Chapter 6

Impacts and Mitigation

Photo credit: U.S. Fish and *Wildlife Service*

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CHAPTER SUMMARY

Wetlands are important to development activities such as agriculture, forestry, port and harbor development, oil and gas extraction, housing and urban growth, mining, and water-resource development. Development activities that involve excavation (or dredging), filling, clearing, draining, or flooding of wetlands generally have the most significant and permanent impacts on wetlands. These impacts vary from project to project, depending on the scale and timing of the project, the type of wetland affected, and many other variables. Direct impacts associated with some development activities often can be mitigated by redesigning the project or modifying the construction timetable.

The ability to restore significantly degraded wetlands to their original condition depends on the type of wetland and on the degree to which it has been affected either by natural processes or by development activities. For example, San Francisco Bay wetlands that were once used for agriculture are being restored by removing manmade dikes that separated these wetlands from the bay. It is also possible to create new wetlands in areas that are not subject to a high degree of wave action or swift currents. Costs of creating new wetlands in relatively calm coastal environments range from as little as $250/acre to over $6,000/acre.

The ability to construct new wetlands should not be used as sole justification for the unregulated conversion of wetlands to other uses: manmade wetlands do not necessarily provide the same values as natural ones. In addition, it is probably not possible to create new wetlands at the rate they have been converted to other uses in the past.

INTRODUCTION

Generally, any wetland-development activity of a significant magnitude has the ***potential*** to affect wetlands adversely. This chapter identifies the activities and operations that affect wetlands and describes the nature of their impacts. The actual impacts of an activity, however, are site and project specific. In other words, an activity with major impacts in one circumstance may have moderate impacts in another. All major development activities responsible for wetland loss, including those regulated under the 404 program, are included in this discussion.

The present ability to predict or monitor impacts on wetlands also is evaluated in this chapter. Impact assessment is a critical step in determining what development activities to allow in wetlands and how to mitigate potential impacts. The uncertainty associated with impact assessment influences both the ability to safeguard wetlands and the equity of regulatory decisions. On the one hand, wetlands require protection from project impacts that are not always obvious; on the other, regulatory decisions based on highly uncertain impact assessments may impose unnecessary burdens on developers.

Finally, opportunities for and limitations of mitigating impacts are evaluated in this chapter. Under the current regulatory program, mitigation conditions are imposed on about one-third of all permits processed annually; in comparison, less than 3 percent of all applications are denied. This suggests that the strategy of the 404 program is to minimize or compensate for impacts rather than prevent development.

DEFINITIONS

The Council on Environmental Quality (CEQ) distinguishes between three basic types of impacts in the National Environmental Policy Act (NEPA) regulations: [1]

- Cumulative ***impacts*** are those impacts on the environment that result from the incremental impact of a development activity when added to other past, present, and reasonably foreseeable future activities. Cumulative impacts can result from individually minor, but collectively significant, activities taking place over time.[2]
- ***Direct effects*** are caused by specific activities and occur at the same time and place as the activities.[3]*
- ***Indirect, or secondary, effects*** are caused by the activities and are later in time or farther removed in distance but still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems.[4]

Impacts can also be described as ***permanent*** or ***temporary,*** and ***short*** or long ***term.*** The former distinction refers to whether or not the wetland restores itself naturally after suffering impacts; the latter indicates the length of time an impact takes to manifest itself after the activity occurs. An activity may have temporary and permanent impacts, as well as short- and long-term impacts, simultaneously.

A canal dredged through a wetland area, for instance, will immediately damage a wetland by removing vegetation and wetland soil; this impact, in most cases, is permanent. The dredging, however, also will cause turbidity—generally a short-term, temporary impact—and slumping of adjacent wetland areas into the canal-potentially a long-term, permanent impact.

Two other terms used to describe impacts in this chapter are onsite and offsite. Activities can impact a wetland whether they take place directly on the wetland (onsite) or some place removed from the wetland (offsite). In general, offsite activities will have less immediate impacts than will onsite activities. Dredging in a wetland will remove vegetation and overlying substrata and cause immediate damage, Erosion of fill material disposed in areas adjacent to a wetland may cause gradual accumulation of sediment in the wetland over a longer time.

The term mitigation as used in the NEPA regulations includes:

a) avoiding the impact altogether by not taking a certain (i. e., activity) action or parts of an action;
b) minimizing impacts by limiting the degree or magnitude of the action and its implementation;
c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and
e) compensating for the impact by replacing or providing substitute resources or environments.[5]

[1] CFR title 40, pt. 325 to end, July 1, 1982.
[2] S. 1508.7.
[3] S. 1508.8.
*The words "effect" and "impact" are used interchangeably in both the CEQ regulations and this chapter.
[4] S. 1508.8.
[5] 40 CFR, pt. 1508.20.

DEVELOPMENT ACTIVITIES

Dredging and Excavation

Both dredging and excavation in wetlands involve the direct removal of wetland vegetation and the underlying wetland soil. Because the elevation of the dredged area is reduced, it normally will be flooded by deeper water most of the time, thereby eliminating the possibility of recolonization by wetland plants unless the area becomes subsequently filled, either naturally or by man. For example, dredging or excavation are responsible for wetland losses associated with agricultural conversion in Nebraska; mosquito-control ditching along the east coast in North Carolina; canal construction in coastal Louisiana, Mississippi, and Texas; peat mining in Maryland, Michigan, and Minnesota; phosphate mining in North Carolina and Florida; the extraction of other materials such as borax, potash, soda ash, lithium, gold, sand, and gravel; and port and other water-dependent coastal development.

Dredging commonly is used to deepen or straighten waterways for navigation, port, and marina facilities or for flood control. In addition to the direct effects of removing wetland vegetation and soil, dredging may impact wetlands even if it takes place offsite. Giese and Mello (21), for instance, found that dredging a navigation inlet into a small estuary increased the tidal range in the upper estuary, exposing the bottom at low tide. Salinity was increased, shellfish beds were exposed, benthic (i. e., bottom-dwelling) invertebrate populations were eliminated, and vegetation patterns were changed. The dredging of canals primarily for ac-

