should be fairly shallow and have gentle slopes. Improperly designed basins may become polluted within a few years. Vegetative buffer strips should surround the basins for restoration of runoff water quality.

2. Areas that are regularly flooded should not be drained or altered. Elevating structures on piles will cause the least disturbance to the flood plain.

3. There should be no excavation, filling, land clearing, grading, channelization, or removal of natural vegetation, and no discharge of pollutants into wetlands or wet tundra areas.

4. Upland sites should be selected for facilities unless they are water-dependent. If facilities are water-dependent, then the non-water dependent parts of the facility (e.g., parking areas) should be located outside of the wetland area.

5. Excavation in wetlands should be avoided except for essential public purposes (i.e. electrical lines, pipelines, and water lines that cannot feasibly be rerouted). Excavation should be limited to as small an area as possible.

6. Solid-fill roads or other structures which obstruct the natural flow of water should not be built in wetlands. The excavation of fill for these structures causes additional adverse impacts. If the construction of roads or other types of access through wetlands is unavoidable, they should be placed on pilings rather than on fill.

7. If drilling for oil and gas is unavoidable in wetlands, ecological disturbance can be reduced by using directional drilling to drill several wells from one site.

8. Wetlands that are altered during the construction of facilities should be restored to their natural state after the project is completed.

    a. The original soil should be saved and replaced after project completion.

    b. The area should be restored to its original topographic configuration.

    c. The area should be revegetated with native species.

9. When the movement of heavy construction equipment through wetlands or wet tundra is unavoidable, culverts and bridges should be used to minimize degradation of the natural drainage patterns. Winter movements are desirable because the substrate is frozen, fish and wildlife are generally absent, and damage is minimized.

10. Construction areas should be graded so that the flow of surface waters is along natural drainage courses.

11. Site preparation activities in wetlands and wet tundra should be scheduled during winter when the least biological damage will occur.

12. Tributary streams should not be altered.

13. The use of permeable surfacing materials such as gravel, rocks, and shells, over groundwater recharge areas is more desirable than the use of impenetrable surfacing such as asphalt. Impenetrable surfaces such as paved parking lots and roads prevent groundwater recharge and accelerate storm runoff. Water that normally filters through the soil remains on the surface. Increased runoff from paved areas results in pollution, causes erosion, and increases flooding.

14. Stormwater should be retained by constructing detention ponds which collect runoff and then slowly release filtered and purified water to the coastal system.

Protection of Permafrost

1. Site specific studies should be conducted to define the type of permafrost terrain present and the degree of potential instability that must be considered in site design.

2. Construction on well-drained, coarse sediments presents fewer problems than construction on poorly-drained, fine-grained sediments.

3. Construction in permafrost areas should use the latest available technology to prevent drainage alterations, channelization of flows, ponding, and permafrost degragation.

4. Where gravel pads are required, impact on drainage patterns can be reduced by building circular pads or orienting one corner of square pads upslope.

5. Gravel pads should be of sufficient depth to insulate the underlying permafrost.

6. Artificial material, such as styrofoam insulation, can be used in conjunction with gravel to provide insulation to the permafrost layer and to reduce gravel needs. However, the long term impacts of artificial materials have not been adequately tested.

7. Temporary structures should be built on piles. Gravel pads should only be used where weight or stability requires their use. Use of piles reduces permanent environmental damage and reduces commitment of surface area for temporary structures.

8. Refrigerated piles can be used in marginal permafrost to assure the permanently frozen state of sediments around the piles. Piles should be spaced far enough apart to allow thawing between them or drainage patterns will be altered.

9. To minimize environmental damage, construction of facilities should be minimized. Unnecessary duplication of roads such as construction of roads between facilities where access to the

facilities from main roads has already been provided, and the use of pipeline construction pads where existing roads could be used, are examples of activities that should be avoided.

10. Facilities should be consolidated so that the area of disturbance is reduced.

11. Vehicular travel and movement of construction equipment should be restricted to adequately constructed roads. Off-road travel should only be allowed after the tundra surface is sufficiently frozen and snow depths are adequate to prevent surface damage.

12. Where possible, off-road travel should be restricted to low-surface-pressure vehicles. Impacts of off-road travel by tracked or tractor-type vehicles can be lessened by:

    a. Traveling only where and when there is sufficient snow cover to protect the vegetative surface and avoiding steep slopes and snow-free areas.

    b. Using the same route each year when activities extend over several winters. Use of the same route for more than two years, providing that the peat layer continues to insulate against summer thaw, is less damaging than a series of parallel roads across the terrain.

B

NOISE & DISTURBANCE

NOISE AND DISTURBANCE

The intense level of support activity associated with offshore oil exploration, development and production causes various degrees of disturbance to fish and wildlife in the coastal environment. Disturbances are primarily caused by an increase in helicopter, fixed wing aircraft and boat traffic; an increase in human presence; the operation of heavy machinery during site preparation and construction of onshore facilities; and by seismic exploration.

When birds or mammals are disturbed they may either abandon or discontinue using favored habitats. The impacts from noise and disturbance can be especially severe if they take place during critical periods in the life cycle of birds, mammals and fish. These critical periods include activities such as breeding, nesting, pupping, staging, wintering, denning, and calving. Interference with these activities may result in lower populations of animals. Breeding success may be reduced as well as resistance to disease, predators, and climatic conditions.

Recommended Mitigative Measures

General Measures

1. Facilities should be sited away from highly sensitive habitats.

2. Noise generating activities such as helicopter and boat traffic, blasting or construction should be scheduled at times and places when there will be minimal impacts on fish and wildlife. Schedule activities in sensitive areas to non-sensitive times.

Facility Siting

1. Site facilities with high levels of visual and acoustical disturbance away from biologically productive areas (sound levels decrease with distance).

2. Facilities should be sited a minimum of one mile away from critical habitats such as seabird colonies and peregrine falcon nesting cliffs.

3. Site facilities where physical barriers such as irregular terrain will prevent sound and visual impacts from occurring over a wide area.

4. Provide vegetative buffer zones around facilities. Indigenous vegetation should be left during the site clearing wherever possible.

5. Use machinery that produces less noise, i.e. modify the design of equipment to reduce noise; equip machinery with parts such as mufflers that will reduce noise.

6. Conduct activities with high levels of acoustical and visual disturbance during periods of least biological activity.

Helicopters and Fixed-Wing Aircraft

1. Helicopters and fixed wing aircraft should maintain a vertical distance of at least 1,500 feet, and a horizontal distance of one mile from sensitive areas during critical life history stages.

2. Under no circumstances should flights over sensitive areas be less than 500 feet. VFR flights over sensitive areas such as seabird colonies, should be cancelled when ceilings below 500 feet have been reported by flight service stations or other pilots. Wildlife observed while flying at 500 feet should be avoided by a one-quarter mile horizontal distance.

3. During all phases of oil and gas development, aircraft, especially helicopters, should follow fixed flight paths which avoid sensitive areas during critical times.

4. If flights over sensitive habitats cannot be avoided during critical periods, the number of aircraft flying over these areas should be minimized.

5. Rapid, linear flight over animals causes less disturbance than circling. Under no circumstances should helicopters unnecessarily hover or circle over animals.

6. If flight over a bird nesting cliff during the breeding season becomes necessary due to weather or other unavoidable circumstances, aircraft should approach the cliff as directly as possible. An approach from behind the cliff may result in the sudden appearance and sound of an aircraft directly above the nesting site, causing panicked flight by the attending adults and fatal damage to the eggs or young.

7. Helicopter and fixed-wing aircraft landing areas should be located at a sufficient distance from sensitive areas so that minimum altitudes can be attained before aircraft overfly any sensitive areas.

8. Orientation classes should be conducted for all new pilots to aquaint them with the long term effects of aircraft disturbance on wildlife populations and State laws relating to harassment of wildlife.

9. In order to establish effective aircraft operation restrictions in sensitive areas, specific studies need to be conducted on

the effects of aircraft disturbance on a variety of mammals and birds found in the Norton Sound-Bering Sea region.

Boats

1. Boats engaged in oil and gas exploration, development, and production should maintain a distance of at least one mile from sensitive areas during critical periods.

2. Oil support activities (such as gravel supply barges, supply boats, and tankers) should avoid all marine mammal concentrations during critical periods.

3. Sirens or horns should not be used near bird colonies or marine mammal haulouts.

4. Navigational aids such as foghorns, or flashing lights should not be placed in or near seabird colonies or marine mammal haulout areas.

Seismic Exploration

1. Seismic exploration should be conducted using only non-explosive techniques which do not physically harm fish and wildlife.

2. If a situation arises where non-explosive techniques cannot be used, and underwater blasting is necessary to protect human

life, prevent environmental damage, or protect property, blasting programs should be designed to reduce energy transmitted to the surrounding waters. Techniques such as blast curtains, small delayed charges, jetted charges, etc. will minimize environmental damage from blasting.

3. To protect ringed seals and marine fish, under-ice pressures from explosive detonations on the ice should not exceed 3 psi.

4. Terrestrial blasting should be: 1) conducted during nonsensitive periods; 2) limited in favor of mechanical methods wherever possible and desirable; and 3) conducted with reduced charges, timed delays or muffled in other ways to reduce noise transmission to surrounding areas.

5. Where possible, there should be coordination of seismic programs among operators to minimize duplication. Overlapping or duplicate seismic programs by various companies can intensify and prolong the disturbance in an area.

6. Onshore seismic activity should be conducted during the winter months when overland travel causes the least damage to the tundra. Winter is also the period of lowest biological sensitivity for most wildlife species. Vehicular traffic should be restricted to the immediate area of operations.

7. No seismic surveys should be conducted in the shorefast ice zone after March 20. Ringed seals begin pupping and rearing young after this date. Along the Beaufort Sea coast, ringed seal abundance in areas where seismic exploration has occurred is only one-half to one-third that of undisturbed areas.

8. In the shorefast ice zone, seismic shot lines should be spaced at intervals of no less than two miles, or the areas of seismic exploration should be as restricted as possible.

9. Seismic surveys should maintain a minimum distance of one mile from sensitive habitats during sensitive periods. Explosives should not be used within two miles of peregrine falcon nests during the period of April 15 to August 31.

10. Explosives detonated near a fish bearing waterbody should be detonated at a sufficient distance so that induced water pressures within the waterbody do not exceed 2 psi. The following table provides minimum stream setbacks for various substrate types and charge sizes.

CHARGE WEIGHT - POUNDS.

