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Document No. 870890
EH&A Job No. 10256

LITERATURE REVIEW OF WETLAND LOSSES AND THE RELATIVE CONTRIBUTION OF THE PETROLEUM INDUSTRY TO THOSE LOSSES

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March 1988

Executive Summary

Until recently, wetlands in the United States were considered by most people to be of little economic value. In fact, the government encouraged wetland reclamation. Over the past two decades, however, with the recognition of the ecological and economic significance of our diminishing wetland resources, several federal and state agencies have developed regulations and programs designed to protect and preserve the remaining wetland resources of the United States. There is, however, no single law or federal program which spells out a wetland policy for the United States.

Wetland Losses

Gulf of Mexico

Estimates of wetland losses in the United States vary depending on definitions and methods used to identify wetlands. Between the mid-1800's and the mid-1970's, approximately half of the 215 million acres of wetlands estimated to have been present in the United States prior to European colonization were lost. Wetlands along the Gulf of Mexico comprise a significant portion of the remaining coastal wetlands. Louisiana alone contains 25-41% of all coastal wetlands of the contiguous 48 states. These Louisiana wetlands are being lost at a rate of about 31,000 acres (0.86%) per year.

Because wetlands are ecologically transient systems, subject to natural processes and fluctuations, naturally caused wetland losses are inevitable. Natural causes include: (1) water level changes due to long-term sea level fluctuations, regional subsidence of the continental crust, and compaction of sediments; (2) changes in deltaic deposition, including freshwater input, sediment input, and nutrient balance; (3) erosion, due to regular wave energy and catastrophic events such as storms and hurricanes; and (4) biological factors, such as overgrazing.

Human factors contributing to wetland losses are associated with the use of wetland areas for human habitat and various industrial activities. Since both these factors tend to be concentrated in coastal areas, their impacts on wetland resources are significant. Anthropogenic causes of wetland losses include: (1) impoundments, including reclamation for agricultural use, conversion to urban and industrial use, aquaculture, fish and wildlife management, and accidental impoundments; (2) dredging and channelization for flood control, insect control, navigation, oil and gas activity access, and transportation; (3) dams and levees for agricultural conversions and water resource management; (4) pollution discharges; (5) surface mining and the subsequent reclamation; and (6) mineral and water extraction which may cause localized subsidence.

The largest contributor to wetland loss in the United States is conversion for agricultural purposes. Over 120 million acres have been converted, much of which is no longer suitable for agriculture. This figure is for the contiguous United States, not just the Gulf of Mexico coast. The Everglades once covered approximately 2.5 million acres and constituted the world's largest area of freshwater peat soils. Levees and canals in the Everglades have dropped the water table an average of 6.5 feet and have caused the complete denudation of about

420,000 acres there. The natural marshes and swamps are limited to the Everglades National Park and much of it is no longer pristine.

Population growth, and concomitant urban and industrial development, provide the need for upland areas and, therefore, further impoundment of wetlands. At least 330,000 acres of wetlands have been impounded for these needs. Aquaculture, fish and wildlife impoundments and accidental impoundments have also been responsible for over 650,000 acres of total wetland conversions.

Oil and gas exploration and production activities affect wetlands through a combination of mechanisms. Wetland loss may be affected by construction and maintenance of canals and pipelines, well pad and levee construction, road construction and rig movement, and oil and chemical spills or discharges.

Impacts of oil and gas exploration and production in Florida, Mississippi, and Alabama have been insignificant due to a minimal amount of drilling in wetland habitats in these states. No estimates of wetland loss due to petroleum industry activities are available for Texas, a major oil producing state. Although Texas has about 400-600 thousand acres of coastal marshland, only 20% of its known energy reserves are in the coastal region.