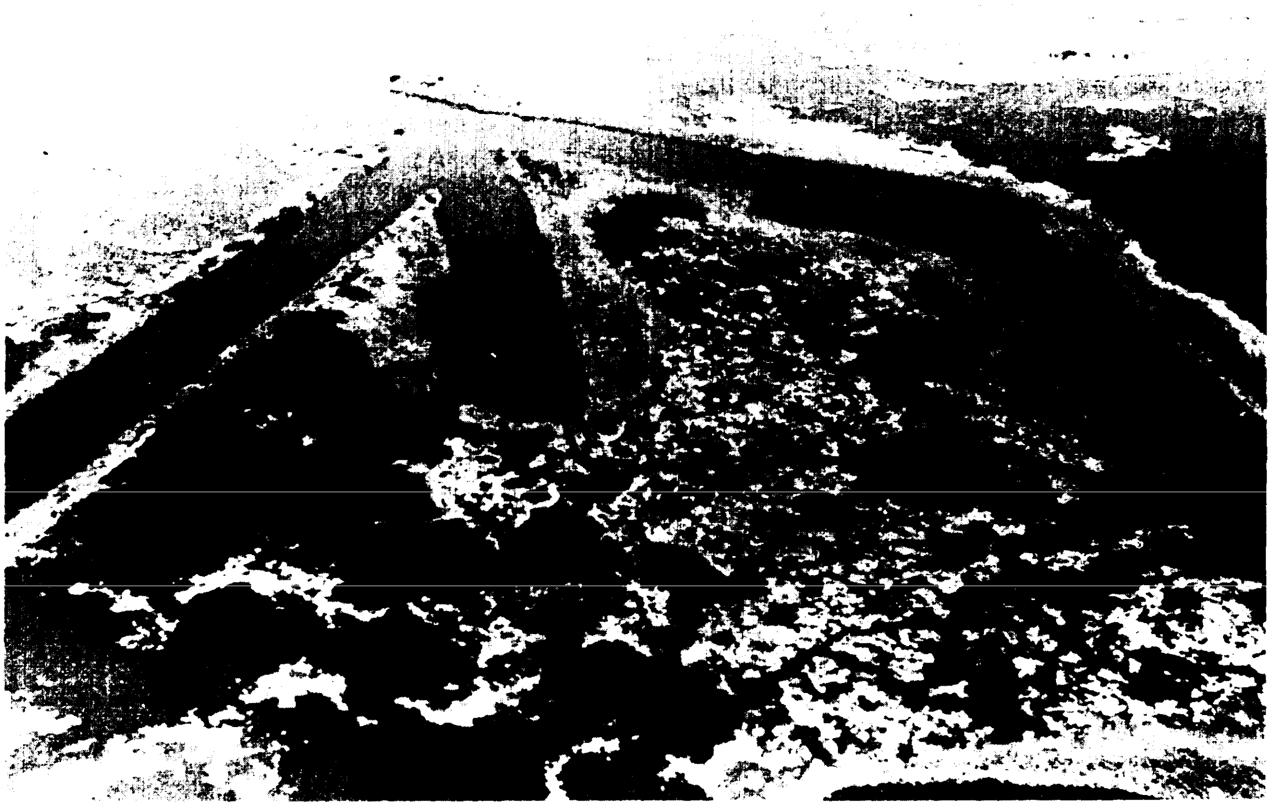


Photo credit: Office of Technology Assessment, Joan Ham

The dredging of canals for navigation and for access to oil and gas development sites in coastal Louisiana has led to saltwater intrusion into freshwater marshes. The excess salinity eventually kills the marsh vegetation cess to oil and gas development sites also has contributed significantly to direct and indirect wetland losses in coastal Louisiana (15). While many early studies attributed these losses to the presence of levees on the Mississippi River, which reduced the sediments contributing to the buildup of deltas and wetlands (8), several recent studies in the Mississippi Delta have shown a positive correlation between canal density and the extent of wetland loss (13,53). In addition to direct wetland loss resulting from the disposal of dredged material along canal banks, the increase in canal density in an area leads to more saltwater intrusion into wetlands as water is flushed in and out by the tides. Salinity changes may kill vegetation, and tidal flows help erode the banks of canals, causing them to widen at the annual rates of from 2 to 14.8 percent per year. At the high annual rate, a canal would double its width in only 4.7 years.

Excavation commonly is used for mining and to create dugouts, or reuse pits, for irrigation. Mining for minerals such as peat, phosphate, and limerock will cause total removal of wetland vegetation overlying these deposits (30). Additional adverse impacts also may result. For example, after limerock was excavated and removed from the Biscayne Aquifer in southern Florida, ground water filled the pits left by the excavation, lowering the water table. The stockpiling of materials, the construction of access roads, and other filling associated with development and operation of a mine also block surface waterflows. Water-filled rockpits, which are attractive locations for residential development, can become degraded quickly by urban runoff. In addition, water in the open pit is subjected to continuous, year-round evaporation (9).

In another example, the number and size of wetlands in the Rainwater Basin in Nebraska have been reduced through the excavation of ‘dugouts, or irrigation reuse pits. This practice results in partial drainage of some wetlands and the flooding of others (22). These wetland losses subsequently have led to increased incidence or risk of disease to waterfowl, reduction in food supply for migratory birds, and loss of breeding and rearing habitat for birds (22).

Filling

The immediate and permanent effect of filling is to bury wetland vegetation, increase the elevation of the area, and eliminate the periodic inundation of the wetland (14). Several types of solid waste are used as fill material. Municipal waste, including household refuse and incinerator residue, has been used for wetland fills. Construction and demolition debris is used occasionally, as are stone, sand, gravel, and broken concrete from highway construction. Even coal ash has been disposed of as fill in wetlands (8), The disposal of some types of solid waste in wetlands carries the risk of detrimental chemical effects owing to leaching of nutrients and toxic chemicals from the fill material.

For example, filling is a major factor associated with wetland loss for land-leveling and agricultural conversion in Nebraska and California; for construction of impoundments in New England, the Lower Mississippi River Valley, Lower Colorado River Valley, South Carolina, and North Carolina; for canal construction and dredged-material disposal in coastal Louisiana, Mississippi, and Texas; for port, harbor, and other coastal development; for urban and industrial development in South Carolina, New Jersey, California, New England, south Florida, Washington, and Alaska; for road construction in Alaska, New England, and Nebraska; and for disposal of waste products in Washington, California, and New England.

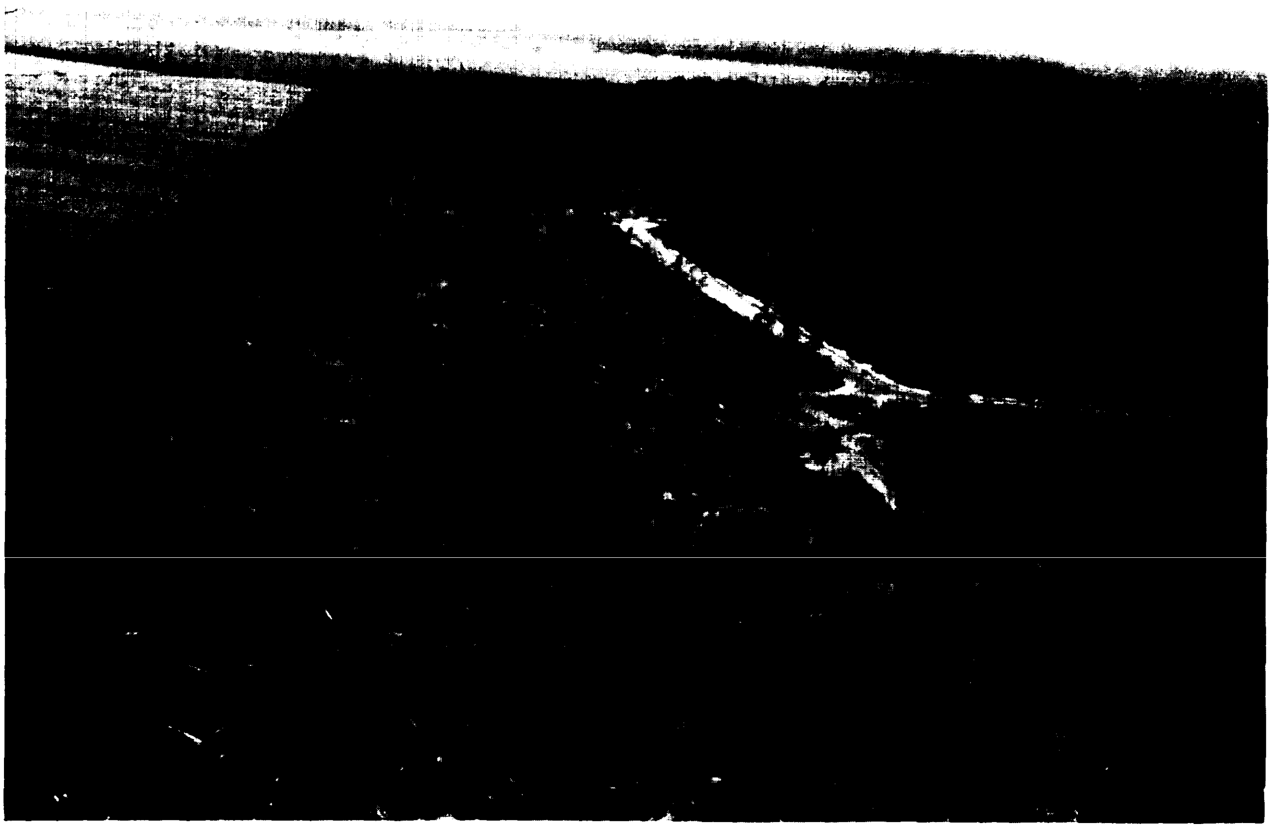
Filling often is associated closely with dredging and excavation activities. For example, the major method used in the Southeast to create waterfront real estate has been to excavate canals within wetlands, using the dredged material as fill for building sites. This practice not only results in complete loss of the wetland but also creates canals that are poor habitat for both flora and fauna (26). A comparative study of a residential lagoon system and natural wetlands has shown that the lagoon supports smaller fish and shellfish communities (28).

