REBUILDING THE NATION'S WETLAND HERITAGE

A Challenge for the 1990s

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Report of the Harvard Wetlands Policy Project

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EXECUTIVE SUMMARY

Wetlands are a resource with important, overlapping, environmental, economic, and cultural functions and values that are in short and diminishing supply nationally. The need for protection has led to policies that favor on-site, in-kind regulation, neglecting the fact that most wetlands occur as area-wide, natural systems. The responsibility for wetlands is currently fragmented among numerous federal, state, and local agencies. An emphasis on achieving no net loss has overshadowed the real possibility of restoring or even creating wetlands: net gain. Thus, there is an urgent need for a well-articulated and properly coordinated, national program for the restoration, creation, and enhancement of wetlands to achieve a significant net gain in the nation's basic wetland supply by the turn of the century. Is such a goal attainable? We think so with modest but meaningful changes in direction and a comprehensive, coordinated approach nationally to wetland conservation, protection, restoration, and management.

Harvard University's Wetlands Policy Project has concluded that rebuilding the nation's once-abundant wetland heritage constitutes an important challenge that should be met by the close of the 1990s. Accomplishing this goal will require the following steps:

• an inventory of restorable sites and the classification and ranking of existing and prospective wetlands;

• planning for wetlands by whole bioregions using the full array of public and private agencies to undertake the needed restoration actions and with the private development community engaging positively in the effort;

• self-financing of wetland conservation programs where feasible, establishment and use of wetland banks, and the possible creation of a National Wetlands Trust Fund to support the large-scale preservation efforts needed;

• greater use of constructed wetlands in conjunction with sewage treatment, landfill, and non-point source control projects;

• institutional changes to enable the creation of a National Wetlands Council and federal-state regional wetland councils as representative forums for coordination and leadership, a revision of the 1977 Executive Order 11990 (Protection of Wetlands), and enactment of a specific title for wetlands in the Clean Water Act reauthorization.

PREFACE AND ACKNOWLEDGEMENTS

The Harvard Wetlands Policy Project is the second in a series entitled Topics in Environmental Policy, initiated in 1988 with an inquiry into federal water policy[1]. The host institution is Harvard University's John F. Kennedy School of Government. Each policy project typically consists of four parts: a graduate-level, one semester, policy course given at the Kennedy School; a range of disciplines, interested faculty, and participants including those from other Greater Boston academic institutions; consultation with visiting experts; and the preparation of a formal policy paper setting forth the findings and recommendations.

The principal researchers were Dr. Charles H.W. Foster, Adjunct Research Fellow and Lecturer at the Kennedy School, and a former Massachusetts cabinet-level natural resources and environmental administrator; and Dr. Peter P. Ropers, Gordon McKay Professor of Environmental Engineering in the Division of Applied Sciences, and a specialist in the analysis of environmental, energy and water systems in the United States and overseas.

Eight students, representing Harvard College, the Kennedy School, the Graduate School of Design, the Division of Applied Sciences, and Tufts University's Urban and Environmental Policy Program, devoted substantial time to the project. Two students contributed working papers which were used extensively in preparing this final report:

[1] Foster, Charles H.W. and Peter P. Rogers, 1988. Federal water policy: toward an agenda for action. Discussion Paper E-88-05. Harvard University, John F. Kennedy School of Government. Cambridge (MA).

Ruben, Adam. 1991. "A scheme for the classification and ranking of wetlands."

Snyder, Robin. 1991. "Wetlands mitigation banking: rethinking an uncertain science."

Faculty participants included Professors Robert N. Stavins, Robert Dorfman (economics), Myron B Fiering, Joseph J. Harrington (engineering), Ralph Mitchell (biology), Arthur Maass (government), and Michael W. Binford (landscape architecture). Loeb Fellow Emily Gabel-Luddy, on leave from the Los Angeles City Planning Office, was also an active contributor.

The Harvard Wetlands Policy Project received extensive advice and guidance from eleven invited lecturers:

Eugene Z. Stakhiv, Chief, Policy Studies Division Corps of Engineers,
Institute for Water Resources

Garrett G. Hollands,
Geologist and Principal IEP, Inc. (environmental consultants)

Dr. Joseph S. Larson, Director
University of Massachusetts' Environmental Institute

Dr. Peter Grenell,
Executive Officer, California Coastal Conservancy

Michael L. Davis,
Assistant for Regulatory Affairs, Office of the Assistant Secretary of the Army

John W. Meagher, Director
EPA's Wetlands Strategies & State Programs Division

Dr. Jon A. Kusler,
Executive Director Association of State Wetland Managers

Dr. Joseph W. Westphal,
Executive Director Congressional Sunbelt Caucus

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Janice L. Goldman-Carter, Counsel
National Wildlife Federation's Fisheries & Wildlife Division

The Hon. Claudine L. Schneider, Institute of Politics Fellow, former United States Representative (Rhode Island)

The seminar discussions initiated by each lecturer were extended by comments from an augmented audience drawn from other wetlands organizations, agencies, and interests.

Douglas E. Cooper
CT Dept. of Environmental Protection

Dr. Ross A. Dobberteen
Lelito Environmental Consultants

Charles J. Fausold
New England Governors Conference

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Edward Moses
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Elizabeth Nicholson
Save the Harbor/Save the Bay

Lawrence Oliver
US Army Corps of Engineers (NE Division)

Ralph C. Pisapia
Asst. Regional Director US FWS (Region 5)

Edward L. Reiner
US EPA (Region 1)

Patricia Reixinger
NY Dept. of Environmental Conservation

Peter L. Shelley Esq.
Conservation Law Foundation of New England

John E. Wiggin
Urban Harbors Institute (U. Mass-Boston)

Ann Williams-Dawe
Esq. US EPA (Region 1)

Two field trips were scheduled to examine wetlands in situ. The topics covered and field trip guides included:

Waste treatment and wetlands (Dr. Ross A. Dobberteen, Lelito Environmental Consultants)

Urban wetlands (Karl Pastore, Belle Isle Marsh MDC Reservation)

Riverine wetlands (Daniel Jones, North and South River Watershed Association)

Agricultural wetlands (William C. Frantz, Ocean Spray Cranberries, Inc.)