DISTANCE TO WATERBODY - FEET

Substrate	1	2	5	10	25	100	500	1000
Rock	53	75	118	167	264	529	1182	1673
Stiff Clay	42	60	95	134	211	423	946	1337
Gravel	41	59	93	131	207	414	927	1310
Clayey Silt Dense Sand	37	52	82	116	184	368	823	1163
Medium to Dense Sand	32	46	72	102	162	324	724	1024
Medium Organic Clay	21	29	46	66	104	207	463	655
Soft Organic Clay	19	28	43	61	97	194	435	615

These charge weights are for single detonations separated by at least 8 milliseconds from the next charge (i.e. if 1000 pounds of charge are detonated in 10 detonations of 100 pounds each, separated by at least 8 milliseconds, the distance for 100 pounds can be used as the minimum distance from the waterbody). The State of Alaska prohibits the use of high explosives for seismic work in lakes, steams, and marine waters of the State.

Human Presence

1. Human visitation to sensitive habitats during critical times should be restricted in order to maintain populations of wildlife.

2. All human activities should be prohibited within one mile of peregrine falcon nesting cliffs between April 1 and August 15.

3. Orientation classes for all employees, including management and supervisory personnel, should be required so as to inform personnel of the dangers, adverse biological consequences, and legal ramifications of animal feeding.

4. All management personnel should be taught proper garbage disposal methods in order to eliminate animal feeding.

5. Construction camps, garbage dumps and incinerators should be fenced and buildings skirted in order to minimize human and animal conflicts.

6. All edible garbage must be thoroughly incinerated or buried to prevent conflicts between humans and animals.

7. Regulations to minimize human and animal contacts must be developed and enforced. An effective regulation and enforcement program must be administered by personnel beyond the influence of contractors or unions. Companies should have policies which penalize violators.

8. Specific research on animal harrassment should be included as part of the design criteria for any oil and gas development plan wherever these activities will impact a sensitive area or a new species.

C

DRILLING MUDS & CUTTINGS

DRILLING MUDS AND CUTTINGS

Drilling muds are special mixtures of clay, water (or oil) and chemicals which are circulated into the drilling hole of exploratory or production oil and gas wells to cool and lubricate the drill bit, to remove formation cuttings from the hole, and to prevent blowouts by holding back formation pressures exerted by oil and gas accumulations. Drill cuttings are composed of bottom sediments and pieces of pulverized rock underlying geologic formations. During the course of drilling, muds are recirculated after cuttings and other debris are removed. These materials along with some drilling muds are then discharged into surrounding waters.

Drilling muds and their chemical components (caustic soda, preservatives, viscosifiers, emulsifiers, completion chemicals and thinners) have been shown to be acutely toxic to fish and marine invertebrates. Even if concentrations found in marine waters are not toxic, the heavy metals in drilling muds may accumulate in animal tissues and, over time, become toxic. Other potential impacts arise through an accumulation of muds and cuttings on the bottom. Organisms which are incapable of moving out of a disturbed area may be smothered. Mobile species might not be smothered, but could be affected by a destruction of habitat or the elimination of food material. Diesel oil added to muds to enhance the drilling of deep wells can adhere to mud particles and settle to the bottom causing pollution of the substrate. Filter feeding animals, such as clams, filter out the oil from the sediments and concentrate it; thereby causing these organisms to develop an unpalatable oily taste.

Recommended Mitigative Measures

General Measures

1. Wherever possible, drilling muds should be retained and used for drilling other wells.

2. Drilling muds should not be discharged into critical habitat areas for marine species.

3. Drilling muds should not be discharged into any nearshore area seaward to the 30 ft. bathymetric contour line, or any body of freshwater, including lakes, streams, or rivers.

4. If artificial islands are used to develop oil reserves, clean drill cuttings can be used as a material source to supplement gravel in island construction.

5. Drilling muds and clean drill cuttings should be discharged near the ocean bottom rather than near the surface in order to decrease the areal extent of outfall and to prevent stratification of toxic components within the water column.

6. Mud discharge rates should not exceed a maximum of 50 bbl per hour, in order to limit toxic concentrations of drilling muds to a small area near the outfall.

7. Muds should not be discharged at low tide or slack water when tidal flushing and dilution is at a minimum.

8. Drilling muds should be diluted prior to discharge. The minimum dilution factor should be 25 parts receiving water to 1 part drilling fluid.

9. Muds containing high levels (as determined by Environmental Protection Agency or Department of Environmental Conservation water quality regulations) of hydrocarbons, surfactants, bactericides, detergents, trivalent chromium salts, carcinogenic compounds and other toxic additives should not be discharged into the aquatic environment. Instead, these muds should be hauled ashore and disposed of at an approved upland site, pumped down the well bore, or disposed of in some other environmentally acceptable manner.

10. During winter drilling in the shorefast ice zone, drilling muds should be dispersed on the ice surface rather than under the ice in poorly mixed subsurface waters where toxic build up may occur.

11. Clean drill cuttings may be discharged without restriction, except in areas which are important for the rearing of juvenile marine species, such as larval king crab; or in areas where such discharges will result in a direct physical loss of productive habitat, such as *Fucus* kelp and eelgrass beds,

wetlands, tideflats, or estuaries. The presence or absence of juvenile marine species and the relative productivity of an area should be determined during benthic and engineering surveys conducted prior to rig placement.

12. Heavy metal accumulations in sediment and animal tissues near production platforms with multiple wells, should be monitored to insure that no toxic build up occurs.

D

OIL POLLUTION

OIL POLLUTION

Oil pollution, either acute or chronic, may occur during any phase of petroleum development. Acute oil spills are those that result from a single infusion of oil into the marine environment, usually through an accidental spill. Chronic oil pollution is that which occurs over an extended period of time. Development drilling, production, transportation, and oil processing operations have been chiefly responsible for most of the world's major and minor oil spills, whereas offshore exploratory drilling has contributed a lesser amount of oil to the environment.

Petroleum spilled along the coast is potentially harmful to all coastal environments and the marine organisms which inhabit them including seabirds, waterfowl, fish, marine mammals, shellfish, and plankton. Oil can affect marine life by: 1) direct kill of organisms through coating and asphyxiation, 2) direct kill through contact poisoning, 3) direct kill through exposure to water soluble toxic components of oil at some distance in space and time from the spill, 4) destruction of the sensitive juvenile forms, 5) destruction of the food sources of higher organisms, 6) incorporation of sublethal amounts of oil and oil products into organisms, resulting in reduced resistance to infection, physiological stress or failure to reproduce, 7) disease due to exposure to carcinogenic components of oil, 8) chronic low level effects that may interrupt any of the numerous biochemical or behavioral events necessary for the feeding, migration, and spawning of many species of marine life and 9) changes in biological habitats. Oil polluted marine waters can affect humans by reducing recreational opportunities, tainting the flesh of commercial and subsistence species of marine fish and crustaceans (salmon, bottomfish, clams, and crab) and reducing commercial fisheries production.

Recommended Mitigative Measures

Prevention of Oil Spills

1. Exploratory Drilling - Because of effective U.S. Geological Survey regulations and enforcement, exploratory drilling operations on Federal OCS lands have a relatively good safety record and a low incidence of oil spills. Exploratory drilling operations would be acceptable with the following measures:

   a. USGS standards for both drilling operations and safety be adopted and enforced on both State and Federal lease tracts.

   b. A second drilling rig with similar capabilities should be available in Alaskan waters to drill a relief well in the event of an uncontrolled flow of oil from a well due to a blowout or accident such as a rig fire. The rig requirement can be satisfied by an operational drilling platform in Alaskan waters, even if it is being used to drill another well, but must be capable of being on site and operational within 7 days after an uncontrolled flow has occurred.

   c. Drilling platforms must be inspected to insure that they are capable of operating under the meteorological and geophysical conditions that are present. Soil conditions at all drilling sites should be inspected and certified as being capable of supporting rig weights.

d. Only temporary drilling structures should be used during the exploration phase of oil development. After drilling, all structures should be removed and the site restored unless those structures will be used in the development of the field.

e. Because of severe winter ice conditions, exploratory drilling from conventional jack-up rigs, drillships, and semi-submersible drilling rigs should be restricted to the ice free months of June through October.

f. Hazardous operations with high oil spill risk factors, such as testing and well completions, should be conducted only during periods when the ability to contain and cleanup a spill are maximized. This would typically be during calm open water periods.

Production Facilities

1. Production platforms must be specifically designed and tested to operate safely under extreme conditions involving moving pack ice, maximum sustained wind speeds of 90 knots (100 mph), extreme wave heights of 32 meters (105 feet), and earthquakes of at least 6.5 on the Richter scale.

Onshore Facilities

1. Oil storage facilities should be sited a sufficient distance away from any open body of water so that even in the event of an uncontrolled spill, oil would not enter the water.

2. If facilities must be sited in wetlands or adjacent to a body of water, provisions must be made in design and construction to prevent the spread of hydrocarbons and to facilitate cleanup above and below ground. Such measures would require that oil storage and processing facilities be bermed and underlaid by natural or artificial impermeable barriers to prevent spilled oil from escaping the area and entering adjacent ground and surface waters.

3. Facilities which store large amounts of fuel should be sited away from sensitive fish and wildlife concentrations, such as seabird rookeries and wetlands.

4. Oil storage and processing facilities should not be located on geophysically unstable sites. This would include sites with unstable substrate, sites which could be affected by storm surges, and active fault zones.

5. Stationary fuel storage facilities for construction activities should not be placed within the floodplain of a fish stream, and vehicle refueling should not occur in these areas.

6. Effluent from refineries, oil treatment facilities, and petrochemical plants should be treated to reduce concentrations of aromatic hydrocarbons to below one ppm. Effluents should not contain any biologically significant amounts of heavy metals or carcinogenic compounds which might build up to toxic levels in sediment over the life of the project.

7. Hydrocarbon contaminated effluents should only be discharged into areas where there is sufficient water volume, strong tidal currents, and a rapid exchange of water to quickly dilute the effluent. Under no circumstances should they be discharged into any body of freshwater, estuary, or area exhibiting sluggish circulation.

8. Alternate methods to dispose of contaminated waste water, such as pumping it into reinjection wells or into impermeable formations underground, should be used whenever possible.

9. Alarm systems and security measures should be developed for all facilities handling oil to prevent spills caused by carelessness, vandalism, or sabotage.

Transportation

1. Pipelines

a. Avoid construction of pipelines in geophysically active areas; i.e., across faultlines, in areas of current scour, in gas charged sediment areas, and areas prone to liquifaction.

b. Submarine pipelines should be buried deep enough so that they will not be broken by ship anchors, gouging ice keels, or by fishing trawls.

c. Submarine pipeline locations should be prominently marked on nautical charts and maps. Sonar targets should be placed on the pipeline at strategic intervals to aid in precise location.

d. Pipelines should be consolidated to the greatest extent possible in order to minimize habitat disturbance and risk.

e. Pipeline design and installation should reflect future developmental considerations such as increased volume during maximum production phases, and the ability to accomodate feeder pipelines from other developing fields.

f. Sensitive alarm systems and automatic shut-off valves should be required on all pipelines in order to minimize the amount of oil that would escape in the event of a pipeline rupture.

g. The number of stream crossings should be minimized. Attempt to make crossings downstream from sensitive habitats such as spawning areas. Uninterrupted movement and safe passage of fish should be provided for. Any artificial structure or any stream channel change that will restrict fish movement should be provided with an adequate fish passage structure or facility.

h. Pipeline routes should avoid areas of productive or critical benthic habitat such as larval king crab settling areas, larval shellfish release areas, salt marshes, and important clam beds.

i. Pipelines should be designed or sited in a manner that will not impede crab passage or migration.