Wetland loss in Louisiana has been well documented, with estimates ranging from 4,200 acres/year in 1913 to 32,000 acres/year in 1980. Of this, approximately 79%, or 25,220 acres, in 1980, are in the Mississippi River Deltaic Plain, the coastal region between Vermillion Bay and the Mississippi state line. Based on one source of information, approximately 1,800 acres/year in coastal Louisiana were lost in the mid 1970s from petroleum activities requiring a

U.S. Army Corps of Engineers dredging permit. Based on the literature, one can assume that the total area affected by an oil and gas canal, both by direct and indirect impacts, is 5.7 times the actual permitted canal area. Therefore, a total impacted area of 10,260 acres/year of wetlands in coastal Louisiana from oil and gas exploration and production canals is supported by the literature. This area is roughly 34% of the total wetland loss in coastal Louisiana in the mid 1970s. This area does not include discharges of drilling fluids or brine into the wetlands, which would tend to increase the percentage, nor does this area include mitigative measures, which would tend to decrease the percentage.

Alaska

Alaska contains the largest concentration of wetlands of any state in the United States. According to various estimates, 36-82% of Alaska's 365.5 million acres is wetlands. Difficulties arise in attempting to classify Alaska's wetlands using systems designed for the contiguous 48 states. In addition to estuarine and coastal lagoons and marshes, lowland spruce and bog-muskeg, broad river valleys and floodplains, and tidal and mud flats, Alaska contains vast expanses of wet tundra where permafrost and flat terrain create a wetland habitat unique to Alaska. The permafrost, sustained by the extreme cold of this region, is the key element to the existence of these wetlands, which comprise nearly 50% of the wetlands in the United States.

Natural processes causing wetland losses in Alaska include: earthquakes which can produce tidal waves (tsunamis), capable of flooding wetland areas, and can cause uplifting and subsidence, which can create and destroy wetlands; erosion and sedimentation following the spring ice melt; coastal "thermo-erosion" associated with melting of the permafrost; and thermokarsting, i.e., the formation of topographic depressions (e.g., thaw lakes) resulting from the thawing of ground ice.

Anthropogenic factors affecting wetland loss in Alaska fall into seven categories: (1) mining for gravel, coal or metals resulting in downstream siltation; (2) urban development, concentrated along the coast; (3) agriculture in both permafrosted and non-permafrosted regions; (4) hydroelectric development; (5) forestry; (6) transportation; and (7) oil and gas development.

Wetland impacts due to oil and gas exploration and production have been categorized as primary or direct, secondary or indirect, and tertiary. Direct impacts include removing gravel from wetland borrow sites and covering other wetlands with gravel for well pads, roads, building sites, and other facilities. Indirect impacts include altering drainage patterns by placement of roads and drilling pads, thermokarsting and subsequent microsubsidence due to heavy dust in the summer, and snowdrifting along lightly-traveled roads which can delay snow melt and impact some wetland plant species. The major tertiary impact is an effect of nearby human presence and activity on wildlife, primarily caribou, although clear evidence of such impacts is not available.

Total direct impacts to the arctic region include 540 acres in the National Petroleum Reserve, and 8,180 acres in the Prudhoe Bay-Kuparuk oil fields.

This represents 0.02% of the estimated 37.2 million acres of arctic region wetlands. However, the National Petroleum Reserve losses were caused by government activity. Therefore, the oil and gas industry is responsible for 8,180 acres of lost wetlands in the arctic, 36.7% of the reported anthropogenic wetland loss in Alaska.

Mitigation

Wetland mitigation consists of one or more actions performed to alleviate, lessen, or offset environmental damages or habitat loss caused by natural or anthropogenic activities. "Passive" mitigation involves avoiding an impact altogether by taking no action or minimizing an impact by modifying or limiting the magnitude of the action. "Active" mitigation involves rectifying an impact by repairing, rehabilitating, or restoring the affected environment; reducing or eliminating an impact by protection and maintenance operations over the life of the action; and compensating for an impact by replacing or providng substitute resources or environments.

Gulf of Mexico

Passive Mitigation

Many potential impacts of petroleum-related activities can be avoided or minimized during the planning phase. Avoidance is the form of mitigation preferred by the Council on Environmental Quality, U.S. Army Corps of Engineers, Environmental Protection Agency and the United States Fish and Wildlife Service. A Geologic Review Process, instituted by the New Orleans District of the U.S. Army

Corps of Engineers in 1982 for the Louisiana Coastal Zone, has been effective in reducing impacts due to oil and gas operations.