Marine wetlands (Dr. John B. Pearce, NOAA Northeast Fisheries Center)

White cedar swamps (Dr. Aimlee D. Laderman, Yale School of Forestry and Environmental Studies)

National estuarine research (Christine Gault, Waquoit Bay Reserve; Donald W. Bourne, American Littoral Society)

Anadromous fisheries (John L. Fiske, MA Division of Marine Fisheries)

Section 404 wetlands (Garrett G. Hollands, IEP, Inc.)

Municipal wetlands (Pamela S. Truesdale, Falmouth Conservation Commission)

Wildlife wetlands, (William C. Ashe, National Fish and Wildlife Foundation)

Toward the end of the project, several individuals were consulted in Washington on current wetland policy developments:

Janice L. Goldman-Carter Esq.
National Wildlife Federation

Robin O'Malley
Associate Director for Natural Resources Council on Environmental Quality

Rhod Shaw
Chief of Staff
US Representative Jimmy Hayes (Louisiana)

Robert Lindsay Thomas
US Representative (Georgia)

Susan Tomasky Esq.
National Wetlands Coalition

Dr. Joseph W. Westphal
Executive Director Congressional Sunbelt Caucus

During the course of the project, many other individuals were contacted for information and materials -- among them:

Matthew B. Connolly, Jr.
Ducks Unlimited

Harley F. Laing Esq.
US EPA (Region 1)

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NH Dept, of Transportation

Dr. Gary S. Markheim
USDA Soil Conservation Service

Eric M. Preston
US EPA (Corvallis Laboratory)

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VA Polytechnic Inst. and State University

Heidi Sherk
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MA Water Resources Commission

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ME Dept. of Envtl. Protection

Susan J.E. Woods
NE Interstate Water Pollution Control Commission

Dr. Sally Zielinski
MA Assn. of Conservation Commissions

The Harvard Wetlands Policy Project is most grateful for the ideas and materials furnished by all of the participants. Although the findings and recommendations of the report are our own, they have been influenced heavily by the admiration and respect we have gained for the many fine professionals who have been working with such dedication for wetland conservation throughout most of their careers.

Charles H.W. Foster
Peter P. Rogers

Cambridge, Massachusetts August, 1991

PART I: THE PROBLEM

Wetlands -- An Introduction

Just what is wetland? It is, of course, wet land -- that is to say, land covered with (or saturated with) water for appreciable periods of time. These areas bear such designations as swamps, marshes, bogs, fens, and wet meadows. But in recent years, wet land has also become wetland -- a natural resource in its own right, duly validated by statute and provided the ultimate distinction of governmentally designated programs and agencies.

The definitional problems of wetlands abound. The initial question involves how wet, how often, and for how long. What constitutes a recognizable wetland is another issue. Still a third question -- one currently rife with controversy -- is how one goes about delineating a wetland. The fact of the matter is that the definition of a wetland will vary by agency and even by advocate. For example, the scientist's view of a wetland may not be the farmer's. Compounding these perceptual difficulties are those of law and regulation. A federal administrator and a local conservation commission, for instance, may have differing views about a proposed wetland alteration. Whether an area is or is not a wetland transcends academic discussion when a permitted activity is involved.

For purposes of this paper, we have elected to use the Fish and Wildlife Service's three part definition of a wetland: in sum, (1) an area that at least periodically supports hydrophytic vegetation; (2) an area whose substrate is primarily undrained, hydric soil; (3) an area on a non-soil substrate that is saturated or covered with water at some time. Such areas fall into two broad categories: (i) those that are vegetated, ranging from forested, shrubby, and emergent wetlands to those whose plant constituents are less prominently displayed (e.g., the moss/lichen tundra of the Arctic, and the aquatic plant beds of the South); and (ii) non-vegetated wetlands, categories that include such varied habitats as rocky and unconsolidated shorelines, offshore reefs, sandy beaches, mud flats, and streambeds.

Why do wetlands matter? Simply because they perform useful functions and provide important values. The full list can be a long one (e.g. Kusler, 1983), but most tend to fall into several discrete categories. The first might be termed physical and hydrological. Wetlands, for example, impede wave action and disperse flood flows over area and time. By doing so, they trap and deposit sediments, and reduce erosion. Much has already been discovered about the important natural relationships that exist between wetlands, surface, and ground water in particular locations. For example, we know that wetlands can store significant amounts of flood water and reduce flood damage. In artificial settings, it is no accident that developers often seek to divert urban runoff into existing wetlands. A second functional category is primarily biological and biochemical. Wetlands are invaluable as habitat for fish and wildlife, furnishing nutrients, food, and cover and even functioning as nursery grounds for living resources. From the human standpoint, the biological capacity of wetlands to break down and assimilate wastes is becoming increasingly important for point and non-point source pollution control. Economic benefits represent one of several categories of values. Directly harvestable wetland resources include such items as berries, rice, hay, peat, bottomland forests, fish, and fur. Significant, indirect returns can occur when wetlands increase water yields, enhance water quality, or prevent flood damage. But real economic value can show up in other settings as well -- for example, the enhanced property values of a second home overlooking a scenic salt marsh. Broad societal benefits are an area of increasing importance as our knowledge of wetlands increases. Recreation, research, culture, education, and aesthetics are examples here. Finally, many wetland experts argue that wetlands also have intrinsic value. They should simply be allowed to exist as part of the natural landscape. It is important to remember that some wetland systems are more difficult to replace than others. In such cases, destruction or alteration is virtually irreversible.