2. Tanker docks and fueling facilities, which must be located in marine waters, should be designed to include:

   a. Automatic shut-off systems to stop the flow of fuel from storage areas in the event that a dock is damaged or destroyed.

   b. Redundant safety systems with exceptional safety factors incorporated in the oil transfer pipes, hoses, and other equipment, to eliminate the risk of failure and subsequent oil spillage.

c. Redundant safety measures and additional crews should be required during operations with historically high spillage rates, such as the loading or unloading of tankers. These measures will help to prevent spills which often occur due to fatigue or carelessness.

3. Tankers

a. Only U.S. Coast Guard inspected load on top or segregated ballast tankers which meet Coast Guard standards should be allowed to transport oil in Alaskan coastal waters. Tankers destined for operation in western Alaska should be specifically designed to withstand ice infested waters, with reinforced double hulls, multiple screws, and redundant steering systems.

b. Mandatory vessel traffic corridors and a vessel traffic control system should be implemented.

c. All tankers and other large vessels should be required to use certified pilots who are familiar with local hazards, weather, wind, wave, ice, and tidal conditions.

d. No discharge of ballast or bilge water should be permitted in the Bering Strait because of sensitive wildlife populations; or east of Cape Nome due to sluggish circulation regimes. Ballast water treatment facilities should be available at the tanker dock.

certain locations (ie Prudhoe Bay)
if oil spill occurs it will
effect dramatically on people not
mention the fisheries on the region
were to be recaptured or production
& before a major spill.

8/21/85

Spill - Per AK Region Contacts
& visit w/ [illegible] impossible
in the Aleutians - Kodiak
really not much recovered. There
spills that occur - not
really difficult to respond
& the ones that become [illegible]
in [illegible] to be taken from up
[illegible] was [illegible]
possible [illegible]

e. Tankers should be required to maintain a distance of at least 15 miles from established seabird colonies.

f. Ocean going tugs reinforced against ice should be available to rescue any tanker which loses power or steerage before it runs aground.

g. At least one ice breaking vessel should be continually stationed in the Bering Sea.

h. Tanker routes should only be established after conducting a careful scientific study and analysis to determine: 1) the safest routes through seasonal ice fields, storm paths, and hazards to navigation, and to 2) avoid sensitive fish and wildlife habitat which might be affected by a spill.

Oil Spill Containment and Cleanup

1. An effective oil spill containment and cleanup organization should be developed for a region before any drilling begins. This organization should have sufficient oil spill containment and cleanup equipment at its disposal to: 1) protect all identified critical habitats, and 2) effectively contain and cleanup the maximum probable projected spill.

2. An effective oil spill response organization should have an oil spill contingency plan which would detail:

   a. Activities associated with oil field development, including offshore activities involving the handling or storage of oil or hazardous substances.

   b. Conditions under which the organization has a clear capability to contain and cleanup spilled oil; and conditions under which hazardous operations should be suspended.

   c. Operational procedures, communications networks, detection and monitoring devices, equipment inventories, response times, and disposal sites.

   d. Contingencies and equipment to handle all oceanographic and meteorological conditions which can be expected to occur in an area of drilling.

   e. Provisions for under ice and broken ice containment and cleanup.

   f. Locations of additional containment and cleanup equipment, the location of ports and airfields for transferring emergency equipment, the availability of transport and support vessels, and approximate response times to various spill sites.

g. Provisions for periodic revisions to the contingency plan, as necessary to accomodate operational changes and allow the incorporation of new technology.

3. Oil spill containment and cleanup equipment should be stationed at strategic points in order to decrease the response time to any point within the lease area to a maximum of six hours after a spill has occurred.

4. Small scale containment equipment, sorbent material, and oil spill response training should be made available to coastal villages which might be impacted by a spill.

5. All tanker terminals, harbors, and ports which are utilized for oil related activities should have sufficient containment equipment available on site to handle the largest spill which might occur in those areas.

6. Anchor points for oil exclusion booms should be identified or placed near the mouths of all important fish streams, lagoons, bays, and estuaries.

7. Because existing oil spill containment and cleanup equipment is in many areas inadequate, satisfactory field demonstrations of equipment and organizational capabilities should be conducted prior to any approval of drilling permits, operation of facilities, or any shipment of oil by tankers. Where existing equipment

is inadequate to effectively contain and clean up oil in broken ice, development of effective equipment for containment and cleanup of oil in ice should be made a requirement of permit approval.

8. Recognize the limited capabilities of existing equipment and the limited amount of equipment available. With present operational and technical oil spill containment and cleanup it can be most effectively used to protect the most sensitive fish and wildlife concentrations or habitats from oil spills.

9. Dispersants - In the event that weather conditions or the location of a spill make mechanical containment or cleanup impossible, dispersants should be considered as an option to protect fish and wildlife resources under certain circumstances. However, there are several drawbacks to the use of dispersants.

   The primary problem is that insufficient data is available on the effectiveness and toxicity of dispersants to make an objective decision regarding their use in Alaskan waters. Certain dispersants and dispersant-oil mixtures can be more toxic than the original parent oil, thereby precluding their use in most cases. The Environmental Protection Agency (EPA) has published a list of approved dispersants; however, the presence of a dispersant on this list only signifies EPA's acceptance of the method used to test the dispersant and is not necessarily an endorsement of its innocuous nature. The second problem is that, dependent upon type, dispersants will only work under certain temperatures and sea conditions. If these conditions do not exist during a spill then dispersants will not work. Third, there has to be a means of delivering the dispersants to the spill site. Vessels, fixed wing aircraft, and helicopters are all feasible, but weather and visability must meet minimum standards to be effective, especially in the case of airborne systems. Fourth, dispersants only remove the threat of mechanical damage (i.e., coating and abrasion) to fish, wildlife, and habitat, and may actually increase the amount of toxicity related damage resulting from a spill.

In light of the aforementioned problems, dispersants should only be considered as an option to protect fish and wildife resources or habitats under the following circumstances:

a. Only after consultation with the Departments of Fish and Game and Environmental Conservation. To effectively utilize dispersants, approval for their use, and the conditions under which they can be used will have to be determined in advance of any spill.

b. When mechanical means of oil spill containment and cleanup are not feasible.

c. When oil spill trajectories clearly indicate that the threat of physical damage and fish and wildlife mortalities at the projected impact site clearly exceed the toxic effects of using dispersants at the spill site or at some point along the spill trajectory.

d. Dispersants should only be used to protect sensitive species and habitats from the physical effects of oil spills and should never be used simply to remove visible components of oil pollution. Dispersants increase toxicity and solubility within the water column and may adversely affect larval marine organisms and fish if used improperly. Species sensitive to physical damage from oil spills include: seabirds, waterfowl, seal pups, intertidal spawning herring, and pelagic juvenile marine species. Sensitive habitats include: eelgrass, Fucus beds, salt marshes, stream deltas, and depositional shorelines.

e. Dispersants should only be used on large oil slicks in open water areas which present a definite threat to fish, wildlife, or sensitive habitat on shore. If a spill is far offshore and is breaking up, it should be allowed to dissipate naturally unless it can be contained or cleaned up by mechanical means.

f. Do not use dispersants in spawning areas during seasons when large concentrations of commercial or ecologically important fish or shellfish eggs or larvae are in the water column.

g. Do not use dispersants on spills of light hydrocarbon products such as gasoline or light diesel fuels. These products naturally dissipate rapidly and dispersants would increase environmental damage by distributing them in the water column. Use only on crude and bunker oils.

h. Only non-toxic dispersants, or low-toxicity dispersants with a very low application rate (one gallon of dispersant to 100 gallons of oil), should be used on Alaskan spills.

Monitoring

1. Ambient hydrocarbon levels should be recorded in the water column and sediments prior to any developmental activity or facility operation which will discharge hydrocarbons or other hazardous substances into the marine environment. Ambient levels should further be monitored regularly to insure that discharge standards are not exceeded.

2. Tissue samples of species which commonly occur and are harvested in an area of oil development should be obtained periodically to insure that hazardous bioaccumulations of hydrocarbons, heavy metals, or other hazardous substances do not occur.

E

GRAVEL MINING & GRAVEL ISLANDS

DREDGING & FILLING

DREDGING AND FILLING, GRAVEL MINING, AND GRAVEL ISLAND CONSTRUCTION

Dredging, filling and gravel mining take place during development and production of petroleum resources and are conducted to 1) create and maintain navigational channels (dredging), 2) lay pipelines for the transportation of oil and gas (dredging), and 3) obtain a source of material for fill or construction (dredging and gravel mining). Filling consists of taking materials produced by dredging and gravel mining and depositing them in another area either onshore or offshore. Disposal of dredge material, road and gravel pad construction, and gravel island building are types of filling.

The most obvious result of dredging, gravel mining, and filling is a destruction of habitat. Dredging and gravel mining may destroy, drain or drastically alter submerged bottoms, coastal wetlands and tidelands and can accelerate coastal erosion. Gravel mining in floodplains can alter stream courses, and change stream flows. Filling changes aquatic habitats to terrestrial habitats, and can alter circulation and surface drainage patterns. Long term damage done by dredging and filling is most likely in nearshore areas such as estuaries and wetlands. Long term damage by gravel mining is most likely to occur on streams and in the nearshore area. Waterfowl nesting and staging areas, fish spawning and rearing areas, and important commercial and recreational harvest areas are located in these highly productive habitats.

Dredging and filling can adversely affect plants and animals living in coastal habitats. Alteration of circulation patterns can displace plankton to different environments. The suspension of bottom sediments causes the water to become turbid (cloudy) limiting the amount of light entering the water column and thus reducing phytoplankton growth rates. Suspended bottom particles can clog the breathing apparatus of fish and the feeding mechanisms of filter feeding animals such as clams, mussels and sponges. As the sediments settle out and collect on the bottom, eggs on spawning grounds and plants and animals that are non-mobile may be smothered. Benthic and epibenthic organisms (animals living on the surface of the bottom substrate) are destroyed as they are swept into dredging equipment. Other organisms are displaced or driven out of the area by the dredging and mining activities.

Recommended Mitigative Measures

Dredging and Gravel Mining - General Measures

1. Dredging and gravel mining should be avoided in highly sensitive fish and wildlife habitats.

2. Before major dredging projects are planned, site specific studies should be conducted in the area under consideration to determine local oceanographic and hydrological conditions including: circulation patterns, temperature, salinity, and dissolved oxygen. The biological productivity of the area should also be evaluated and the location of vital habitats identified. This information should be used to plan and schedule dredging so that minimal environmental damage occurs.