Highways built on fill material can have indirect impacts by either flooding or dewatering adjacent wetlands. Culverts normally constructed at soil level will prevent flooding of the road, but will not allow the flow of subsurface water. In some instances, borrow canals adjacent to the highways also have diverted the drainage directly into a coastal estuary, permitting saltwater intrusion into the wetland where the normal drainage had been cut off.

Drainage and Clearing

Narrow drainage ditches (less than 5-feet wide) may be excavated to accelerate and channel surface water runoff and to lower ground water levels, increasing the value of the drained land for agricultural and forest management. For example, draining and clearing is a major factor associated with wetland conversions in the prairie potholes and in Nebraska, California, the Lower Mississippi River Valley, North and South Carolina, and south Florida; for urban development in south Florida and Washington; and for forestry management in North Carolina and the Lower Mississippi River Valley.

The major ecological impact from draining and clearing wetlands for agricultural purposes is the loss of diverse wildlife habitat. Studies in Missouri where wetland channelization projects were undertaken to reduce flooding problems indicated that 78 percent of bottom land hardwood forest previously flooded was converted to crop production after project completion (19). In Louisiana, 51 percent of the original 4.5 million hectares of forested wetlands have been converted to agricultural use, mostly for soybean and cotton production. The loss of hardwood forests has meant a loss of prime habitats for birds and mammals, as well as a loss of critical spawning grounds for aquatic species. Under some circumstances, ditches in agricultural areas also may increase the runoff of pesticides, her-



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bicides, fertilizers, and animal wastes to downstream wetland systems. The drainage may change vegetation in adjacent areas; the runoff may cause pollution of adjacent land and open water areas (45). Drainage of wetlands for agricultural uses results in the loss of organic material from the soils due to oxidation. In some parts of the country, this may lead to soil subsidence and increased hazards of fire (9). For example, reclaimed peat-based agricultural land in the Sacramento-San Joaquin Valley has subsided through processes of compaction, oxidation, and wind loss and is now up to 20 ft below sea level (1 7).

In some instances, the creation of new habitats has changed the behavior of migrating birds; rice cultivation in southwest Louisiana and eastern Texas has encouraged overwintering of waterfowl that normally overwinter in eastern Louisiana wetlands. Natural filling of drainage ditches may cause an area to revert to a wetland, as occurred on some former agricultural lands in New England (56).

Forested wetlands are also partially drained to lower the water table and allow harvesting of the forested land. After harvesting, an area may be allowed to regenerate naturally or replanted as a pine or hardwood plantation. Active forest management can significantly increase the yield of wood from the land but also decrease wildlife diversity within forested plantations, depending on a number of factors. Maki, et al, (31) report that the practice of "high grading, ' in which only desirable large and shade-intolerant species are harvested, produces extensive stands of shade-tolerant species having less value as habitat. Large-scale drainage and channelization could contribute to decreases in resident invertebrate density and diversity (3). If good management practices are not used, constructing drainage ditches and channelizing streams in forested wetlands may also increase erosion and sedimentation, which in turn affects wildlife habitat and water quality in adjacent areas (7). In addition, the drainage of wetlands (14) may increase the danger of floods in downstream areas.

Drainage of wetlands in south Florida has been cited as contributing to flooding, drought, oxidation and subsidence of peat, saltwater intrusion, reduction of fish and wildlife resources, and water-quality problems in Lake Okeechobee-particularly increases in nutrients, suspended solids, and pollutants introduced from land uses to which wetlands are converted (9).

Grazing of livestock in wetlands has been a common practice because of the relatively rapid and lush growth of some wetland plants, particularly in arid regions. Some wetland vegetation has proved more nutritious for livestock than upland forage (38). Overgrazing leads to trampling and compaction of soft wetland soils and the loss of natural food sources for resident and migratory wildlife. Moderate grazing, on the other hand, can help maintain a wetland by encouraging the growth of annuals and by setting back vegetative succession.

Other agricultural practices, such as mowing, disking, and burning wetland vegetation to control crop weeds and mosquitoes, are often carried out in the playa basins of the southern Great Plains. The adverse effects of these practices are temporary and, like moderate grazing, can promote the growth of annual wetland vegetation (38). However, such practices conducted late in the growing season may severely curtail winter cover for upland game birds and waterfowl.

Extensive Flooding

Permanently inundating wetlands to certain depths will eliminate wetland vegetation. Sometimes wetlands are flooded to create ponds for growing aquatic organisms, particularly fish and shellfish. Extensive flooding of wetlands is also associated with agricultural conversions of prairie potholes; development of impoundments for municipal- and agricultural-water supply, hydropower, and flood control in places such as New England, the Lower Mississippi River Valley, the Lower Colorado River Valley, Nebraska, and Alaska; waterfowl management in South Carolina; for mosquito control in North Carolina; and aquiculture in Louisiana.

Culture ponds for crayfish and shrimp, for instance, are prevalent in Louisiana. These ponds are constructed by building dikes to raise water elevations. In addition to its direct effects on the wetland vegetation, such flooding may have indirect effects on adjacent wetlands. For example, an experiment in shrimp culture, in which a dike was built to impound part of a coastal wetland, led to large variations in temperature and salinity with subsequent die-offs of many organisms, including the cultured species (41).

The construction of dikes or the disposal of spoil from dredging operations may result in the impoundment of swamps and marshes. An impounded swamp does not dry out periodically like a natural swamp and has a lower water turnover. This results in reduced primary and secondary productivity and decreased value for wildlife habitat. Virtually no fish are found in the stagnant water of such an area (10).

Water Withdrawals and Diversions

Alterations in the hydrologic regime from large water withdrawals for municipal-industrial use or large-scale diversions of water for irrigation and flood control can cause various impacts on wetland ecosystems. The effects of these withdrawals and diversions on downstream wetlands are twofold, First, upstream depletions may lower the water table in downstream freshwater wetlands, causing a temporary or permanent loss of vegetation and a decrease in habitat values. Second, decreasing freshwater inflow in coastal areas will allow tidal incursion of saltwater into the brackish and freshwater marshes. The increase in salinity to these marshes will reduce species diversity and abundance as well as overall ecosystem productivity. Water diversions and withdrawals also reduce the input of detritus into the estuarine food chain.