Just how do wetlands come about? Many are the remnants of earlier glacial action. Examples are the pothole region of the northern Great Plains, and the kettleholes of the Northeast.

Erosion and deposition have created many important wetlands. Prominent examples are the delta of the Mississippi River on the Gulf Coast and the great braided channel of the Yukon River in Alaska. Other major wetland regions are found in wave-protected reaches of the Atlantic, Pacific, and Gulf coasts. Man-made wetlands are becoming increasingly important. They are created by transportation corridors, storm water runoff from urban streets, and water impoundments. Wetlands of animal origin are represented by beaver flowages. Phenomena like wind erosion or earth movement have been known to create as well as destroy wetlands. In fact, the growth and decline of wetlands due to natural processes is an aspect not well documented and one largely overlooked in the press of attention given anthropomorphic influences.

With respect to size, numbers, and distribution, wetlands are a resource of world-wide proportions (Maltby, 1988). By accepted definition, they cover some 6% of the land surface of the earth. In certain countries (e.g., Indonesia), wetlands represent 25% or more of the land area; in others they are extremely rare (e.g., the 700 acre Mai Po marshes of Hong Kong). Wetlands take many forms -- the productive mangroves of the Asian and American tropics, the extensive peatlands adjacent to the South China Sea, the wildlife-rich savanna floodplains of drainage -- accounts for the bulk of the losses. From the 1780s to the 1980s, on average, over 60 acres of wetlands were lost every hour in the lower forty-eight states. More recently, thanks to a combination of declining agricultural conversions and more vigorous protective actions, the rate of loss has been cut in half to an estimated 275,000 acres annually (OTA, 1984). Regrettably, recent press accounts of significant gains seem to be illusory and are attributable simply to an adjusted data base. We have been advised by the Fish and Wildlife Service that the next national wetland trends study is expected to show losses continuing at the rate of 300,000 - 350,000 acres annually.

Viewed over time, by far the largest losses of wetlands occurred in one period alone (1849-70). The Swamp Land Acts of 1849, 1850, and 1860, intended as incentives for the states to encouragement settlement and use, resulted in a reported 65 million acres made available for

sale at an average cost of $1.25 per acre (Gates, 1968). The practice of ceding public lands to the states for resale to private owners spread eventually to fifteen states, largely in the South and in the former Northwest Territory (the Midwest).

Wetland depletion must be viewed in two contexts -- decline in absolute acres, and proportion of acres lost (see Appendix A). Alaska, for example, is the state with the most wetlands (170 million acres) and the least proportional losses to date (approximately one-tenth of one percent). Fifteen states account for more than two-thirds of the historic acreage lost (Florida's 9.2 million acres heads that list); but seven of those states (Florida included) still have more than 5 million acres remaining of wetlands each. In Alaska, Florida, Louisiana, Maine, and South Carolina, despite a significant loss of wetlands over time, approximately one-quarter or more (45% in the case of Alaska) of the states' surface area remains wetland.

Not surprisingly, one-third of acreage losses historically have occurred in the eight, midwestern, farm-belt states. They and California have sustained depletions approximating ninety percent of the original resource. Four other regions have experienced losses near or above forty percent: the four prairie states (North Dakota, South Dakota, Nebraska, and Minnesota); five of the states of the deep South (Florida, Mississippi, Alabama, Louisiana, and Texas); the mid-Atlantic coastal region from New York to North Carolina; and four of the New England states (Vermont, Massachusetts, Rhode Island, and Connecticut). This suggests that any national wetlands program must operate with sensitivity to regional variations in the nature and occurrence of the resource.

Wetland Conservation

The first stirrings of concern over wetland losses in the United States were manifest in the wildlife conservation movement of the late nineteenth century (Reiger, 1975). Sparked by the creation of the Bureau of Biological Survey in 1885, and the successful effort to restrict commercial traffic in hides and plumes (passage of the Lacey Act in 1900), the nascent

sportsmen/conservation movement faced its first major crisis when the continental waterfowl population crashed in the early 1930s -- the result of unfettered agricultural development and widespread drought during the depression years. In response, several important measures came into prominence --among them, the Duck Stamp Act, and the Fish and Wildlife Coordination Act. Funds derived from the sale of duck stamps became the primary means of acquiring wetlands in the breeding and wintering grounds; the coordination act permitted the Fish and Wildlife Service to begin intervening in agency development decisions. By the late 1930s, a powerful private partner had emerged. Ducks Unlimited, a continent-wide sportsmen's organization, would come to raise more then $400 million in non-governmental funds to secure and develop seventeen million acres of waterfowl habitat from coast to coast (Ducks Unlimited, 1990).

The second stimulus to wetland conservation occurred in the decades following World War II, an era marked by particular attention to natural resources. Area-wide planning came into vogue, and elements of the comprehensive approach to river basins favored at the time included consideration of wetlands as a natural resource (Foster and Rogers, 1988). When outdoor recreation caught the public's fancy in the 1960s, wildlife, water, and wetlands found a common rationale for existence. To this very day, the State Comprehensive Outdoor Recreation Plans (SCORPs), a prerequisite for federal Land and Water Conservation Fund grants for land acquisition and facility development, require a formal wetland component (USDI, NPS, 1987).

In the meantime, concern for marine and coastal resources was mounting, too. Upon closer examination, wetlands were found to serve as important nursery grounds and nutrient producers for many species of fin and shell fish. The extensive loss of such areas to drainage, mosquito control, and development prompted passage in 1963 of the first coastal wetland protection act under state auspices (Massachusetts General Laws Chapter 131).