3. Detailed plans for dredging and gravel mining operations should be submitted to resource management agencies well in advance of proposed activities so that operational delays can be eliminated and site specific mitigating measures may be developed to protect local fish and wildlife resources from unnecessary impacts.

4. Activities which are likely to require dredging, such as the construction of nearshore facilities and onshore pipeline routes, should be sited where minimal dredging would be required.

5. Dredging and mining activities should be scheduled to avoid breeding periods and other critical life history stages of sensitive species.

6. Dredging should be conducted in a manner which will prevent the release and spread of silty bottom sediments with a high biological oxygen demand into the water column. "Silt curtains" or "diapers" may be used to retain sediment laden waters near the dredge site. However, silt curtains are only effective in still waters.

7. Hydraulic dredges should not be used in areas which support large populations of larvae or juveniles of commercially or environmentally important marine species which can be entrained or injured in the pumps and dredge lines. In areas with large populations of larval or juvenile marine organisms, a clam shell dredge produces fewer impacts.

8. Silt levels from dredging operations should be at ambient levels by the time they reach sensitive habitats.

9. Operating controls for dredges should be established which will reduce adverse environmental impacts.

10. Because in some cases gravel may be scarce, quarry rock and alternate materials should be used for construction whenever possible.

11. Where possible, gravel from abandoned structures such as tailing piles, drill pads or airstrips, should be reused to avoid impacts to watercourses and aquatic habitat.

12. Upland and offshore gravel sites are preferred over floodplains and nearshore areas. Impacts resulting from transportation of gravel and other secondary impacts associated with mining operations need to be considered when selecting a site. The site selected should be that which would result in the least total impact.

13. Gravel mining sites should not be located within the annual floodplains of fish streams or rivers, unless feasible alternatives are non-existent. Gravel mining in floodplains can result in channel changes, channel blockages, siltation, and fish entrapment.

14. Gravel mining should not occur on spits protecting lagoons, in the lagoons themselves, or in nearshore areas.

15. Gravel mining in wetlands should be avoided.

16. Development of a minimal number of upland, intensive-use gravel sites is preferable to a proliferation of small sites; minimization of sites reduces access road requirements and limits the area of habitat disturbance.

17. A mining site should meet the long term requirements for all activities in a given area; sites slated for one-time use by a single project should be avoided.

18. Deeply mined gravel pits should be converted to water reservoirs where the need exists. This will provide a dependable winter supply of water, and will preclude the need for water removals from biologically sensitive habitats such as fish overwintering areas.

Dredging for Channels

1. Appropriate choices should be made for the location and design of channels. Plans should include: 1) proper alignment of the channel to minimize erosion and maintenance dredging; 2) minimum dimensions for length, width, and depth of channel to limit destruction of productive marine habitat and maintain natural circulation patterns; 3) appropriate choice of dredge type which will minimize siltation (usually suction dredge); 4) establishment of beneficial operating controls for dredging operations which will minimize short term impacts on fish and wildlife; 5) proper disposal of spoil in upland sites; and 6) time of year in which dredging operations would encounter the least amount of biological activity.

2. Existing natural channels should be utilized to the greatest extent possible. New channels should be located so as to prevent the loss of vital areas and to avoid erosion of shorelines.

3. Channel dredging can be avoided in most vital habitats by limiting dredging to natural channels. Depositional areas will require continual maintenance dredging. All vital habitats

should be identified during the planning phase of each dredging operation and a buffer zone of several hundred feet or more should be maintained between those areas and dredging operations. Buffer zone boundaries should be determined on a case-by-case basis.

4. Minimize the length, depth, and width of the channel to maintain the natural pattern of water circulation, to avoid major salinity alterations, and to protect vital habitats. Excessively wide channels may lead to an unnecessary loss of vital habitat areas such as clam beds or eelgrass beds. In general, a navigation channel needs to be no wider than about three or four times the width of the largest vessel for which it is designed. Similarly, channels do not need to be deeper than about 4 feet beneath the deepest draft vessel at low water, provided that traffic moves at moderate speeds to reduce stirring up the bottom where fine sediment has accumulated. In many cases it is not unusual to add to this 4 foot depth an additional foot or so to accommodate siltation or slumping. This will further reduce the frequency of maintenance dredging.

5. To avoid excessive slumping of the adjacent bottom into the channel and repeated maintenance dredging, channel sides should be dredged out to a final stable slope, or "angle of repose" during the initial operation. The exact cut will depend on local geohydrological conditions.

6. Projects which would cause accelerated shore erosion should be avoided, or operated in such a manner as to eliminate erosion-inducing effects. Dredging too close to the shore in shallow-water areas may cause severe shoreline recession, both from channel slumping and from direct erosion of banks, and should be avoided.

7. Dredging near the toe or face of a bluff should be avoided as it exposes the bluff to increased erosion.

8. New channels should not be created between freshwater aquatic systems and coastal waters.

9. Avoid alteration of natural water channels through straightening, deepening, or diking.

Dredging for Pipeline Laying

1. Pipeline routes should avoid highly productive, economically valuable, or unique habitats.

2. If important habitats cannot be avoided when planning pipeline routes, avoid dredging during such sensitive periods as fish migration and spawning, and waterfowl nesting and staging. Onshore pipeline laying should be conducted during the winter when the ground is frozen and impacts caused by construction equipment are minimized.

3. Limit dredging to the smallest area necessary for pipeline placement.

4. Avoid permanently blocking surface drainages during pipeline installation. Elevated pipelines and roads should be adequately culverted. Soil over buried pipelines should be contoured to original slopes, and banks at stream crossing should not be altered. Care should be taken to prevent slumping in permafrost soils or altering drainage patterns.

5. Whenever possible, "double ditching", the removal of topsoil and vegetation first and replacement of it last, should be used. This promotes more rapid restoration of vegetation.

6. Limit equipment and activities to the pipeline right-of-way

7. Use hydraulic dredges instead of jet systems when bottom sediments are silty and siltation is likely to affect important habitats. Hydraulic dredges are capable of pumping dredged spoils up to one mile from the site, thus protecting habitats adjacent to the dredged area.

8. Use silt curtains (polyethylene sheets hanging from float lines to the water's bottom) to trap silt and sediment. Silt curtains, however, are effective only in still waters.

Dredging in Streams

1. Dredging should occur only during low water periods in order to minimize siltation.

2. Dredging should not occur in known or suspected fish spawning or nursery areas. Wherever possible dredging should occur below spawning areas.

3. Dredging operations must follow procedures that will minimize the resuspension of instream materials.

4. Dredging should occur during periods of lowest biological activity.

Gravel Mining in Marine Areas

1. Gravel mining should be avoided in highly sensitive fish and wildlife habitats.

2. Gravel should not be mined from spits, beaches, deltas of rivers that support fish, lagoons, estuaries, or barrier islands.

3. Gravel mining site selection should be based on a study which considers not only gravel availability but also concentrations of biological resources; commercial, recreational and subsistence harvest activities; and effects of siltation on downstream habitats.

4. Silt control measures should be practiced in areas of biological productivity or where silt could be carried into productive habitats.

5. Organic overburden from offshore mining areas should be backfilled into previously mined areas to speed recolonization of the area by marine life.

Gravel Mining in Upland Areas

1. Detailed mining plans should be submitted to resource management agencies well in advance of mining operation to expedite permitting. Site specific mitigating measures should be developed if necessary to protect local wildlife resources from unnecessary impacts.

2. Where mining occurs in areas which support critical life history stages (esp. grizzly bear denning, raptor nesting, and moose and muskox wintering) operations should be timed to avoid those life history stages.

3. Impacts of roads and other support activities and structures should be considered during site selection.

4. Sites should be located so as to prevent mass wasting into fish streams.

5. Vegetation removal should be limited to the area necessary for one years operation.

6. Mined areas should be revegetated and restored to original contours or used for water storage.

Gravel Mining in an Annual Floodplain

Annual floodplains are the least desirable location for gravel mining. Mining in offshore marine areas or in uplands is preferable. In an area where the only feasible gravel source is within an annual floodplain, the following guidelines should be followed to minimize impacts.

1. Floodplains of streams which do not support fish populations should be considered as gravel sources before those streams that support anadromous or non-anadromous fish. Because of increased risk of hydrological changes in the stream, floodplains of anadromous fish streams should be considered last.

2. Where mining must occur in active floodplains, braided rivers should be considered as primary gravel sources; other river configurations, listed in order or likelihood of causing the least physical change, are split, meandering, sinuous, and straight.

3. When small quantities of gravel are required (approximately 50,000 m^3 or less), select sites that will scrape only unvegetated gravel deposits.

4. When large quantities are required (in excess of 50,000 m^3), select larger rivers containing sufficient gravel in unvegetated areas, or select terrace locations on the inactive side of the floodplain and mine by pit excavation

5. Consider length, location and other impacts of access roads in site selection. Mined areas should be on the same side of a stream as the access road to minimize stream crossings.

6. Work should be scheduled to avoid peak biological events such as local fish migration and spawning, bird and mammal breeding, nesting, and rearing-of-young. Critical habitats such as spawning and overwintering areas should be avoided.

7. Riffle areas should be avoided except in the following situations:

   a. When more rapid site recovery is desirable.

   b. When the riffle is an unproductive aquatic habitat because of cementation or infiltration by fine sediments.

   c. Where deepening the thalweg may reduce or eliminate *aufeis* development.

   d. In a long riffle, excavation may be acceptable near the middle of the riffle.

8. Vegetated areas should not be disturbed when sufficient quantities of gravel can be obtained in unvegetated areas of floodplains.

9. Material removed from unvegetated and exposed (de-watered) bars of a watercourse should only be removed to the existing ice or water level. Following mining, bars should be sloped to enhance drainage.

10. Where removal must occur in vegetated areas, preference should be given to locations in dominant, homogeneous vegetative communities.

11. If mining in vegetated areas, all overburden and vegetative slash and debris should be saved for use during site rehabilitation to facilitate vegetative recovery. This material should be piled or broadcast in a manner so that it will not be washed downstream.

12. Material sites within the active floodplain should not disturb the edge of active channels or form new high-water channels through the site.

13. Site configurations should avoid use of long straight lines. Sites should be shaped to blend with physical features and surroundings.

14. Gravel mining should occur in such a manner that the flow of the watercourse is not rechanneled, blocked or diverted.

15. When scraping in active or inactive floodplains, maintain buffers that will contain active channels to their original locations and configurations.

16. Banks of watercourses should not be altered. Undercut and incised vegetated banks especially should not be altered.

17. Stream crossings should be selected at points where no alteration of the banks is necessary.

18 Equipment should not enter or cross an active (open flowing) channel of the watercourse.

19. Movement of equipment through willow (Salix) stands should be avoided whenever possible.

20. Mining should occur in such a manner that berms, potholes, and/or depressions that could cause fish entrapment are not created.