Water diverted for irrigation and then returned to the wetland can increase salinities and temperatures considerably. For example, salinity in Suisun Marsh, which represents the largest contiguous wetland area in California and 10 percent of the total State wetland acreage, has been increasing along with increasing water diversions by the State and Federal water projects in the Central Valley and the Sierras. One result has been a decline in certain high-food-value plant species that are favored by brackish-to-fresh soil-water conditions. These brackish plant species are particularly important to wintering ducks and geese (17). In addition, increases in water temperature owing to thermal effluents from powerplants or from irrigation return flows may cause a reduction in species diversity of wetland flora or a shift to the more temperature-tolerant, blue-green algae that tend to produce eutrophic (oxygen-deprived) conditions.

Restricting or manipulating water flows with dams and reservoirs also can dewater downstream wetlands. Any wetlands downstream that are not immediately dewatered may be subject to reduced flushing, leading to a decrease in the amount of nutrients reaching the wetlands. Greater than normal floodflows can occur also when large reservoir releases are sustained, possibly washing out wetlands downstream.

Dikes and flood-control levees often are built to convert wetlands in flood plains to dry farmland. These flood-control levees retain floodflows within a river channel, dewatering the wetlands behind them. Levees within the floodway also tend to increase the velocity of storm runoff, produce an overall loss of flood storage capacity, and increase the chance of downstream flooding (45). Increased flows may increase scouring and erosion. Unlike the conversion of wetland by filling, land that is drained behind or within dikes or levees can be restored to a wetland if the embankments are removed or breached.

Disposal and Discharge of Pollutants and Nonpoint-Source Pollution

Wetlands have been used to purify wastewater of nutrients and suspended solids, sometimes with adverse effects (4). Abundant nutrients in the waste may increase the productivity and biomass of tolerant vegetation in the wetland while more sensitive species disappear (58). Algal populations also may shift in species composition, which may lead to wetland eutrophication (23). If the wastewater volume is large enough to raise wetland water elevations, a conversion from emergent wetland to open water can occur. Stormwater discharge also can have adverse impacts on wetland functions and values. For example, contaminants from urban runoff have been noted to cause detrimental effects on tidal wetlands around Hilton Head Island in South Carolina (43).

A long-term effect of the disposal of contaminated dredge spoil in or near wetlands is the potential bioavailability of toxic chemicals such as oil and grease, pesticides, arsenic, and heavy metals, when the sediments are resuspended periodically (1). Although the bioavailability of these contaminants generally is quite low, under certain conditions there may be some long-term potential for bioaccumulation of these harmful substances within the food chain, especially when contaminated dredged materials are exposed to the air (27).

For example, filling of wetlands by eroded soil is also a factor associated with wetland conversions from forestry, agricultural, and development practices in watersheds of the California coast; from agricultural and development practices around the Chesapeake Bay in Maryland; and from agricultural activities in the prairie potholes and Nebraska.

VARIABLES OF WETLAND-IMPACT MAGNITUDE

The actual impacts of a specified construction or development activity will vary geographically and by season of the year according to regionally or locally distinct characteristics of the physical-chemical environment. The characteristics of biological populations and habitats and of the whole wetland ecosystem also will modify the impacts. A discussion of these variables has been included here to illustrate both the site-specificity of wetland-project impacts and the range of factors that must be understood to make realistic impact assessments, and to suggest how these variables may be manipulated to mitigate project impacts.

Physical and Chemical Variables

Composition of Wetland Soils

The physical characteristics of wetland soils will have considerable influence on the severity of impacts produced by different activities in wetlands. Wetland bottom type is an important factor in species diversity and productivity. For example, a project that introduces large quantities of silt and clay would have a significant impact by smothering productive substrates. A wetland's chemistry also may influence the magnitude of a project's impact. The effects of dredging in marine or brackish waters are likely to be less severe than in freshwater because of the buffering capacity of these waters. Also, since cold water generally has higher levels of dissolved oxygen, the effects of activities that tend to deplete the dissolved oxygen will be greater if water temperatures are higher.

Hydrologic Regime and Water Dynamics

The hydrology of a wetland will affect substantially the magnitude of impacts from activities in wetlands. For example, wetlands that are hydrologically isolated from ground water supplies, such as perched bogs or playa lakes, will be more adversely affected by excavation or dredging than wetlands that have sources of water besides precipitation. Excavation in these isolated wetlands may damage the compact peat layer and/or clay layers that seal the bottom of the wetland and hold water within it (32).

The construction of highways on wetland fill has different impacts, depending on the particular wetland hydrology. Culverts placed through a highway fill may cause flooding of the upslope side and dewatering of the downslope side (44). In the Florida Everglades, however, the same type of highway fill with drainage culverts may be able to accommodate the water that flows over the surface of the wetland.

Composition of Fill Material

The disposal of solid wastes, however, carries the risk of detrimental chemical and biological effects due to leaching of the fill material. The magnitude of adverse impacts depends on the actual waste composition, which can vary physically and chemically according to geographic region, community standards, and seasonal variations. In general, municipal solid wastes have a high proportion of biodegradable animal and vegetable waste, rags, wood, cardboard and paper products, as well as ferrous metals. Leaching of organic matter such as garbage and wood waste can lead to an increased biological oxygen demand (BOD) and reduced levels or large fluctuations in dissolved oxygen (DO). Such changes in water chemistry can cause stress to aquatic populations and changes in species diversity.

Biological and Ecological Variables

Population Abundance, Diversity, and Productivity

Productivity, abundance, and diversity are important factors in evaluating the potential impacts of a certain activity on a wetland. Highly diverse wetland ecosystems with high overall productivity but low abundance of many species maybe affected heavily by activities that change the limiting factors for selected species, thereby unbalancing the whole structure (species composition) of that ecosystem. A less diverse ecosystem may be impacted less by the same activities. Spartina marshes, which almost can be considered a monoculture, are known to be highly resistant to changes in salinity and might not be affected significantly by, for example, the reduction of freshwater inflows to the estuary from upstream use of water for cooling a powerplant.

Presence of Key Species Important to an Ecosystem

The severity of impact from a particular activity will be greater if the adverse effects focus on a key species in the wetland ecosystem. For example, detritus-based food chains can easily be disrupted by activities that would lower the abundance of snails and small crustaceans that help produce detritus by shredding the marsh grasses.

Habitat Diversity and Carrying Capacity

Fish and wildlife may require different habitats during their lifecycles, in each season, and even daily, in order to meet their needs for food, water, cover, and reproduction. Wetlands offer a variety of habitats for a variety of species and life stages. Habitat diversity often has been assessed as an indication of the importance or health of a wetland. The degree of impact on a wetland often will depend on which habitats are adversely affected; for example, fish that use coastal marshes may be diverted from their normal routes by large changes in salinity and flow (24).

Operations Variables

Frequency, Duration, and Season of Activity

The frequency, duration, and season of a development activity in or affecting a wetland will modify the severity of impact. Frequent channel-maintenance dredging, for example, might limit the recovery of an adjacent wetland from the temporary effects of sediment resuspension, especially where there is high exposure to wind and waves. Oil exploration may have rather minor and temporary adverse effects on waterfowl if access to wetlands is limited during the breeding, nesting, and rearing season. Similarly, construction of a highway through a wetland will have less impact on water quality and wildlife if the construction is rapid and efficient, avoids the period of high spring runoff, and is carried out before or after the waterfowl breeding season.

Location of Activity Within an Ecosystem

The location or orientation of development projects within a wetland can alter the magnitude of their impact considerably. One example would be the placement of highway fill in a wetland. If the causeway fill is placed parallel to the direction of surface sheet flow and subsurface flow, the problems of blocking wetland drainage or channeling the flow through culverts will be minimized (44). In another example, if pipelaying in wetlands is confined to the "push-ditch' method and the equipment can operate on dry soil at the edge of the wetland, the impacts will be less than if the equipment is operated from mats in the wetland.