Despite these accomplishments, the full flowering of wetland conservation was yet to come. It would occur under the twin rubric of environmental protection and water quality improvement. In December of 1969, Congress passed the National Environmental Policy Act

(NEPA), making it national policy to minimize damage to the natural environment. The procedural guidelines for environmental impact assessment were made binding on all federal agencies, and wetlands were among the resources singled out for attention. In 1972, as a result of widespread public support for a national goal of "fishable, swimmable waters", Congress passed the first Clean Water Act. Section 404 of that act required a specific permit for the discharge of any dredged or fill material into waters of the United States, including their associated wetlands. This authority was clarified and strengthened in the Clean Water Act amendments of 1977 (USEPA, OWP, October 1989). Executive branch agency compliance with respect to wetlands was further assured by the issuance of Executive Order 11990 (Protection of Wetlands) by President Jimmy Carter in May of 1977.

Wetland Regulation

Since that time, a curious, bimodal form of implementation has emerged. The basic responsibility for issuing wetland permits under Section 404 (a) rests with the Corps of Engineers, coincident with the agency's existing permit authority under Section 10 of the Rivers and Harbors Act of 1899. Yet, the Corps' actions with respect to wetlands are constrained by guidelines promulgated under Section 404(b) by the Environmental Protection Agency, an agency also given the statutory authority under Section 404(c) to intervene in and even override a permit action by the Corps of Engineers with which it disagrees.

After an initial period of sparring, the two federal agencies have developed generally concordant methods of operation at the headquarters level, utilizing the device of formal memoranda of agreement (MOAs) on such procedural matters as delineation, geographic jurisdiction, mitigation, enforcement, and permit issuance. Notwithstanding potential impediments, the permit issuance business has burgeoned (ASA Semiannual Regulatory Briefing, Corps of Engineers, November 28, 1990). In Fiscal Year 1990, for example, the Corps received more than 9,500 requests for individual wetland permits. It carried an enforcement case load of

more than 10,000 wetland violations. Some eight hundred engineers, biologists, technicians, and administrative personnel are now involved in the Corps' portion of this nationwide effort.

Indeed, so popular a topic has wetlands conservation become that other federal agencies have flocked to enter the wetland arena, often with the explicit encouragement of the authorizing committees of Congress to which they are responsible. A partial list of such participants and authorizations includes nearly seventy separate federal programs and virtually every major cabinet and independent agency (Final paper of the Subgroup on Federal Programs to Protect Wetlands, November 30, 1990). They involve activities in the areas of state/local/tribal support, incentives/disincentives, planning, acquisition, restoration, and federal assistance.

Concurrent with these federal actions has been a spate of additional wetland regulation by the states, and often their local political jurisdictions, such that several layers of permitting may now govern a proposed wetland alteration. Consolidation of permitting functions at the state level has occurred either through the issuance of state general permits by the Corps, or outright delegation of the Section 404 authority by EPA. However, these avenues have been employed only infrequently and, in the case of the state general permits, questions have arisen as to the statutory basis for such actions. In consequence, individual state wetland acts can and often do have their own systems of definition and regulation. However, there has been general agreement with the federal sequencing practice for wetlands: first avoidance, then minimization of damage and, after all other options have been exhausted, mitigation. Nevertheless, the regulatory framework has become so daunting that logic and even reason do not always prevail. A strong presumption exists against the use of even marginal wetlands. Creation of substitute wetlands is equally suspect, largely because even the possibility of replication could be seen as opening the door to assaults on existing wetlands.

No Net Loss

A rising tide of protest in the early 1980s over inconsistent regulation led wetlands to become the target of attention of the Presidential Task Force on Regulatory Relief, chaired in 1987 by then-Vice President George Bush. Throughout the Reagan years, there had been a steady drumbeat urging the resolution of intergovernmental complexities and the reform of the cumbersome wetland regulatory procedures. In August of 1987, the Environmental Protection Agency enlisted the help of a respected private organization, the Conservation Foundation, in mediating the conflicting viewpoints. The Foundation's National Wetlands Policy Forum, a balanced group of federal, state, local, and private participants, hammered out a set of recommendations that was released in December of 1988. The Forum finding that captured the greatest attention, first with Presidential candidate George Bush and later in the President's February 1989 budget address, was the concept of a "no net loss" policy nationally for wetlands. As President Bush told the Sixth International Waterfowl Symposium convened by Ducks Unlimited in June of 1989: "You may remember my pledge that our national goal would be no net loss of wetlands. Together, we're going to deliver on the promise of renewal. I will keep that pledge." The concept of no net loss, as interpreted by wetland regulators, was engagingly simple. If the alteration or destruction of a wetland could not be avoided, it would have to be replaced by an equivalent area on-site and in-kind.

How to accomplish that worthy goal in practice has been the focus of recent efforts. An interagency task force on wetlands of the White House Domestic Policy Council has been hard at work on the issue for the past two years. In the meantime, EPA and the Corps of Engineers arrived at a working agreement on mitigation criteria and procedures (MOA, February 7, 1990), a set of decisions that did not engender widespread approval. Developers found the required mitigation to be cumbersome and costly, and environmentalists tended to derogate wetland creation as nothing more than a form of aquatic gardening. When an interagency manual was issued delineating wetlands, a veritable firestorm of protest erupted, for many privately-owned

areas became subject to governmental regulation. All of these procedural uncertainties were amplified in the course of six regional public meetings sponsored by the Domestic Policy Council in August and September of 1990. 1,600 individuals attended these sessions, and some 4,500 written comments were submitted for the record (Federal Register, February 28, 1991).