21. Pit mining if required, should be located in areas where there is a low probability of diverting active stream channels into the mined area. Such areas include terraces, inactive floodplains, or stable islands with adequate buffers.

22. Pit excavations should be separated from the active floodplain by a buffer designed to maintain this separation for two or more decades.

23. If pits are left in floodplains, an outlet should be constructed to provide escape for fish trapped during high water. A pit connected to a fish stream, if properly designed, can provide for fish rearing and overwintering. Where a pit is adequately protected from flooding, and will not be used for fish habitat, waterfowl and shorebird habitat can be created by providing a diversity of water depths.

24. Pit outlet channels should be deep enough to allow fish passage during low flow conditions and be as narrow as possible. All outlet channels should be at the downstream end of the pit, angled downstream, and connected to a non-depositional area of the main channel. Outlet channels should be constructed at the end of site rehabilitation to minimize siltation in the river.

25. Where gravel washing operations are required in floodplains, wash water should be recycled with no effluent discharge to the active floodplain. If settling ponds are required, they should be designed to provide adequate retention time for site-specific conditions. Outflows should be constructed to avoid fish entrapment.

26. Upon completion of material removal the mining site should be graded smooth with all berms and potholes removed, and all depressions filled to prevent entrapment of fish. Stored material should not be stockpiled in the floodplain.

Filling - General Measures

1. Filling (dredge disposal, gravel pad and road construction, and gravel island building) should be avoided in highly sensitive fish and wildlife habitats.

2. Activities which are likely to require filling, such as the construction of near shore facilities and onshore pipeline routes, should be sited where minimal dredging and filling would be required.

3. Detailed plans for filling operations should be submitted to resource management agencies well in advance of proposed activities so that permitting delays can be eliminated and site specific mitigating measures may be developed to protect local fish and wildlife resources from unnecessary impacts.

4. Filling activities should be scheduled to avoid breeding periods and other critical life history phases of sensitive species.

5. Easily erodable material (i.e. silt) should not be used for construction of offshore facilities. The grain size of these

materials is too small to withstand ocean currents and waves and are likely to result in increased water turbidity and burial of downstream habitats.

6. Because gravel sources may be scarce, quarry rock and alternate materials should be used for construction whenever possible.

7. Solid fill structures such as gravel islands and causeways should not be located in areas where they will disrupt local circulation patterns, adversely affect water quality, or interfere with fish or marine mammal migrations.

8. Do not construct long continuous fill causeways or docks. Use piling structures or provide sufficient breaches to allow normal fish passage, and for maintenance of water quality.

9. Use fill material compatible with the area. In areas where there is a high ambient silt level such as the Yukon River Delta, silt may be acceptable for structures. In areas with low turbidity - use only clean material and armor to prevent erosion and siltation.

Dredge Disposal

1. When the spoil removed in a dredging operation is compatible with existing material (i.e. mud on mud, sand on sand), direct disposal of the dredge spoil onto the bottom may be acceptable.

However, the spoil should not contain toxic pollutants, should spread in a thin layer (less than two inches) which will allow marine organisms to burrow through it, should not be deposited in ridges that significantly impede water flow, and should not cover vital habitat areas, i.e., wetlands, tideflats, estuarine waters, productive benthic habitats or Fucus and eelgrass beds.

2. In some areas, littoral zone disposal of material dredged from rivers or nearshore channels may be required if deep water disposal would create a deficit budget in longshore sediment transport. Such disposal should be planned to avoid impacts to sensitive species and habitats.

3. Dredged material should not be deposited in wetlands, but rather in a designated area where there will be a minimum of environmental alteration.

4. Dredged material should be disposed of at a sufficient distance inland to prevent reintroduction of materials into the waterway.

5. In water depths in excess of 2 meters (6.5 feet), water column turbidity can be reduced by vertically discharging the dredged slurry through a diffuser (a 90-degree elbow) at a depth of 0.5 to 1 meter below the water surface. Use of a diffuser minimizes areal coverage over the disposal area but maximizes mounding of the fluid mud and dredged material. The

simple open-ended pipeline, discharging above and parallel to the water surface, creates the greatest water column turbitity but produces a relatively thin, widespread fluid mud layer.

Gravel Pad and Road Construction

1. Gravel pads and roads should not be contructed in vital fish and wildlife habitats.

2. All linear gravel structures, such as roads and construction pads, should be adequately culverted to prevent artificial ponding or water starvation.

3. Facilities and associated developments should be designed to reduce number and size of pads needed and the amount of gravel needed.

4. Avoid building pads, especially roads, near waterways to lessen erosion potential.

5. Pads and roads should be of sufficient thickness to prevent permafrost melting. Artificial insulation should be incorporated in fill to reduce gravel requirements.

6. Berms and drainage ditches in non permafrost areas should be installed to control the rate of runoff from unvegetated surfaces.

7. Pads should be built in such a way that drainage patterns in surrounding areas will not be altered.

8. Dust should be controlled on pads by watering, not oiling. Dust accumulation on snow and vegetation leads to accelerated spring snow melt and vegetation changes.

9. Roads across wetlands or wet tundra should be aligned perpendicular to the direction of sheet flow.

Gravel Islands

1. Vital fish and wildlife habitats should be avoided as sites for gravel islands.

2. Construction of gravel islands should be scheduled to avoid breeding periods, migrations, and other critical life history stages.

3. Barge routes for transportation of material to construction site should be planned to avoid marine mammal and bird concentrations. Bubbles from the barges wake can persist for several hours, causing a "behavioral" barrier to migratory movements and barge traffic disrupts resting and feeding birds.

4. To reduce turbidity and siltation, use of coarse-grained gravel is preferred over use of fine-grained construction materials such as silt, sand, and in some cases gravel.

5. Shorelines of artificial islands should be protected from erosion using the methods found in the Shoreline Alteration section of this report. Erosion can cause siltation and environmental damage to downdrift areas as well as necessitating continual replenishment of eroded material.

6. Caisson retained islands require less gravel fill, can be moved, and should be considered for use during exploration and production drilling over solid fill gravel islands.

7. Gravel islands should not be sited in locations where significant interference with local circulation and subsequent changes in salinity, temperature, and sediment transport may occur.

F

SHORELINE ALTERATION

SHORELINE ALTERATION

Shoreline alteration involves the construction of coastal structures in order to stabilize the shoreline (riprap, breakwaters, groins, jetties, bulkheads) and to provide transportation access between or across land and water (piers, causeways, bridges).

Fish, wildlife and aquatic plants may be adversely impacted by the construction and placement of structures along the coastline. These structures can lead to an alteration of tidal circulation, disruption of shoreline sediment transport, and an alteration or destruction of habitat. Highly productive habitats such as waterfowl staging areas, eelgrass beds and herring spawning areas would be affected by shoreline alteration. Shoreline alteration, proceeding one project at a time, can ultimately alter or destroy the entire natural shoreline of a coastal system.

Recommended Mitigative Measures

General Measures

1. Structures that will alter the coast should not be built along the shoreline unless there are no alternatives.

2. Only water-dependent facilities should be placed along the coastline. All other facilities should be located inland if possible.

3. If coastal construction is necessary:

   a. structures should not be placed in vital coastal habitats such as wetlands, tideflats, estuaries, lagoons, or shellfish beds;

   b. natural drainage patterns of shorelands should not be altered. Channelization or diversion of coastal streams away from tideflats and wetlands can lead to increased pollution, altered salinity levels, and decreased biological productivity in estuarine waters;

   c. coastal structures should not be built in intertidal and subtidal areas which provide valuable habitat for aquatic organisms;

d. channel erosion should be minimized by routing shipping into deeper channels and establishing speed limits;

e. construction activities should adhere to water quality standards and should be scheduled to avoid critical periods of breeding, feeding, and migration of coastal species;

f. large coastal structures should not be built in areas used for marine mammal harvest;

g. coastal structures should not be constructed in areas where rapid coastal erosion or deposition is occurring. Coastal engineering studies should be conducted as part of each project to identify these areas and to insure that construction will not aggravate the problem; and

h. during construction of coastal structures, turbidity should be kept to a minimum and turbidity control devices should be used when necessary.

Bulkheads

1. Bulkheading should be avoided by siting development away from eroding shorelines.

2. The construction of bulkheads to prevent coastal erosion should only be used when there is no alternative. Whenever possible use natural erosion protection such as planted marsh grasses rather than building bulkheads to minimize erosion on unstable shores or banks. Riprap causes less impact than bulkheads and should be a second choice for erosion prevention.

3. Bulkheads should not be built where they disrupt wetlands or other vital habitats such as clam beds. Even if bulkheads are not placed in vital areas such as estuaries, wetlands, or tideflats, they should be located far enough away to avoid altering sedimentation and water circulation in these important habitats.

4. Bulkheads should be placed inland from all wetlands. Bulkheads and similar structures used to prevent shoreline erosion in wetland areas should be built above the annual flood mark. Exceptions to this requirement may be made when bulkheads are constructed on shorelines which are devoid of vegetation or cannot be revegetated. Erosion is usually severe on unvegetated shorelines, thus requiring bulkheading for stabilization. It is recommended that bulkheads built on unvegetated shorelines not extend outward from the mean low-water mark.

5. Bulkheads should not disrupt the outward flow of groundwater or runoff, and should be designed to be permeable to the

natural flow of both groundwater and runoff. Wooden bulkheads should be built with "weepholes" backed by filter screens to allow the passage of water through the structure.

6. In cases where bulkheads must be used, establishing a buffer strip of vegetation between the bulkhead and the water will protect coastal habitat and help reduce undermining of the bulkhead. When possible, existing shoreline vegetation should remain undisturbed.

7. Bulkheads should be designed so that reflected wave energy does not erode intertidal or subtidal areas.

8. Bulkheads should be constructed on a gently sloping shoreline rather than a steep one to reduce erosion.

9. During construction of bulkheads, it is generally desirable to drive supporting pilings in rather than jetting them in because jetting causes siltation and affects water quality. However, there may be instances (i.e., bird nesting) where the disturbance from pile driving may outweigh the effects of siltation, and jetting may be more desirable.

10. In appropriate cases, dredging should be done after the bulkhead is installed and then the area behind the bulkhead should be backfilled. This will prevent materials from slumping into the channel and will reduce the need for frequent maintenance dredging.

11. Fill material should not be excavated from shallow water and productive wetlands.

12. Riprap should be placed in front of a bulkhead to minimize its impacts on wave refraction and toe scour.

13. Bulkheads should not be constructed with sharp angle turns because this may create flushing or shoaling problems.

14. Vertically designed bulkheads (especially when they protrude to minus tide levels) should be avoided in salmon rearing areas. Stair-step design bulkheads or riprap revetments with a slope of less than 45° provide more protective habitat for salmon fry.