Distribution, Scale, and Type of Activity

The type, scale, and spatial distribution of construction or development in a wetland must be considered in order to estimate reliably the project's impact. Wetland filling, if confined to a single area of marsh while leaving other areas undisturbed, may be preferable to a patchwork of fills distributed throughout the marsh. Draining and clearing of a significant number of small, isolated wetlands for cropland have contributed to the decline of waterfowl in the Central and Mississippi flyways (35).

PREDICTING IMPACTS OF DEVELOPMENT ACTIVITIES

Limitations

According to U.S. Army Corps of Engineer regulations, "the decision whether to issue a permit will be based on evaluation of the ***probable*** impact, including cumulative impacts of the proposed activity . . . ." Under the Corps' public interest review, the impacts of a proposed project must be weighed against its other costs and benefits to determine if the project will be allowed. While there are certain characteristic impacts associated with particular activities, it is clear that the actual impacts of any project will vary with each site and project and will depend on the time at which they are conducted. This suggests that in most cases similar activities or projects cannot necessarily be regulated in a uniform way; the potential impacts of major projects that might generate significant impacts must be evaluated on an individual basis.

Guidelines established for the 404 program recognize the variability that exists from site to site and project to project. The 404(b)(l) guidelines, for instance, require that the "permitting authority . . . shall determine in writing the potential short-term or long-term effects of a proposed discharge of dredged or fill material on the physical, chemical, or biological components of the aquatic environment. This includes determinations of the nature and degree of effect that a proposed discharge will have on the following: physical substrate, water circulation, fluctuation and salinity; suspended particulates/turbidity; contaminants; the aquatic ecosystem and organisms; and cumulative and secondary effects.

Even under conditions of very careful site-specific and project-specific examination, however, the ability to assess potential impacts accurately often is limited. In general, the immediate effects of an activity are easier to predict than long-term impacts; physical-chemical impacts are more predictable than biological impacts; direct effects are more apparent than secondary effects; and the impacts of each project individually are much easier to predict than the cumulative impact of many individual projects. The short-term turbidity caused by dredging, for instance, is predicted relatively easily and precisely; predictions of most cumulative impacts are merely speculative. A study of the impacts of deepening navigational channels on fish and wildlife concluded that:

> Assessing the impacts of navigational dredging and the disposal of dredged material is a controversial exercise; the viewpoints and approaches are endless. Without question, dredging can devastate fish and wildlife resources; however, in the absence of definitive information, impacts are sometimes more imagined than real (l).

It is well recognized that the routine application of section 404(a) authority to issue individual permits for the discharge of dredged or fill material cannot provide for the assessment of cumulative impacts on wetlands or other aquatic resources from many individual projects that are evaluated separately. The Corps' proposed general policies for evaluating permit applications makes a clear declaration:

> Although a particular alteration of wetlands may constitute a minor change, the cumulative effect of numerous such piecemeal changes often results in a major impairment of the wetland resources. [6]

The separate examination of potential effects at different but interrelated wetland sites cannot, by itself, account for the cumulative effects. The Corps' Environmental Advisory Board concluded that:

> Individual permit processing in specific regions is costly and ineffective in addressing the cumulative impacts of existing and future similar permit

[6] *Federal Register,* vol. 45, No. 184, pp. 62, 740.

actions in the same region. There was general agreement that without planning, the cumulative impact of activities associated with the regulatory program could indeed lead to serious consequences. Planning required to assess cumulative impacts of individual actions must be done on a large scale—regional, watershed, ecosystem, etc. It was also generally agreed that any analysis of cumulative impacts on an area must of necessity be based on a knowledge of local growth patterns and local planning objectives.[7]

Wetland Reviews

As noted in the Code of Federal Regulations,[8] "the District Engineer may undertake reviews of particular wetland areas . . . to assess the cumulative effect of activities in such areas. " Some districts have conducted such inventories of wetland resources, called ' 'wetland reviews, particularly where there are large numbers of permit applications and pressures for development. In some cases, the Corps has worked with State and local officials to plan for future demands for development that might require section 404 authorization. Such activities also can help to reduce the time it takes to make a permit decision and to reduce uncertainty as to which areas are regulated under section 404. These efforts are described below.

Wetland reviews have been conducted for at least six estuaries on the west coast, one area in Alaska, and in the Atlantic City, N.J., area. Each review is different; however, the review of the Snohomish Estuary by the Seattle District in 1977-78 provides a good example of information that can be presented to help reduce the uncertainty associated with the 404 process. The review's goal was to provide a comprehensive inventory of wetland habitats, a discussion of existing regulatory controls, and recommendations for wetland protection. As part of the project, a complete inventory and mapping of land use and land cover was prepared. In addition, fish and wildlife habitats and physical, cultural, and esthetic characteristics were mapped and evaluated.

From the data gathered, wetland areas within the estuary were designated as areas of importance, areas of environmental concern, and other areas. Areas of importance were those areas with unique resources or those which served critical functions. It was recommended that they be maintained in their present state and that any 404 permit be approved "only if the activity is clearly in the public interest. Areas of environmental concern were sensitive to development or change, but might have uses that are "consistent with maintenance of their habitat values. " It was recommended that "only uses in the public interest and compatible with the habitat values should be approved. " Other areas were those in which "new development would have minimal impacts on wetlands and other valuable habitat types. "

Since its completion, the Snohomish Estuary Wetland Study has been used regularly by the Seattle District. Within the Regulatory Functions Branch, use of the document has emphasized the identification of wetlands as a means of determining Corps jurisdiction under section 404. As a result, the need for time-consuming site visits has been reduced. It also is used in preapplication conferences to inform applicants of issues of concern and to suggest methods for minimizing impacts associated with their proposal. In the Environmental Resources Section, the analysis of wetlands values has been used in preparing environmental assessments (EA's) of proposed 404 permit activities. The detailed data base presented in the review saved both time and effort in preparing environmental documentation. Furthermore, in the winter it provides data that would not be available even on a site visit. On occasion, the review even has been used as a data source for EA's on sites in other estuaries with similar habitats.

It should be noted that the Snohomish County Planning Department also uses the study to evaluate substantial development permits under its Shoreline Master Program. The small county staff lacks the technical expertise to evaluate all the functional characteristics and potential impacts associated with a particular site; the review contributes to the accuracy and consistency of their decisions. In addition, the important wetlands that were identified in the study have been incorporated as "areas of special concern' in the county comprehensive plan (45).

[7] U. S. Army Corps of Engineers, 29th Meeting of the Environmental Advisory Board, held Apr. 21-24, 1982, Arlington, Va.
[8] 33 CFR 320.4(6)(3).

General Permits

Advantages

In 1977, Congress authorized the Corps to exempt categories of activities "similar in nature' on a nationwide, districtwide, or statewide basis from case-by-case permit reviews. The Corps is required to establish that activities regulated in this way "will cause only minimal adverse environmental effects when performed separately and will have only a minimal cumulative adverse effect on the environment. " Regionwide and nationwide general permits provide several positive features for wetland regulation. They provide regulatory consistency, avoid administrative delay and paperwork, and circumvent possible duplication of control by other agencies. Myhrum (34) notes that the nationwide permit program allows the regulatory agencies to focus limited personnel and finances on activities generating greater impacts. Twenty-five nationwide permits for categorical activities, such as shore stabilization and minor road-crossing fills, have been authorized with special conditions attached to each that must be followed in order for the permit to be valid. Division engineers of the Corps are authorized, at their discretion, to modify nationwide permits by adding regional conditions applicable to certain activities or geographic areas. Further, individual permits may be required if general permits are not adequate to protect aquatic ecosystems.