The Congressional Response

While the executive branch was wrestling with implementation issues, Congress has also been at work staunching the hemorrhage of wetlands nationally. The Food Security Act of 1985, for example, instituted the so-called agricultural "swampbuster" sanctions, disincentives for wetland conversion that were strengthened in the 1990 farm bill. The tough new requirements for cost-sharing written into the Water Resources Development Act of 1986 now make it unlikely that wetlands will fall victim to public flood control and navigation projects.

The Tax Reform Act of 1986 closed many of the tax deduction loopholes and removed incentives for wetland filling on private lands. The Emergency Wetlands Resources Act of 1986, among other provisions, increased Duck Stamp funding to speed wetland preservation nationally and internationally. In December of 1989, Congress passed the North American Wetlands Conservation Act, which will direct up to $30 million in federal funds annually toward the implementation of the historic North American Waterfowl Management Plan agreed to by the Secretary of the Interior and the Minister of the Environment (Canada) in May of 1986. And in the Water Resources Development Act of 1990, as an extension of a new primary mission for the Corps of Engineers in environmental protection, Congress directed the Corps to prepare an action plan for the restoration of wetlands nationally.

All of the above has not been without its share of concern and controversy. A National Wetlands Coalition of agricultural, business, and landowner interests has now been formed (National Wetlands Coalition, 1990). At their urging, and with the support of over a hundred

members of Congress, measures are pending for a comprehensive overhaul of the federal wetlands conservation and management program. But the real debate is expected to occur in the forthcoming reauthorization of Section 404 scheduled for the twentieth anniversary of the first Clean Water Act. Although EPA has declared 1991 to be the year of the wetlands, it is 1992 that is apt to be the real watershed year for wetlands nationally.

Wetlands ... In Summary

From this abbreviated account of the history of efforts in the United States, what might we conclude about the current state of wetland affairs?

• It is clear that wetlands are a resource with important, multiple functions and values, and that wetlands are in short and diminishing supply nationally.

• The need for protection has virtually dominated the wetland public policy agenda in recent years, but the policies have tended to ignore the wide variability in the location, functions, and values characteristic of the wetlands themselves. Clearly, not all wetlands are created equal. Moreover, most protective actions have been site-specific, neglecting the reality that wetlands occur as area-wide, natural systems.

• The responsibility for wetlands is currently fragmented among numerous federal, state, and local agencies with corresponding amounts of overlap, duplication, and inconsistency in regulatory policies. In consequence, public support for wetland protection is showing signs of eroding.

• The emphasis on achieving no net loss simply through permit actions has overshadowed the real possibility of restoring or even creating wetlands.

• There is an urgent need for a well-articulated and properly-coordinated national program designed to achieve a significant net gain in the nation's basic wetland supply by the turn of the

21st century.

How much of a gain, in what kinds of wetlands, where, and for what purposes, are legitimate questions for which there are no complete answers. Regrettably, concrete national and regional targets are available largely for waterfowl wetlands, and those principally because of the North American Waterfowl Plan endorsed by Congress in December of 1989, and the National Wetlands Priority Conservation Plan mandated by the Emergency Wetlands Resources Act of 1986. In the absence of other definitive plans, only generalized assertions can be made about wetlands needed to ensure other functions and values. Nevertheless, a conservative estimate might place these needs at half the approximately 2 million acres required for waterfowl habitat enhancement by the year 2000. These 1 million replacement, or restored, wetland acres would require an investment of at least $250 million. The net effect would be to add wetlands at approximately the same rate as they are now being lost. The turnaround would be dramatic.

Is such a goal attainable? We think so with modest but meaningful changes in direction and a comprehensive, coordinated approach nationally to wetland conservation, protection, restoration, and management. The elements of such a program will be discussed in more detail, but they will have to include an inventory of restorable sites, the development of a viable classification and ranking system, the formulation of area-wide wetland plans, the encouragement of restoration activities by public and private entities alike, the identification of fund sources, and the creation of an institutional structure that will provide leadership, reduce overlap, and generally harness the available talent to this end.

Before commencing the detailed discussion, the terms we intend to use need defining. Creation occurs on sites where wetlands never existed in recent human memory. Replication suggests that the created wetland will function as the minor image of the one it replaces -- a hypothesis we find conjectural. For that reason, the term replication will not be used. Restoration, on the other hand, aims to put back on a site all or part of a wetland that was once there. Enhancement refers to an effort to improve one or more functions or values of an existing

wetland. Mitigation will be used only in the regulatory sense -- that is to say, the requirements imposed as a condition of the issuance of a permit. When we talk about rebuilding the nation's wetland base, restoration and enhancement, abetted by mitigation, will be the primary tools.

PART II: THE SOLUTION

Wetland Inventories

Since 1954, the Fish and Wildlife Service has been engaged in an assessment of the wetland resource within the continental United States (Gebhard, 1988). The original impetus was the need to obtain reliable information on the status of waterfowl wetlands. More recently, the Service has broadened its approach to encompass a comprehensive national wetlands inventory. Its normal inclinations have been fortified by provisions of the Emergency Wetlands Resources Act of 1986. Some fifty agency personnel and contractors are currently engaged in the effort. The goal of the inventory is to produce a detailed wetlands map of virtually the entire country at a scale of 1:240,000 by the year 1998 (Alaska will be completed shortly thereafter). To date, 65 % of the coterminous United States has been mapped. Over 30,000 individual sheets have been prepared. Twenty entire states have been completed. 10% of the information collected is now digitized. The ultimate objective is to create a geographic information system (GIS) that will be readily available to regulators, researchers, and program administrators at federal, state, and local levels. The data will also be used to prepare the ten year wetland assessments now required by Congress.