15. Bulkheads should be used only for erosion control and not to create real estate by filling. Do not use bulkheads for cosmetic purposes.

Riprap and Other Revetments

1. Armor unit revetments should be made of clean, non-polluting material. Any material contaminated with grease, phenol, lead, or other toxic elements should not be used.

2. Revetments with facings that are highly irregular (such as riprap) and have a shallow slope, have a greater ability to

support marine life and are preferred over steep-sided smooth revetments.

3. Riprap should be used rather than bulkheading wherever possible, although planting suitable vegetation to prevent erosion is more desirable than riprap.

4. When compared to bulkheads, riprap is more permeable to the flow of groundwater and runoff. The water can move unimpeded through the filter cloth and crushed rock backing of riprap structures. Other advantages of riprap are that it provides attachment for marine life, it can be built to conform to the natural configuration of the shoreline, and it is less expensive to build then most other erosion prevention structures.

Breakwaters, Groins, and Jetties

1. The use of groins to stabilize or widen beaches should be avoided if at all possible.

2. If groins are built the following recommendations should be followed to minimize the impacts:

   a. Place the shoreline end of the groin above the normal storm-tide line to prevent scouring.

b. Fill the area around the groin with sand, thus allowing drifting sand to bypass the groin and replenish downdrift eroded areas.

c. Place polyethylene mat (filter cloth) under the base of the groin to protect the structure from slumping due to erosion.

d. In some cases, excessive amounts of trapped sand can be mechanically transported around the groin to replenish eroding areas.

e. Groins which capture all littoral drift, thus encouraging or aggravating downbeach erosion, should not be constructed. Permeable groins or groins designed to include several weirs are preferable.

3. Dredging to bypass or remove accumulated sand from behind jetties should be scheduled for times of low productivity. Care should be taken in choice of downdrift sand release sites to avoid movement of sand into productive fish and shellfish areas or important plant communities.

4. Jetties should not be built at the mouths of productive anadromous fish streams. Changes in an inlet following construction of a jetty can affect runs of migratory fish.

5. In the construction of breakwaters, the use of riprap or dumped stone is biologically more desirable than breakwaters with flat faces since either of the former provides more habitat for aquatic species.

6. The base of breakwaters should be protected from erosion so that scouring does not affect structural integrity and, therefore, aquatic organisms in the area.

Piers and Docks

1. When utilities, pipelines and roads cannot be routed around vital habitats, they should be elevated on piers rather than placed on solid fill causeways.

2. Piers crossing marshy areas should be elevated high enough to avoid continual shading of the area under the piers.

3. Pilings should be driven in rather than jetted in. Jetting affects water quality in the construction area.

4. In marine and estuarine areas, construction of docking facilities on a series of ice resistant mono-pod type legs should be considered as an alternative to solid fill causeways.

5. Spacing of pilings should allow free flow of tidal currents and littoral drift.

Bridges and Causeways

1. The location of bridges and causeways should avoid vital habitat areas. Whenever possible these structures should be located upland away from wetlands and water basins.

2. Bridges or causeways built across water areas should be elevated on pilings to minimize the disruption of natural water flow and to avoid alteration of vital habitat areas. Solid fill causeways should be avoided.

3. When fill or abutments must be used in areas subject to flooding, they should be designed so that the floodwaters will not be raised more than 0.3 meters (1 ft) above the natural flood level.

4. Culverts should be sufficiently large, and enough culverts should be used, to permit a natural rate of water passage through solid-fill causeways. To provide adequate fish passage, culverts should protrude sufficiently above the water so that the entire passageway is well lighted and that water velocities do not exceed 0.5 fps under all tide and wind conditions.

5. Bridged breaches should be used in causeway design instead of culverts where tidal flow, littoral transport or fish migrations will be affected.

6. When building causeways or bridges in wetland areas, heavy equipment should be operated from the construction site (i.e., roadbed) rather than from the wetland area.

7. Environmental disturbances should be minimized during construction. Matting and/or vehicles designed to prevent soil compaction are recommended for use in wetlands.

Small Boat Harbors

1. Small boat harbors should only be located on bodies of water with a high rate of flushing.

2. Small boat harbors should be designed to minimize the extent of excavation, shoreline alteration, and disturbance of vital habitat areas.

3. In order to eliminate channel excavation, floating docks should be used whenever possible. When it is not appropriate to use floating docks, piers built on pilings should be constructed over wetlands to provide access to deep waters. The piers should connect to land above the annual flood level.

4. The natural coastline should be preserved by placing boat slips farther out into the water and connecting them to the shore with piers. This will eliminate the adverse impacts of dredging and bulkheading.

5. Small boat harbors should not be constructed in wetlands. Piers and docks can be designed to extend over the wetlands to deep waters on pilings.

6. The construction of bulkheads, groins, and jetties should be avoided when building small boat harbors.

7. Support facilities for small boat harbors, including storage areas and buildings, should be located inland away from the coastline.

Coastal Pipelines

(See additional recommendations for pipelines in the Oil Pollution section)

1. Pipelines should not be placed in vital habitat areas such as wetlands, eelgrass beds, or clam beds.

2. When habitat disturbance is unavoidable, construction activities should be limited to the shortest time and smallest area possible.

3. Pipelines should be built during periods of low biological productivity.

4. After the pipeline is laid, the construction area should be restored to as close to its original state as possible, using original substrate and native species wherever feasible.

Coastal Roads

1. Build roads perpendicular rather than parallel to the coast.

2. Coastal roads should not cross wetlands.

3. Stream crossing should be designed to allow fish passage during any flow. Bridges are preferred. If culverts must be used, the following guidelines should be followed:

    a. Culverts placed in rivers or streams frequented by fish should be installed so that at least one-fifth of the diameter of round culverts or six inches of elliptical or arch culverts is set below the lowest elevation of the natural stream bottom.

    B. Culvert dimensions necessary to pass fish upstream are dependent upon the velocity of the water within the culvert when the fish are present; the time of year these velocities occur; the length of the culvert which must be negotiated by the fish; and the species, size, and age class of fish present and their upstream swimming capabilities. Table 1 represents the maximum water velocities through different culvert lengths which can be successfully negotiated by several Alaskan fish species. To avoid the possibility of restricting fish passage, velocities through culverts should not exceed 0.5 fps.

c. Alternative drainage structures, other than culverts, should be installed if fish passage cannot be assured through culverts.

d. All culverts should be aligned with the natural stream channels.

e. All bank cuts, slopes, fills, and exposed earth work attributable to culvert installation should be stabilized to prevent erosion during and after the project.

f. No culverts should be built in fish spawning or rearing areas. Roads crossing streams at such critical habitats should be re-routed or a bridge installed instead of a culvert.

TABLE 1

Maximum water velocities through different culvert lengths which can be successfully negotiated by several Alaskan fish species.

Length of culvert in feet	Group I Upstream migrant salmon fry and fingerlings when upstream migration takes place at mean annual flood	Group II Adult spring spawning slow swimmers: grayling longnose suckers	Group III Adult moderate swimmers: pink salmon chum salmon	Group IV Adult high performance swimmers: king salmon coho salmon sockeye salmon steelhead	Group V Juvenile slow swimmers and other adult slow swimmers: grayling, longnose suckers, broad whitefish, burbot, sheefish, humpback whitefish, Northern pike, Dolly Varden/ Arctic Char, upstream migrant salmon fry and fingerlings when migration not at mean annual flood
30	1.0	3.7	6.8	9.9	2.0
40	1.0	3.1	5.8	8.5	1.8
50	1.0	2.6	5.0	7.5	1.7
60	0.9	2.3	4.6	6.6	1.6
70	0.8	2.1	4.2	6.0	1.4
80	0.8	1.9	3.9	5.5	1.3
90	0.7	1.7	3.7	5.1	1.2
100	0.7	1.6	3.4	4.8	1.2
150	0.5	1.5	2.8	3.7	1.2
200	0.5	1.5	2.4	3.1	1.2
>200	0.5	1.5	2.4	3.0	1.2

feet/second

Source: Alaska Boards of Fisheries and Game and Alaska Department of Fish and Game Proposed Regulations Governing Fish and Game Habitat Protection

G

FORMATION WATERS

FORMATION WATER

Crude oil as it comes from the ground is generally composed of natural gas, petroleum, and water. The water, called formation or produced water, is contaminated with hydrocarbons, heavy metals, and hydrogen sulfide. Before crude oil is delivered to a refinery, the water must be separated from the oil and gas. Once separated, it is treated with heat or chemicals and discharged back into marine waters, sometimes in the same location for several years. Formation waters may also be reinjected into disposal wells or pumped back into the production well to maintain pressure. Discharged formation waters can retain up to 50 ppm of oil as small droplets and up to 35 ppm of dissolved hydrocarbons.

Formation waters are highly toxic and their disposal into the marine environment can be detrimental, especially if they are discharged into shallow nearshore waters or waters which exhibit a very sluggish circulation regime. Deeper waters, as well as larger bodies of water, tend to dilute formation waters. In shallow depths where dilution by seawater may not occur, benthic (bottom dwelling) organisms living near the point of discharge may be totally destroyed. Fish and free swimming organisms do not seem to be greatly affected by the discharge of formation waters because of their ability to move through and out of contaminated areas. However, ammonia, a constituent of formation water, is known to produce gill enlargement (hyperplasia) in fingerling chinook (king) salmon; and mercury, a heavy metal found in formation waters, has been shown to concentrate in fish in excess of 10,000 times the amount present in surrounding water.

Studies have also shown that formation waters are anoxic (depleted of oxygen) and may have higher temperatures and/or lower salinity values than receiving waters. Waters depleted of oxygen may kill animals directly, although the usual effect is impairment of health or, if they are mobile, abandonment of an area.

Recommended Mitigative Measures

General Measures

1. Wherever possible, formation waters should be reinjected back into offshore or onshore subsurface strata in a manner that will not pollute surface or subsurface waters.

2. Formation waters containing significant amounts (as determined by Environmental Protection Agency or Department of Environmental Conservation marine discharge standards) of heavy metals, hydrocarbons, hydrogen sulfide, or other toxic chemicals should not be discharged into the marine environment.

3. To insure that all potentially adverse impacts are mitigated, the following information is needed before siting a facility that will discharge formation waters:

    a. A study should be conducted on the body of water into which the formation waters will be discharged in order to determine the rate of flushing; the volume of the water basin; the pattern of water movement; and the suspended sediment load by season;

    b. The type of facility that will be discharging formation water, the rate, volume, and composition of formation water that will be discharged; and

c. The degree to which formation waters will have to be treated before being discharged so that they do not alter or reduce the carrying capacity of the coastal environment.