While section 404 authorizes general permits for activities similar in nature, the Corps also has authorized two general permits on a nationwide basis for areas rather than activities. The Corps' justification for this goes back to its history of using general permits on an areawide basis, before the 1977 amendments authorized general permits oficially. The Corps also argues that the areas granted general permits (isolated waters and waters above headwaiters) have not been regulated in the past and that the geographic scope and distribution of these waters make them impossible to regulate effectively on a case-by-case basis. On the other hand, granting a permit on an areawide basis, rather than on an activity basis, allows activities and projects to take place on wetlands, regardless of the scope and magnitude of their impact.

Disadvantages

Despite these advantages, Blumm (5) has expressed the view: "Absent reporting requirements, the cumulative impacts of general permits remain largely a matter of speculation. " He cites the criticism by the General Accounting Office (GAO) of cumulative impact assessment by the Corps in a GAO 1977 report: "It is not clear that our foundation of knowledge about impacts can support the premise that activities or discharges and conditions specified under nationwide permits will necessarily ensure minimal adverse impacts, particularly minimal ***cumulative*** adverse impacts. For example, minor road-crossing fills are permitted in nontidal wetlands if they discharge less than 200 cubic yards below "mean" high water and do not extend beyond 100 ft past the ordinary high water mark. Each such fill is required to be "part of a single and complete project for crossing of a nontidal waterbody . . ."[g] However, successive ' 'minor' crossings of a road over many isolated small freshwater wetlands in the Great Plains or separated narrow riverine wetlands in a coastal delta cannot always be said to involve only minimal cumulative impacts. While the Corps is required under section 404(e)(2) to review the status of nationwide permits every 5 years to determine if impacts have been minimal, it is almost impossible to assess the impacts that have taken place as a result of the permit if reporting is absent. In light of this problem some general permits now have reporting requirements and additional reporting requirements are being considered for others.

Another difficulty with general permits is that it is difficult for some developers and landowners to determine if they meet the conditions of the permit. To meet the general-permit conditions, for example, that a discharge of fill in an isolated wetland does not adversely modify the critical habitat of a threatened wildlife species requires a high level of

[g] *Federal* ***Register***, vol. *45, No. 184,* pp. *62, 776.*

technical expertise. Parish and Morgan (40) discuss this problem:

> Lack of certainty is inherent in the language of the permit conditions. A discharge will be permitted if it consists of "suitable' materials free from toxic materials, and the fill will be "properly" maintained. Certain classes of activities will be permitted if management practices are followed to the extent "practical" and adverse effects are minimized. If the discharger incorrectly interprets any of these terms and an individual section 404 permit is required, its issuance will involve the need for federal environmental assessment.

MITIGATING IMPACTS

In line with the definitions used by CEQ mitigation includes:

- avoiding adverse impacts to wetlands altogether by denying a project permit;
- minimizing impacts by limiting the degree or magnitude of a project;
- rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
- reducing or eliminating the impact on wetlands by preservation and maintenance operations during the life of the project; and
- compensating for the wetland losses by replacing or providing substitute resources or environments."[10]

For the purposes of the following discussion, a basic distinction can be drawn between those actions taken to ***minimize*** the impacts of a project on wetlands and those actions taken to ***compensate*** for a project's impact. Though the two may be used in combination, the strategy to compensate is most suited to situations where little can be done to minimize project impacts. Typically, in such a case, the project totally eliminates the wetland and compensation entails either restoration of wetlands or creation of new ones at another site. Filling and bulkheading of wetlands for real estate development or draining and clearing of wetlands for farming are good examples.

Under the 404 program, adverse impacts are reduced by ***conditioning*** individual permits or by using "blanket conditioning" for general permits. Conditioning usually entails either onsite design requirements and construction and management practices to minimize impacts or requirements for offsite compensation of unavoidable impacts. Like the difficulties associated with assessing impacts, the effectiveness of mitigation measures in ameliorating the impacts of a project sometimes can be very uncertain or even speculative. Although the Corps strives to tailor mitigation measures to individual permits, controversies may arise from requirements for expensive mitigation measures if the benefits of these measures are questionable. In some cases, the expense of mitigation can reduce the profitability of projects to a point where they are no longer worthwhile to pursue, and developers complain that the agencies sometimes use permit conditions as leverage to discourage projects.

Current Corps policy does not give much guidance on the level of mitigation appropriate in cases of great uncertainties, calling only for modifications that are "commensurate in scope and degree with the impacts of concern. However, the Corps currently is establishing a more specific policy: in the interim final regulations issued July 22, 1982, the Corps indicates that it is beginning to address the problem of uncertainty. Whether permits may require mitigation of secondary impacts, for instance, "will depend on whether the impact is at least probable, rather than speculative."[11] In its May 12, 1983, revisions of the 404 regulations, the Corps proposed expanding authority of the district engineer to provide for either onsite or offsite mitigation.

In the following sections, the feasibility of these strategies is evaluated, and opportunities for and limitations of using them are explored.

[10]CFR, pt. 1508.20(a-e).

[11]*Federal Register*, vol. 45, No. 184, pp. 62, 657.

Feasibility of Compensation or Offsite Mitigation

Creation

Producing a new wetland usually involves falling an open-water or upland ecosystem, which may, in itself, possess important values. Developing a new wetland entails providing the proper substrate level and type, assuring chemical compatibility, and providing erosion control during establishment of vegetation. The complexity of these factors introduces considerable risk of failure; however, the historical record shows that creation of wetlands can be successful, given proper site selection and preplanning.

Marsh creation has occurred mainly in coastal waters or along shorelines that are not exposed to large storm waves or the wakes of ships (20,39,60). Planting aquatic plants predates the 1940's. Marshes of various sizes have been developed along the Mississippi River since the 1930's, in Utah in the 1930's and 1940's, and in Wisconsin and other States since the 1940's. Although some projects range up to several hundred acres in size, marsh creation by means of artificial plantings tends to be on a smaller scale (0, 1 to 10 acres) owing to high costs for establishment.

The largest concentration of projects has occurred in brackish and saline environments along the mid-Atlantic and Southeastern coastlines. Wetlands also have been created successfully in New England, along the Gulf Coast, particularly in Texas (57), and along the west coast [e. g., San Francisco Bay and the Columbia River estuary (51)]. Some freshwater marshes have been established on rivers (55), on the Great Lakes (59), in isolated ponds as part of surface-mine reclamation (1 1), and in sewage lagoons, to assist with wastewater treatment (16).

Restoration of Wetlands

Restoration involves taking an existing marsh from a poor, unhealthy, or degraded state to the level of productivity and habitat value associated with undisturbed natural wetlands occurring in the vicinity. This process often can be accomplished by changing surrounding water inflow or drainage, eliminating erosion and siltation, and reducing pollution from adjacent areas (6,29,46). Restored areas generally will have at least some semblance of the natural elevations and substrate unless erosion or sediment deposition has been severe. Residual populations of natural plants usually are present to serve as seedstock for widespread regeneration. However, re-creation of wetlands has occurred from seed remaining in the soil for decades.

Restoration, although not widely reported, has been practiced in estuarine systems where diking has degraded coastal wetlands (33,47), in areas where normal sediment input or hydrologic patterns have been disrupted (48,49), and in brackish or saline marshes that have been modified heavily by construction activities or exposed to different types of pollutants (55). In some cases, freshwater wetlands have been restored, as in the case of Florida's extensive freshwater ecosystems (50,52). Marsh-restoration projects tend to be small-usually 20 acres or less.