During drilling and production, vegetation removal or destruction may increase erosion, affect food chains and ecological balance, and affect water quality. Mitigation techniques which can prevent or minimize vegetation destruction basically involve: (1) minimizing the frequency, duration, and magnitude of travel over vegetated areas; (2) timing activities so as to avoid sensitive periods; (3) avoiding or bridging highly sensitive areas; and (4) minimizing excavation. Alteration of hydrologic regimes (i.e., surface and subsurface water quantities, quality, and flow characteristics) can often be minimized or avoided by judicious site selection and road or pipeline alignment; use of culverts, bridges, plugs, and bulkheads to maintain existing water flows; minimization of the use of levees; staggering borrow pits to prevent the formation of long ditches along roadways; and routing canals through open water instead of marsh. Minimization of pollution and wetland loss during drilling and production involves containment to prevent spreading of pollutants and the use of low impact vehicles.

Upon abandonment of a well, measures designed to minimize wetland impacts include: (1) removal of all temporary impervious surfaces and plugging the well; (2) restoration of water flows; (3) proper disposal of drilling mud and other wastes; and (4) revegetation of disturbed wetland areas. Employment of wildlife management techniques, such as construction of nesting or denning areas, may also be desirable to restore preactivity wildlife habitat value and usefulness.

Active Mitigation

Rectifying impacts to wetlands involves repairing, rehabilitating or restoring affected areas to the level of productivity and habitat value prior to the activity. Restoration has the best chance of success when sediments are restored to their original elevation and vegetation is returned to its original condition. Double ditching is one technique for backfilling pipeline trenches which promotes natural revegetation. The pumping or spraying of dredged material onto eroded or subsiding areas can promote stabilizing plant growth as well as increase elevation. Restoration after oil spills may be necessary, depending on the extent and accessibility of the affected area and its chemical, physical, and biological characteristics.

Compensation for wetland losses can take several forms. New wetland habitat can be created in appropriate areas by using suitable substrate and directly planting wetland vegetation. When the active mitigation methods noted above are not feasible, mitigation banking can be employed whereby wetland areas are created, improved, or protected in advance of anticipated losses. Compensation can also be accomplished through the purchase of wetlands or wetland easements to be set aside and conserved.

Akaska

Passive Mitigation

Avoidance and minimization of impacts in sensitive arctic environments is accomplished mainly through careful advance planning and coordination with regulatory authorities. Detailed baseline studies and impact analyses precede the design and construction of well pads, roads, pipelines, and other facilities. Emphasis is placed on issues such as minimizing disturbance of hydrologic regimes, use of existing roads, seasonal timing of various activities, waste disposal, avoidance of high-value habitats, and arctic land form constraints.

Mitigative efforts during drilling and production are directed to wetlands, fish and wildlife. Off-road construction and maintenance is conducted from ice roads in winter and is restricted in summer. Facilities are consolidated or shared to the extent possible. Drainage devices (e.g., culverts) are routinely inspected and repaired. Rivers and deltas are bridged and causeways to nearshore facilities are breached.

Mitigation activities associated with abandonment include clearing and level the site to its original elevation, removal of culverts and restoration of natural drainage patterns, and, if practicable, introduction of wetland vegetation.

Active Mitigation

Studies on arctic revegetation techniques are currently underway. Harsh environmental conditions require careful substrate preparation and the use of native species. Restoration of oil spill sites may be accomplished in several ways depending on the type, amount, and extent of the spill; season of the year; physical features of the site; climate; and type of ground cover. Regardless of the techniques employed, restoration activities must be conducted carefully to avoid further damage from the cleanup and restoration activities themselves.

Mitigation through compensation (i.e., wetland creation, banking, or purchase) has apparently not been used in arctic Alaska and does not appear to be as readily feasible as in the Gulf of Mexico wetlands.