In order to implement these guidelines, site specific studies will have to be conducted and mitigating measures adopted on a case by case basis. In many instances, the chemical composition and quantity of formation water will need to be monitored prior to setting effluent limitations. In instances where information is not available regarding the effects of formation waters on the various stages of animal life history, more research will have to be done to determine those impacts.

4. Do not discharge formation waters into any freshwater lake or stream.

5. Facilities should not be located in vital habitats such as wetlands, tideflats or estuaries. These highly productive areas are important for the production and harvest of waterfowl, crabs, clams, herring, salmon, and a variety of other fish species.

6. Facilities releasing formation waters should be sited in areas with good circulation and strong currents, where the discharged effluent will be rapidly diluted and dispersed. Formation water discharge into shallow waters with weak circulation will cause the greatest environmental damage and is discouraged.

H

COOLING WATERS & WATER WITHDRAWAL

COOLING WATERS AND WATER WITHDRAWAL

Large quantities of water are required during petroleum development for cooling and other industrial purposes and for domestic use. Cooling waters are used to reduce waste heat produced by treatment facilities, oil refineries, petrochemical plants, LNG (liquified natural gas) plants, and power plants. Other industrial uses of water include drilling, construction, and maintenance of snow and ice roads or other roads, hydrostatic testing, and waterflooding (the injection of water into a geologic formation to increase pressure at the well site). Domestic water requirements depend upon the number of people using the water and the amount of water available. Water requirements are met by drawing water from nearby lakes, streams, springs, estuaries, lagoons, bays, or the ocean; by collecting groundwater runoff; or by melting snow and ice.

The aquatic life in waters used for cooling is threatened by passage through plant cooling systems (entrainment), by entrapment on the protective screens of water-intake structures (impingement), by the discharge of heated water into the aquatic environment (thermal pollution), and by the addition of chemicals to the cooling waters (chemical pollution). These impacts can be especially severe if facilities using cooling waters are located in the estuarine spawning and nursery areas of fish and shellfish.

Most of the impacts on aquatic life by other water withdrawal activities are similar to those produced by withdrawal of cooling waters (ie. entrainment, impingement, thermal pollution, and chemical pollution). However, in Arctic climates the most severe impact of water withdrawal is the depletion of winter water reserves in freshwater lakes and streams.

Recommended Mitigative Measures

Cooling Waters - General Measures

1. Closed cycle cooling systems should be used instead of open cycle (once through) cooling systems wherever possible. Closed cycle cooling systems cause fewer environmental problems than open cooling systems.

2. Before siting facilities which will use either closed cycle or open cycle cooling systems, site specific studies should be conducted to determine the location of vital habitats in the vicinity. Site specific oceanographic studies and bioassays should be conducted to determine the natural systems ability to absorb heat without biological damage.

3. Before choosing a site for a facility that will require a cooling system, a sound and comprehensive water management program should be developed to study: the supply of ground water, aquifer replenishment sources, the potential for contamination and depletion of waters, and the possibilities for reclaiming wastewater and minimizing unnecessary water withdrawals.

4. Cooling water channels should not be dredged through wetlands nor should natural creeks be used as cooling water conduits.

5. Screens on intake structures should not exceed 1 millimeter (0.04 inches) mesh size and intake velocities at the screens should not exceed 7.5 cm/sec (0.25 ft/sec).

6. Outfalls should be located in areas of rapid dilution and at an adequate distance from the intake so that water is not recirculated in the system.

7. The use of toxic chemicals to remove encrusted sealife in cooling systems should be avoided to prevent toxic impacts on recieving waters. Mechanical cleaning methods or heat treatment should be used instead.

8. Freshwater lakes, streams, or wetlands should not be considered as a water source for cooling waters, or sites for thermal discharges.

Closed Cycle Cooling Systems

1. The use of closed cycle cooling systems (such as cooling towers or spray ponds) is preferred over open cycle systems because they cause less environmental damage.

2. Only closed cycle cooling systems should be used in estuaries and other areas that are vital to the coastal ecosystem or which have a high biological productivity. With this type of cooling, water is recirculated rather than being continuously withdrawn from or discharged into aquatic environments thereby reducing the volume of water needed.

3. To minimize entrainment of organisms, intake velocities should not exceed 7.5 cm/sec (0.25 ft/sec) at the surface of the intake screens and screen mesh size should not exceed 1 millimeter (0.04 inches).

4. Toxic chemicals (such as chlorine) added to cooling waters to reduce corrosion in cooling towers and growth of fouling organisms in condenser systems, should be collected and treated before being released to the environment. The chemicals can be reduced by treatment such as chrome reduction or precipitation using ferrous sulfate in a reducing pit. These hazardous wastes should be disposed of in a landfill site designated for hazardous wastes.

5. Normally, adverse effects of vapor plumes and salt fallout from closed cycle systems are significant only in the immediate vicinity of the plant and may be alleviated by locating plants appropriately with respect to climate and geography. Plants should not be located near important wildlife wintering areas and early spring use areas where additional snowfall could impact wildlife populations.

6. Among various types of closed cycle cooling systems, spray canals appear to cause less environmental damage than evaporative cooling towers, and should be used wherever possible.

Open Cycle Cooling Systems

1. Facilities that use open cycle cooling systems should not be placed in critical habitats nor in coastal areas such as wetlands, tideflats, and estuaries where waters for cooling would be withdrawn from or discharged into sensitive habitats.

2. Facilities using open cycle cooling systems may be located along the open coastline provided that the following criteria are used as guidelines during site selection:

   a. Facilities should not be located near estuaries (e.g., inlets, bays) where water is transported in and out by tidal action.

   b. Facilities should not be sited in or near vital or critical habitats found along the open coastline.

   c. Intake and outlet structures should be located offshore where discharges will be diluted and cooled more rapidly, and waters are not withdrawn from productive nearshore habitats.

   d. Intake and outlet structures should not be placed in areas of high biological productivity.

e. Cooling water intake and discharge points should be separated as widely as possible, taking advantage of water layering or other natural features to prevent recirculation of discharge water and the impingement of discharge-weakened fish on intake screens.

f. Cooling waters should be withdrawn from depths where water temperature is low enough that when discharged near the surface, the temperature of the surface water will not be greatly increased.

g. The temperature differential between waste cooling water the ambient water temperature should not exceed 1°C (1.8°F).

3. Open cycle cooling systems should be designed to limit the discharge of chemicals into the coastal ecosystem, provide for minimal disruption of natural water flow, and place intake and outlet structures for minimal effect on aquatic organisms. The following criteria should be used in the design of intake structures:

a. Systems should be designed to keep the velocity of inflow below a maximum of 7.5 cm/sec (0.25 ft/sec) at all points ahead of the intake screens and screen size should not exceed 1 millimeter (0.04 inches).

b. No successful device has yet been developed to divert fish larvae and eggs from the intakes of facilities using open cycle cooling systems. Much of the reported progress in this field is exaggerated and deceptive. (Minimal success has been made in diverting fish through fish by-pass systems).

c. All containing structures ahead of the intake screens such as forewalls, channels, bays, and recesses should be eliminated.

d. Intake structures should be located at depth and in locations of the absolute minimum concentration of biota.

4. Monitoring programs should be set up following plant construction to monitor system performance and the adequacy of mitigating measures. Suggested monitoring programs include: (1) frazil ice formation on the intake structure and outfall line; (2) impingement of organisms and ice on the intake screens; (3) entrainment of organisms in the intake system; (4) biofouling of the intake structure; (5) sea-ice level in relation to the intake structure; (6) intake velocities; and (7) the physical condition of fish in marine life return systems, and their fate and behavior after leaving the outfall (e.g. predation and disorientation).

5. Biocides should not be used to remove fouling organisms or should be removed from cooling water before discharge. Systems should be designed to use mechanical methods to remove fouling organisms.

Water Withdrawal for Purposes other than Cooling

Primary problems associated with withdrawal of fresh water for domestic, or industrial use are (1) entrainment and impingement of fish (both summer and winter) and (2) dewatering of stream channels and fish overwintering areas. Entrainment, impingement, and alteration of circulation patterns are the major problems associated with large withdrawals of marine waters.

Activities requiring water for other than cooling should be sited and operated according to the following criteria:

1. Large quantities of freshwater for domestic or industrial uses should not be withdrawn from any body of freshwater supporting fish.

2. No freshwater should be withdrawn from any body of water supporting overwintering fish.

3. When very limited amounts of water are required, use of several different water sources during the winter will lessen impacts on any one source.

4. When large amounts of water are required, storage facilities should be constructed to hold water collected during the summer for winter use. Abandoned gravel sites can be converted for water storage.

5. Water should not be removed from streams or lakes in excess of recharge rates. To do so causes collapse of the ice cover and stream blockage.

6. Water impoundment structures should not be built over permafrost. Melting of the underlying permafrost layer can result causing settlement and changes in drainage patterns.

7. Water wells should be carefully sited so that they do not deplete surface aquifers and dewater lakes and streams.

8. Wherever possible, water consumption should be reduced by water recycling. Examples include: recycling water from mud pits during drilling, and recycling domestic water for industrial uses.

9. When withdrawing water from marine areas, intakes should be designed to prevent entrainment of marine organisms or alteration of circulation patterns.

    a. Intake structures should be located at depth and in locations of absolute minimum concentration of biota.

    b. Intake velocities should not exceed 7.5 cm/sec (0.25 ft/sec) at all points ahead of the intake screens. Intake screen size should not exceed 1 millimeter (0.04 inches).

c. All containing structures ahead of the intake screens such as forewalls, channels, bays, and recesses should be eliminated.

d. Intake structures should be designed so as to not funnel organisms into the intake (i.e. siting an intake at the end a long solid fill breakwater, jetty or causeway that extends into or across a fish migration route).

I

COMMERCIAL & SPORT HARVEST

INTERFERENCE WITH SUBSISTENCE

INTERFERENCE WITH SUBSISTENCE, COMMERCIAL, AND SPORT HARVESTS

The intense level of support activity required for offshore drilling could have significant effects on harvest activities in the northern Bering Sea-Norton Sound region. The mere physical presence of equipment used during offshore oil exploration and production will create conflicts between the oil industry and traditional subsistence, commercial, or sport harvest groups. Fishing and marine mammal harvest areas may be lost if numerous offshore structures take up space in those areas. Increases in boat traffic will create navigational and docking problems. Fishing gear may be lost through entanglement with seismic vessels, oil tankers, drilling rigs and tugs. Offshore pipelines will present a problem if regulations do not require that they be buried beneath the sea floor. Land based facilities may prevent access to traditional harvest areas. Noise and disturbance associated with various operations will influence harvest success in surrounding areas, and competition may arise between indigenous harvest groups and development associated personnel over limited fish and wildlife resources.

Conflicts will also arise if spawning, nursery, or rearing areas of harvested species or critical habitats of their food species are used for the laying of pipelines, are contaminated by acute or chronic oil pollution, or are otherwise adversely impacted by the activities of oil and gas development.