Costs of Creation and Restoration

Any successful marsh-creation or marsh-restoration project must involve costs for project planning, site investigation, careful seasonal scheduling, and postproject monitoring. Total project costs typically range from $250/acre for a small, relatively simple marsh-creation project (57) to over $6,000/acre for a marsh established for sewage treatment (16). Transport of substrate material by barge, truck, or dredge, and subsequent site preparations usually account for the largest single cost wherever the site requires extensively raised elevations. In most newly created wetlands, artificial plant propagation is also a necessary and significant cost, Scheduling of project operations within natural environmental constraints, such as the periods of tides, plant germination time, and limits of the growing season can increase costs in the short term but will contribute greatly to project success over the long term. In general, it is far less costly to restore degraded wetlands than to create new wetlands.

Prospects for Success

The success of efforts to create or restore wetlands depends on many factors, including wetland type and location, project scope and size, materials and methods used, and good project planning and management, especially during the first two or three growing seasons. However, even a properly developed wetland will require an extended period of time for the functions of a natural wetland to evolve. For example, hydrological values and the ability of manmade wetlands to enhance sedimentation of suspended material are achieved within a relatively short time; wetland ability to assimilate nutrients and toxic substances takes somewhat longer. The diversity of a site and its ability to support more wildlife also generally increase over time. However, there is insufficient data at this time to say how long it takes for all the biological functions of a natural wetland to develop.

WETLAND PRESERVATION VS. RESTORATION OR CREATION

Some States may call for ***protecting*** wetlands equivalent in biological value to the wetlands filled or diked. Others, such as Oregon, prescribe that no net loss of existing wetland values should occur: "Oregon's mitigation requirement . . . is that areas of similar biological potential must be ***created or restored,*** not simply protected (25). The mitigation goal is to replace lost wetlands with restored or new wetlands similar in quantity and quality of flora and fauna. Recently, the concept of "no net loss" has been criticized. The skepticism arises from a concern over whether new marsh creation really compensates for losses of natural wetlands. Race and Christie (42), for instance, write:

> A reevaluation of data from manmade marshes is necessary before there can be a determination of whether coastal salt marshes are truly being replaced or expanses of marsh vegetation that persist temporarily are merely being planned . . . a newly created marsh is not the functional equivalent of a 1,000-year-old marsh,

These authors warn that mitigation should not be offered as justification for the development and destruction of wetlands. The assumed ability to ''create' wetlands, they say, creates the perception that wetlands are a renewable resource, a perception that could lead to more widespread development. Regulators, they feel, should be "judicious" in allowing mitigation by marsh creation. Race and Christie conclude that:

> Marsh creation in suitable situations can be an effective tool to minimize onsite damage at post-construction sites, to abate shoreline erosion, and to return degraded wetlands to tidal influence by means of restoration. However, because of the limited scientific evidence on the development and stabilization of important biotic and physical characteristics of manmade salt marshes, managers must be cautious in the widespread adoption of marsh creation as a mitigation strategy.

OPPORTUNITIES FOR WETLAND MITIGATION BANKING

The Statewide Interpretive Guideline for Wetlands and Other Wet, Environmentally Sensitive Habitat Areas, adopted pursuant to the California Coastal Act, provides for the payment of a fee to a public agency for purchase and restoration of a degraded wetland to a productive value at least equivalent to that of a wetland being filled. The payment to a "mitigation bank' would be in lieu of dedicating or restricting the use of a comparable wetland provided directly by the permitholder (36). This feature relieves the burden on landowners and developers of searching out suitable mitigation sites. It also promotes a cohesive rather than a fragmented approach to wetland-impact mitigation, with significant opportunity for economy of scale.

A Federal wetland bank, as suggested by the Corps, would operate as in California except that creation of replacement wetlands would be emphasized (54). In fact, Congress has authorized use of a wetland mitigation bank associated with the Tensas project in Louisiana.

Onsite Mitigation to Minimize Impacts

Site-Specific Requirements

Many development activities produce ***primary, secondary,*** and ***cumulative*** impacts in or adjacent to wetlands that can be minimized feasibly when fully understood. Thus, successful control of the primary impact, in turn, will reduce subsequent secondary and cumulative impacts. Further mitigation efforts may be necessary, however, where an activity is known to produce significant indirect or compounding adverse effects. An areawide wetland review may uncover further unforeseen impacts.

One of the major problems in mitigating project impacts is the difficulty of mitigating cumulative and secondary impacts. The lack of reliability in impact prediction complicates the mitigation process. As an example, a short-term, isolated, primary impact of a dredging operation is suspension of sediment in the water column. The narrow approach toward mitigating this effect might include avoiding periods of fast tidal currents and deploying silt curtains. However, secondary impacts may include the release of excess nutrients and toxic contaminants. Long-term cumulative impacts from repeated dredging and other excavation at many sites throughout a single estuary might include low-level, but widespread, bioconcentration of metals and synthetic organic compounds, with consequent chronic, sublethal effects within the food chain. Mitigative measures designed merely to minimize the direct, localized effects of separate dredging operations may fail to address systemwide, indirect effects.

General Requirements

Mitigating impacts on wetlands may take the form of standard conditions attached to individual dredge or fill permits, conditions incorporated into general nationwide and regional permits, and the best management practices (BMP's) prescribed for activities exempted from any permits. While the nature of general prescription has eased the regulatory burden of issuing individual permits covering site-specific situations and has set approximate standards for common development practices, it overlooks the likelihood of environmental damage that may occur because specific wetland functions, values, and sensitivities are not considered. As an example, disposal of spoil from maintenance dredging might be required under a regional general permit to avoid discharge in or near active currents. This practice could lead to several shallow-water spoil sites in a wetland area with long-term effects, such as chronic resuspension of sediments from wind and waves, periodic disruption to bottom-dwelling populations, and possible bioaccumulation of toxic chemicals (37). Under an individual permit, however, site-specific conditions might stipulate long-term disposal within a diked containment site to avoid contamination of a nearby wetland heron rookery or of a municipal ground water supply.

BMP's are applied to common activities such as minor road construction for maintenance of natural surface and subsurface drainage or pipeline installation for sediment control. A representative BMP for a minor road might be to install culverts through the causeway fill with spacing, elevation, and capacity needed to maintain lateral drainage, including stormflows and the passage of fish and other aquatic animals (37). The application of BMP's on an indiscriminate basis can reduce the effectiveness of mitigation measures by overlooking limiting, site-specific conditions. To ensure their effectiveness, adequate site investigations are necessary to show that critical or sensitive wetland values and functions are not jeopardized and that local environmental conditions will not negate normal BMP effectiveness. For example, where there is unchanneled sheet flow in a marshland, the required number and spacing of culverts will be quite different than where surface flow is already channeled; otherwise, the usual BMP approach could cause adverse hydrologic impacts by promoting channeling. In conclusion, BMP's generally are appropriate where impacts from a specified activity are localized, consistent, and predictable; the mitigative measures are highly standardized and proven effective; and the landowners or developers responsible possess the necessary technological and management capabilities to use these practices effectively.

Controversy over mitigation arises over application of blanket stipulations of mitigation requirements as opposed to case-by-case tailoring of permit conditions. Blanket stipulations greatly increase the uncertainty over the effectiveness of mitigation requirements, and developers complain that they are required to meet blanket stipulations that are not applicable to their specific permit situation. Because it lacks resources to undertake the extensive site investigations or studies to determine the effectiveness of different mitigation measures, the Corps has been forced to use stipulations recommended by its staff and staff from other resource agencies. GAO, in a report to the Congress on improving wetlands permit processing in Alaska, concluded:

> (The) Corps imposes controversial and costly permit conditions without assuring that these conditions are, in fact, needed. The need for these conditions, which are frequently proposed by various Federal and State agencies, is not substantiated by site-specific data and research findings (12).