Impressive though the national wetland inventory may be, it does have its drawbacks. For example, since the inventory is designed to provide information on a national scale, its data cannot readily be disaggregated to furnish information that is valid for regional or local purposes. Further, the inventory is strictly quantitative in nature. It does not attempt to assess the quality of

the wetlands so identified. And it does not per se identify wetlands that are potentially restorable. Nevertheless, the National Wetlands Inventory represents a useful building block to that end. For example, in the course of examining aerial phtos, Fish and Wildlife experts have been able to pick up evidence of diked and drained wetlands (e.g., the Sacramento valley region of California), farmed wetlands (e.g. the prairie pothole region), and changes in vegetation (e.g., invasion by Phragmites in the north Atlantic coastal region) that may suggest opportunities for restoration and enhancement.

Given a concerted commitment to compiling an inventory of restorable sites, other important information sources could be tapped. For examples, USDA soil surveys routinely identify areas of hydric soils, one of the preconditions for a delineated wetland. Under the "swampbuster" provisions of the Food Security Act, the Soil Conservation Service has been charged with inventorying prior converted agricultural wetlands. The files of the Corps of Engineers, the Soil Conservation Service, and other federal agencies (e.g., the Federal Energy Regulatory Commission) bulge with information on prospective reservoir sites. Since many of these sites are already wetlands, judicious adjustments to the hydrology could expand their size quite readily. The Bureau of Land Management in Interior is a primary source of information on existing and prospective riparian wetlands in the west. So too is NOAA's National Marine Fisheries Service for coastal sites. And many of the states have undertaken extensive site inventories of their own.

We are convinced that a relatively simple process of information assemblage, conducted on an interagency and intergovernmental basis, could accomplish the restorable site inventory within a year. With that data in hand, one could begin to move to the priority setting, planning, financing, and implementing steps needed to enlist the sizable array of willing public and private wetland actors in a national net gain program.

Classification and Ranking

Before doing so, it would seem only sensible to sort wetlands into various categories. This can be done by physical location, by vegetative characteristics, by ecological function, by human-related value, or even by degree of threat they are facing. This process is termed classification. Once wetlands have been so categorized, there is often a need to place them in some kind of priority order. This is termed ranking or indexing. Whether or not wetlands should be formally classified and ranked is a matter of current debate and controversy (Ruben, 1991).

On the positive side is the need to sort out wetlands systematically by function and value, and the desirability of focusing the limited manpower and resources available on wetlands of the greatest significance. On the negative side of the issue are those who fear that a classification process simply encourages the wholesale destruction of these wetlands ranked at the lower end of the scale. Proponents say that classification and ranking respect the fact that not all wetlands are created equal, and not all display the same functions and values. Opponents respond that judgments about wetlands are so flawed by scientific uncertainty that the safest way to proceed is to assume that no wetland is without value. But ranking occurs routinely now in administrative decision-making, the classifiers assert. An established system would merely institutionalize the process and encourage consistency and predictability. Perhaps so, the skeptics reply, but ranking would require time-consuming and expensive efforts nationally and still would not provide the basis for choosing between wetlands that are high in different values, or wetlands that change functionally over time.

Regardless of the merits and demerits of the issue, classification is commonly employed, particularly at the state level. In New England, for example, two of the six states (Maine and Vermont) have explicit classification systems (NEIWPCC, 1991). The two most common evaluative approaches nationally are the Wetland Evaluation Technique (WET) advanced by Paul Adamus for the Department of Transportation; and the Habitat Evaluation Procedure (HEP) utilized by the Fish and Wildlife Service (Birkitt and Gras, 1989). Many of the states have

developed variants for their own purposes. The principal distinction between the two is that HEP focuses on values to wildlife, whereas WET attempts to assess ten different wetland functions. HEP, however, is better grounded in ecological theory, whereas WET is more of a comparative and descriptive assessment tool. In using any classification system, it is important to remember the mix of science and policy that accompanies any ranking system. There is no black box that can replace subjective, human judgment.

As is so often the case, arguments over the relative merits of ranking obscure two underlying issues. One is the effect of ranking on the future of wetlands at the lower end of the scale. Are these to become simply throw-away wetlands? The other issue relates to the higher-ranked wetlands. By placing them in such a position, does ranking deprive their owners of all practical economic usage and thereby appropriate property value without compensation? Since three-quarters of the nation's wetland base is in private ownership, this could be a serious problem.

The first issue of the seemingly value-less wetlands can be resolved by requiring all wetland permit requests to go through the same sequencing process -- avoidance, minimization of damage, and mitigation. Thus, if even a lower ranked wetland can be avoided, it should be. In terms of compensation for high value wetlands, one recourse is outright acquisition. But we are intrigued with another approach at least in principle (Ruben, 1991), and that is a variant of the transferable development right (TDR) approach employed so successfully in farmland preservation. Although one would not want to confirm an inalienable right to fill any wetland, a contingent development right (CDR) might be granted by a wetland administrator in certain cases. With the approval of zoning authorities, the CDR could be used to increase the density of development on an unaffected upland site either by the owner or by a purchaser of that right. This indirect form of compensation might meet the objections of wetland owners halfway, permit wetlands to remain under private stewardship, and avoid the appropriations outlays necessary for a large-scale public acquisition program.

Under such circumstances, we conclude that wetlands should be classified and ranked; but distinct from the taxonomic approach taken by wetland scientists, we feel that categorization should be simply by regulatory processing category. Attempting a numerical expression of value, for example, would unfairly and inaccurately pit one wetland against another. Thus, four ranking categories might be employed.

A no permit would be granted except in extraordinary circumstances of overwhelming public interest;

B permit could be granted if the alteration is small and mitigation more than compensates for the loss of functions and values;

C permit would be granted if the alteration is moderate and full mitigation is provided;

D permit would be granted without mitigation if justified under full sequencing procedures.