Recommended Mitigative Measures

Mitigating measures in previous sections of this report have been proposed in an attempt to minimize development impacts on fish and wildlife populations and their habitat. It is assumed that impacts which affect species of subsistence, commercial, or sport value will also affect harvest levels. The following recommendations address impacts as they directly relate to current harvest patterns and practices.

Noise and Disturbance

Measures to minimize the effects of noise and disturbance have been discussed previously in the Noise and Disturbance section of this report, and are applicable toward minimizing harvest interference with the following additions:

1. Activities which produce turbid water conditions in important fishing and marine mammal harvest areas should either be scheduled during periods when they will not affect harvest practices, or should be designed so as to minimize the amount of suspended material present in the water column. Such activities would include dredging and filling, shoreline alteration, gravel island construction, discharge of drilling muds and cuttings, etc.

2. The random or erratic operation of machinery, aircraft, boats or ATV's should be discouraged in harvest areas.

3. Exploratory drilling on lease tracts that are located on traditional fishing grounds should be scheduled during periods when fishing does not occur.

Competition for Resources

1. The Board of Fish and Game should anticipate potential harvest conflicts and should implement special game and fisheries management procedures or regulations which will serve to reduce competition between new workers and indigenous user groups.

2. In important subsistence areas the leasee should voluntarily limit the off-duty hunting, fishing, and trapping activities of its employees on leased lands.

3. When lease activities must be conducted in or near important harvest areas, the developer should arrange for community involvement in processes such as the siting of facilities, or the timing of activities, in order to minimize the adverse impacts of such operations on traditional hunting and fishing practices in the area.

Competition for Space

1. Leasees should not restrict public access to, or use of, leased public lands except in the immediate vicinity of development

operations. Exceptions may be provided for in areas of extreme biological sensitivity.

2. Leasees should be sensitive to local industries and traditional vocations and should plan their activities to avoid impacting them. An example would be to insure that industry boats do not monopolize fish processing plant docks or staging areas.

3. The local coastal resource service area can identify separate and distinct areas for different kinds of economic activity through its coastal management plan. Where there is competition for a particular coastal site, the only solution may be a trade-off between conflicting parties. For example, an oil company might be convinced to locate a staging area away from an important harvest area in exchange for an offer of less expensive land or a zoning change.

4. During the site selection process for onshore and offshore facilities, leasees should avoid traditional harvest areas or sites which might block access to traditional harvest areas.

Physical Destruction or Restriction of Fishing Gear

Vessel Traffic

1. All development related marine vessel traffic including ice breakers should be required to travel point to point in a

linear fashion, avoiding areas of marine harvest during periods when such harvests might occur. This would allow fishermen and hunters to predict where they might safely place their gear, or pursue marine mammals without disturbance.

2. Because high petroleum finds coupled with other forms of economic development (such as coal or offshore gold recovery operations) may make non-corridor vessel traffic extremely hazardous, permanent or recommended shipping corridors should be established based upon the following considerations:

   a. Maximum safety of all vessels utilizing limited navigational channels. Because of shallow waters and restrictive ice conditions, deep draft vessels may be forced to conform to relatively narrow natural corridors which, without regulation, will enhance the chances of collision.

   b. Minimum interference with traditional commercial or subsistence harvest areas.

   c. To provide an adequate buffer zone between vital habitat areas and vessel traffic.

   d. Maximum public input.

3. Shipping corridors should:

a. Be clearly designated on marine charts.

b. Have adequate navigational aids such as buoys, beacons, and VTS (Vessel Traffic Safety) radar.

c. Have a reasonable speed limit established.

d. Be regulated, patrolled and enforced by the U.S. Coast Guard.

4. All oil tankers, LNG tankers, and other large vessels operating in an area must be required to use licensed pilots familiar with local conditions and navigational problems in ice infested waters.

5. A reporting and communications system should be established for tankers and other large vessels utilizing the corridor system.

6. Permits issued to seismic boats operating in near coastal areas should stipulate:

a. Daylight operation only.

b. No operations within or adjacent to areas of concentrated commercial or subsistence fishing gear. Operations in these areas should only be scheduled during closed fishing periods.

c. If seismic surveys are absolutely unavoidable during periods when commercial king crab fishing occurs, cable length for seismic streamers should not exceed 1/4 mile in order to allow for adequate control in avoiding obstacles such as fishing gear.

d. Ship captains should report to the Alaska Department of Fish and Game, Area Management Biologist, for consultation on fishing gear concentrations prior to operating.

7. Commercial, subsistence or sport fishing vessels should not anchor, fish pots or trawl in zones designated as shipping corridors.

8. The Ports and Waterways Act of 1972 should be amended to designate mandatory shipping corridors.

Pipelines

1. To the greatest extent possible, pipelines should be routed around active bottom fishing or trawling areas.

2. Where the placement of pipelines in these areas cannot be avoided the following techniques should be utilized:

   a. Trenching - trenching should be used to bury pipelines beyond the point where they might entangle crab pots and anchors, be struck by trawl doors, or be ruptured by gouging ice keels.

   b. Pipeline route marking - unburied pipelines should be marked on navigation charts to discourage anchoring or trawling in those areas.

Oil Pollution - Avoidance and Tainting

Specific measures to minimize the impacts of oil pollution may be found in the Oil Pollution section of this report.

J

SECONDARY DEVELOPMENT

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If commercially exploitable quantities of oil or gas are found in an area, a variety of support facilities are required in order to begin development and production. Inevitably, with the establishment of onshore petroleum facilities an additional amount of secondary development will also be needed. Secondary development has two major components: indirect development, as typified by those industrial projects which serve and support the primary projects, often through sub-contracts; and induced development, the construction or expansion of community facilities and services (such as housing, utilities, transportation, schools, recreation and commercial facilities) to serve the added population which is attracted by employment opportunities in direct, indirect, and induced development.

Environmental disturbances from secondary development are primarily caused by construction activities and an increase in numbers of people. The construction of houses, buildings, roads and utility corridors will result in a direct loss of fish and wildlife habitat. Animals which connot tolerate disturbance will leave an area permanently and, if no equivalent habitat is available, their numbers may be reduced.

The construction of utility corridors may require extensive cutting and clearing pratices which may act to remove essential vegetational habitat or ground cover. Such practices can result in soil erosion or degradation, water quality degradation, air quality degradation if open burning is prescribed, and elevated noise levels. Additionally, utility corridors can provide access to non-native species resulting in increased levels of predation, competition, or incidence of disease and parasites.

The impacts of road construction include all of the considerations listed for utility corridors as well as some additional consequences. Roads can increase traffic and human presence in areas not previously subject to such intrusions, which in turn could promote harassment, injury, or death as animals venture near or across such road systems. Roads may also impede animal movements and can result in the parcelling of a species habitat.

Recommended Mitigative Measures

The adverse impacts of secondary development on fish, wildlife and habitat are a combination of disturbances that, for the most part, have been discussed previously in other sections of this report. Through compliance with the mitigating measures already identified in those sections, many of the impacts associated with secondary development may be substantially minimized, or in some cases, completely eliminated. Additional mitigatory measures which have not been addressed include:

General Measures

1. Site specific environmental studies should be conducted in any marine or terrestrial area likely to be impacted by secondary development operations. These studies should include comprehensive species inventories, food and habitat requirement surveys, and site specific mitigations.

2. Avoid siting and constructing road systems and facilities which parcel or separate a species critical habitat range.

3. During winter, roads should be plowed so that snow barriers are not left alongside which might serve to impede animal movements.

4. Salt should <u>not</u> be used on roads during winter in order to minimize wildlife attraction.

5. Off-road traffic should be restricted as much as possible to minimize damage to surrounding vegetation and to avoid undue harassment of animals living adjacent to the road system.

6. During summer months (June through September) or during periods when snow cover is inadequate to protect underlying vegetation, only low surface pressure vehicles should be allowed off of established roads or prepared foundations.

7. Public access on roads or airfields should be restricted where necessary to prevent increased human presence in critical fish and wildlife areas, and to maintain current sport and subsistence harvest levels in areas made accessible by lease activities or onshore development. Determinations of this nature should be made only after consultation with the Alaska Department of Fish and Game.

8. Utility corridors should be designed to accomodate additional loads to limit further construction in undisturbed areas.

9. Utility corridors should be consolidated with road systems as much as possible to minimize habitat disturbance.

10. Power and telephone lines should be constructed above ground to facilitate quick repair and to avoid extensive trenching in permafrost areas. Additionally, they should be constructed so

as to utilize existing land contours and natural barriers which will aid in minimizing bird/powerline collisions.

11. Implement environmental training programs to educate personnel as to the dangers of feeding, handling or harassing wildlife.

12. Limit the off-site and off-duty activities of workers to eliminate animal and human conflicts in sensitive areas.

13. Implement special game and fisheries management procedures or regulations which will serve to reduce competition between new workers and indigenous user groups.

14. Arrange for an exchange of dialogue between developers and surrounding communities. This may be accomplished by establishing meetings or forums on a regularly scheduled basis (bi-monthly/quarterly), in which representatives from the private and public sector may discuss problems and issues, new proposals, etc.

15. Edibles should be adequately stored from their initial arrival to their eventual disposal to avoid attracting animals. All edible garbage should be thoroughly incinerated.

16. A solid waste disposal program should be initiated which will; a) utilize materials that will not generate a large amount of

solid waste in the form of packaging; b) maximize on-site recycling of parts or materials, including specifically purchasing parts or materials amenable to rebuilding or recycling; and c) schedule support activities so that all freight carriers return with a load of solid waste.

17. Liquid waste disposal systems should, a) reduce the temperature of effluent discharge to minimize thermal erosion of subsurface permafrost; b) recycle water in a cascading system if certain processes do not require high water quality; and c) use a series of interconnected lagoons so that water for industrial use may be withdrawn from the last holding lagoon.

18. All liquid waste treatment lagoons should be lined and bermed with an impermiable material that will prevent leaching into the surrounding substrate.

19. Pesticides or defoliants should not be used for mosquito control or site maintainence unless it can be demonstrated that such chemicals will not accumulate in animal tissues, groundwater supplies, or soil sediments; and that such techniques will not preclude habitat utilization by other species.

20. Revegetation techniques should proceed immediately following termination of activity in an area not subject to additional operations.

21. All efforts should be made to restore an area to its original state. This would include restoration of vegetational composition, land contour, waterflow and soil characteristics.

22. Habitat improvement techniques should be implemented concurrent with development operations when it has been determined what species will be displaced, what their habitat requirements are, and if it is concluded that such practices will be beneficial. Examples of habitat improvement techniques would include the creation of additional denning, nesting, spawning or rearing sites; planting additional cover to compensate for that which is removed; seeding additional vegetation for forage in outlying areas, etc.

23. Whenever it is necessary to destroy important fish and wildlife habitat, mitigation should be required.