GAO recommended increased site-specific investigation to prescribe impact controls adapted to unique site characteristics instead of blanket stipulations. This recommendation was aimed at the uniform application of particularly costly measures that may burden the oil companies, such as seasonal drilling requirements in wetlands. However, GAO admitted that without more research to substantiate such restrictions, neither their imposition nor the removal of blanket restrictions could be justified.

Uncertainty of Mitigation Cost Effectiveness

In the Corps' proposed regulations for processing of section 404 permits, special conditions may be attached "only to respond to effects and impacts of the permit which are at least probable rather than speculative.[12] Banta and Nauman (2) believed that, "While ideally (mitigation) involves an objective judgment by scientific standards . . . , it has frequently become the last ounce of environmental quality that can be injected into a project within legally and politically acceptable limits. " For example, a standard mitigation criterion in the Environmental Protection Agency's (EPA) section 404(b)(l) guidelines is to minimize adverse effects by "selecting sites or managing discharges to prevent or avoid creating habitat conducive to the development of undesirable predators or species which have a competitive edge ecologically over indigenous plants or animals. This much sophistication actually applied to the conditioning of permits would entail considerable subjectivity and speculation.

Clearly, there is more objectivity and accountability where mitigation is prescribed in more specific terms tailored to local conditions, or at least to regional situations. On the other hand, a total site-specific approach would impose an inordinate regulatory burden on both the permitters and permit-holders. Mitigation may not be cost effective where, as GAO has pointed out, costly measures for wetland protection are requested without a site examination to ascertain the need in each case. Also, requesting untested or (experimental) practices for impact mitigation may be insupportable in view of the proposed regulation to eliminate conditioning of permits for speculative impacts. Unfortunately, the followup evaluation of actual cost effectiveness for classes of mitigative measures has been very deficient.

[12] *Federal Register*, vol. 45, No. 184, pp. 62, 757"

Management Plans

To design a mitigation plan covering secondary and cumulative impacts in an area subject to significant development activities, a systemwide impact assessment such as that provided by the Corps' ' 'wetland review' must be undertaken prior to developing an estuary management-and-mitigation plan. The offsite, cumulative effects of many wetland fills within an estuary on basinwide tidal circulation and water levels could be controlled by limiting the siting, uses, and overall amount of landfills. Through this approach, appropriate resource-based constraints to development projects can be identified based on an inventory of physical, biological, esthetic, social, and economic resources. Objectives of the plan are linked consistently with all project proposals, and the costs are shared equitably.

Management plans are initiated generally by groups that have responsibility for local planning and development. To help ensure that the plan will be implemented, the sponsoring group may seek the participation of the Corps and other agencies with regulatory responsibilities. Management planning efforts can be particularly useful for specific areas where pressures for development are intense, there are constraints to development, and inconsistent policies and plans for an area make decisionmaking especially difficult.

Management plans can be used to define which areas are to be protected or developed. For example, the Anchorage Wetland Plan classifies areas into four categories: ***preservation,*** which precludes any development; conservation, which allows limited development with mitigation measures; devel***opable,*** which allows complete draining and filling; and special study, which requires additional environmental data to determine status. The plan is being implemented through local planning and control mechanisms and includes a provision for Federal consistency with local coastal-management policies. The Corps currently is preparing to issue a general permit to the city for development activities that occur in wetlands covered by the plan (18).

Management plans also can be used to restrict certain development activities and establish standards for other types of development. For example, the East Everglades Management Plan prohibits road construction in permanent wetlands, allows agricultural use in some drier areas (particularly those that were disturbed previously), restricts the density of residential development, and defines BMP for three basic management areas. To implement the law, the local government must develop some new mechanisms, including a site-alteration overlay ordinance and a system of transferable development rights; establish new zoning districts; and continue to regulate obstructions to surface water flows under an existing ordinance. State government also has the responsibility of continuing to regulate dredge and fill in the area to the extent authorized under State law and of revising water-quality standards for the area.

Continued regulation of section 404 by the Corps is also an important element in the implementation of the plan, particularly in cases of violations. Corps jurisdiction is broader than the State's, and the Corps has acted more quickly than the county in enforcement actions (9).

Management plans also have been used to resolve the conflicts and inconsistencies between the policies of the numerous agencies with jurisdiction in an area. For example, an objective of the Grays Harbor (Washington) Estuary Management Plan is to set guidelines that offer some assurance that activities permitted by the plan would have general concurrence from all the agencies involved. This planning process is described in detail below.

The Grays Harbor Estuary Planning Task Force was formed in 1975 with representatives from all the agencies responsible for plans and regulations in the area. In 1976, funds were acquired from the Office of Coastal Zone Management (OCZM) for development of the plan, which began with the development of a comprehensive data base delineating the physical and biological resources, ownership, land use, comprehensive plan designations, areas of conflict, and other data. Development of the actual plan occurred during a series of workshops in which the task force determined planning areas, established specific management units, and developed policies to direct development activities in the estuary. The draft plan underwent extensive review, and a final plan recently has been completed.

The Grays Harbor Regional Planning Commission is the lead agency for the plan but has no authority to adopt or enforce the plan. Instead, the plan is recognized as a recommendation from the task force to the numerous agencies involved in the planning process and in development activities in the estuary. At present, an environmental impact statement (EIS) on the plan is being prepared by OCZM.

Each of the agencies involved has been asked also to prepare a memorandum of understanding (MOU) to explain how it perceives the plan, and how it will be used. To date, none of the MOU's have been completed and probably will not be until the EIS is finished. Unofficially, several agencies have indicated that the plan probably will not be considered binding; however, it will be given serious consideration in evaluation of local concerns and the public interest. The Fish and Wildlife Service (FWS) notes that it supports the plan; it has accepted some major environmental losses in exchange for long-term protection of other portions of the estuary. FWS also observes that the plan does not make decisions but will serve as a guideline and should streamline permit review. The Corps also generally supports the plan. The Corps has been asked to give serious consideration to issuing general permits for some activities in the area; in particular, the disposal of dredge or fill material in unvegetated and vegetated intertidal areas designated in the plan for industrial development. To date, no decision has been made on these general permits.

A major issue in the plan is the predesignation of dredged-material disposal sites within the estuary. The Regional Planning Commission and the Port of Grays Harbor have expressed a strong desire for predesignation by EPA; to date, EPA has not made a decision on this issue. Since some of the areas are vegetated and unvegetated wetlands of significant environmental value, EPA has expressed some concern about whether such a predesignation is legal.

State and local concerns about Federal involvement in the plan also have been expressed in another manner. The plan is viewed as an attempt to create a regional plan for shoreline management that will provide consistency and predictability for both development and conservation interests. Through the planning process, least damaging alternatives and compromise solutions were investigated and pursued.

Greater legal commitment of different Federal agencies to the results of any planning efforts of this sort are very much needed. If the Federal agencies cannot commit to the final components of the plan, then case-by-case permit evaluation will replace long-term planning. Not only will predictability and shortened permit processes be precluded, but other local jurisdictions will be discouraged from pursuing comprehensive shoreline planning, an outcome perceived to thwart the goals of OCZM.

In spite of the concerns described above, the plan is considered by many to have been a successful exercise. Representatives from most of the jurisdictions involved felt it was a good idea and have committed time and effort for almost 6 years. The port often has been able to maintain momentum when other agencies lost enthusiasm or became mired in the process. Furthermore, many areas of 'predictability' have been identified. Development interests can learn which are controversial locations and which are acceptable. At least some regulatory agency personnel already are using the plan to assist them in making decisions, even if they have not firmly acknowledged its authority (45).

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