The existing Section 404(c) veto provisions would continue to provide a safety net for inappropriate administrative decisions. To eliminate the necessity of another lengthy and costly process, only the A category wetlands should be classified in advance. The others should be assigned a classification at the time of a permit application. And to help ensure even-handed classification and ranking and reduce the chance of bias, specialists in addition to regulators should be involved in the process.

Creation of an A category of wetlands would spur the application of two presently underutilized authorities (Davis and Barrows, 1990). One is the Special Area Management Plan (SAMP), a provision of the 1980 amendments to the Coastal Zone Management Act that permits the Corps of Engineers, in conjunction with local authorities, to identify and regulate in advance coastal areas of significant value facing prospective development pressure. The other is the Advance Identification (ADID) process available to EPA under Section 404 (b)(1) of the Clean

Water Act. Although the ADID designations are purely advisory, they do serve to put potential developers on notice of a potential use of the Section 404(c) veto authority. In time, making them binding would tend to strengthen the justifications and remove a present area of uncertainty.

As we have seen, much of the debate over classification and ranking revolves around the regulation of wetlands that already exist, but the approach is equally applicable to wetlands that are candidates for restoration. Upon closer examination, some of the C and D wetlands will warrant elevation to a higher status because of their potential restorability. But the validity of such assertions rests on the availability of a credible inventory of restorable sites, target figures for the creation of new or improved wetlands, and a process for achieving restoration in practice. These elements must be addressed in any effort to achieve a significant net gain in the nation's basic wetland supply, and they must be arrayed in workable wetland conservation plans.

Planning for Wetlands

Natural wetlands often occur as connected systems, not as isolated sites. Where wetlands border water bodies or water courses, harbors, bays, and estuaries, the interconnections are self-evident. Less obvious, however, are the seemingly-discrete upland marshes, bogs, and swamps that, upon closer inspection, may be closely related hydrologically, or the isolated prairie potholes that, in actuality, are part of a complex pattern of hydrogeologic linkages. And for certain functions -- flood water storage, for example, or habitat for waterfowl -- the cumulative benefits of wetlands as regional systems may exceed their individual values. Yet, wetland alteration and restoration proposals, for the most part, are still judged principally on a site specific basis. More of a regional approach to wetlands than is required by current regulations would seem to be in order.

Once the location of existing or prospective wetlands has been determined, an attempt should be made to define the regions of which they are a functioning part. The ultimate configurations are apt to be those determined hydrologically -- a tributary watershed or a coastal

drainage basin, for example. However, the scale of such regional delineations, while hydrologically sound, may turn out to be unmanageable in practice. A process of sub-regionalization should be used to make the designated wetland regions as sensitive as possible to political, economic, and social realities, especially the human place relationships and loyalties so essential to a politically viable wetlands conservation program (Foster, 1990). The decisions made, and any tradeoffs authorized, would then occur on an in-region rather than an in-kind, on-site basis.

This "bioregional" approach to wetland conservation can and should result in different kinds of regions at different scales. Many would be wholly in-state -- the Saugus River system in Massachusetts, New Jersey's Hackensack Meadows, San Francisco Bay, the North Slope of Alaska, for example. For sparsely populated states, such as Nevada, the entire state might be the appropriate region. Multi-state regional designations could be used to service an area like the prairie pothole region. Interstate regions would come into play where the wetland system overlaps adjoining state boundaries. Good examples here would be Narragansett Bay in New England, Chesapeake Bay in the mid-Atlantic states, the Mississippi River delta, and the Great Lakes. The operative element in such designations should be not just the hydrologic integrity of the region, but the human sense of place that makes possible an effective wetland conservation program. Non-adjacent wetlands would continue to be handled on a case-by-case basis, because every wetland would not be expected to fall within an identifiable system configuration.

In light of the above, the present status of wetland planning can only be described as inadequate. Provisions of the Emergency Wetlands Resources Act of 1986 directed the Fish and Wildlife Service to prepare a National Wetlands Priority Conservation Plan (USDI, FWS, 1989). Such a document was issued in April of 1989, and similar versions are being prepared for each of the Service's seven field regions, but the approach has been largely a traditional assemblage of existing resource data. On paper, every state must have a wetlands protection component in its State Comprehensive Outdoor Recreation Plan (SCORP) in order to qualify for Land and

Water Conservation Fund (LAWCON) grants. The Emergency Wetlands Resources Act mandated that the state SCORPS be consistent with provisions of the National Wetlands Priority Conservation Plan. In practice, however, most state wetland plans are general in nature, primarily concerned with regulatory approaches, and lacking the specificity needed for a balanced program of wetland protection, restoration, creation, and enhancement. Moreover, the boundaries of a given state rarely reflect the bioregional realities described earlier. More recently, a modicum of financial support for state planning has been available through EPA's new state development grant program (USEPA, OWP, 1991). In FY 1990, for example, three states (Missouri, New York, and Tennessee) received funding support specifically for the preparation of state wetlands conservation plans. These program funds can be used more flexibly than those under LAWCON.

In 1988, members of the National Wetlands Policy Forum debated long and hard about the preferred locus for wetland planning and regulation (National Wetlands Policy Forum, 1988). The consensus was that the states, despite their imperfections, were the ones to play the central role. Under our federal system, it is here that the full range of management, regulatory, land use, and financing powers resides; and it is the state capitals that possess the inherent capacity to bring together federal, state, and local governmental programs into a cohesive whole.

Regrettably, not much has happened to advance the recommendations of the 1988 Forum report. Beset by regulatory responsibilities and financial uncertainties, and the fundamental inhospitality of the federal statutes to state involvement, the states have taken little action to lay out the basis for a systematic approach to wetland conservation. The vacuum has been filled by the national agencies -- notably EPA and the Corps -- who have moved to further federalize the process. The absence of state plans has placed on hold the delegation of federal regulatory responsibility to the states authorized by the 1977 amendments to the Clean Water Act, an outcome not entirely displeasing to the federal agencies and their national environmental and congressional supporters who seem to prefer that the primacy remain at the federal level. In cases

where state assumption has been explored seriously, the conditions imposed by the federal side, and the lack of resources available to carry out the delegated functions, have represented insuperable obstacles (Glubiak et al., 1986). At present, only Michigan has availed itself of the delegation opportunity. However, an alternate approach has begun to emerge. Under Section 404 (e) of the 1977 amendments, the Corps of Engineers is authorized to issue general permits on a nationwide, regional, or statewide basis for periods of up to five years' duration. In eight specific instances, the Corps has issued (or is contemplating) state program general permits where strong regulatory programs exist -- in essence, delegating its permitting responsibilities to the affected states. Since the approach tends to bypass the rigidities of the permanent regulatory delegation mechanism contained in Section 404 (g), it is being viewed with interest by many other states. On its part, the Corps is urging use of state program general permits as the principal method of increasing the role of the states in regulating wetlands.

What is now needed, in our opinion, is a set of positive inducements from Congress for the states to carry out their wetlands responsibilities comprehensively. By a certain date, every state should be required to have an approved plan covering its principal wetlands, both existing and prospective. The advance consent of Congress should be available to encourage wetland planning on an interstate basis where these conditions apply. Once a plan is prepared and approved, the primary responsibility for managing the resource and regulating its usage would thereafter reside in the state or region. Program support should be available through EPA to help accomplish these objectives, and provisions comparable to the federal consistency requirement of the Coastal Zone Management Act should apply to prevent jurisdictional overlap and competition. The only exception should be areas within a given planning region receiving advanced designation by EPA and the Corps where, for federal reasons, the right to intervene in state decision-making would be reserved.

To help prepare these wetland plans, sort out the best regional configuration, and adjudicate the questions of function and responsibility, we urge consideration of the use of

federal-state wetlands councils. Like the earlier Title II river basin commissions (Foster and Rogers, 1988), the councils would come about by state petition, be supported equally by the states and the federal government, and operate on the basis of co-equal consensus. But unlike their predecessors, there should be provision for non-governmental participation, a limited lifespan, and a set of specified work products. The councils' establishment may need to be authorized by Congress, but the particulars of their operation could be included in a modified version of Executive Order 11990. While the councils would have the appearance of new agencies. -- a discomforting prospect in light of the profusion of agencies that already exists -they would merely be temporary instruments to bring together all the parties involved in wetland conservation within a given region. In that regard, they would function much like the earlier, successful, National Wetlands Policy Forum within their respective regions.

To reemphasize the point made earlier, the wetlands plans, state or regional, should be comprehensive in nature. This means that despite the political urgency of matters involving delineation and regulation, equal attention should be given to wetland management, restoration, and even creation. All wetland functions, not just those associated with wildlife, should be considered. The plans will also need to address research and education, and the institutional and financial mechanisms needed to carry out a broad-scale program on an area-wide basis. If these good intentions materialize, the United States, for the first time in its history, will have a genuine sense of direction and strategy to guide its wetland conservation programs.

The Wetland Restorationists

Just who should begin putting back the much-beleaguered national wetland resource remains an open question. In some respects, restoration has become everybody's business, but nobody's responsibility. The proposed wetland conservation plans, by allocating responsibility, would certainly help provide a sense of order and structure to what is now an episodic and

uncoordinated process.

At the federal governmental level (Davis and Barrows, 1990), Interior's Fish and Wildlife Service has been engaged in wetland restoration for more than half a century. Three modem authorizations have extended this tradition: the North American Wetlands Conservation Act of 1989 with its ambitious, continent-wide program of new waterfowl wetlands; the Partners in Wildlife Program, a private wetlands assistance effort that in four years' time has already restored the hydrology of some 7,000 wetland tracts covering 86,000 acres; and a new National Coastal Wetlands Conservation Grant Program, authorized by the Coastal Wetlands Planning, Protection and Restoration Act of 1990, that is likely to be funded at a $5 million level. Under its recently-announced riparian wetland initiative for the 1990s, the Service's sister agency, the Bureau of Land Management, has a similarly ambitious program to restore and maintain 23.7 million acres of riparian wetlands, primarily in western states (USDI, BLM, 1990).

USDA agencies have been equally active (Davis and Barrows, 1990). The Conservation Reserve Program, for example, now includes 410,000 wetland acres -- the Water Bank Program some 184,000 acres. The new Wetland Reserve Program, authorized in the 1990 farm bill, makes provision for a 1 million acre national wetland reserve. The Soil Conservation Service, acting through its conservation technical assistance program, is engaged in many efforts to restore, create, and enhance wetlands on behalf of local sponsors and private landowners. A Partnership in Habitat Program, available to the Forest Service and other agencies, now offers cost-sharing opportunities to conservation and service organizations for wetland and other conservation projects.

The Corps of Engineers, under such authorities as its beneficial use of dredged material program and specific authorizations in various Water Resources Development Acts (WRDAs), has undertaken numerous wetland creation and restoration projects, often in cooperation with other agencies and local sponsors. More recently, Section 1135 of the 1988 WRDA led to a proposal for sixteen demonstration projects at existing Corps' facilities to restore, improve, or

create wetlands; and Section 307 of the 1990 WRDA directed the Corps, in consultation with other agencies, to prepare a national action plan for no net loss of wetlands, and a national wetlands restoration and enhancement demonstration program to evaluate the long-term technical and scientific feasibility of such an approach.

In coastal regions, the Corps of Engineers and the National Marine Fisheries Service (NOAA) recently completed a three year pilot study to assess the feasibility of restoring or creating fisheries habitat and coastal wetlands. As a result of this cooperative investigation, NOAA is now seeking budgetary support for a new National Restoration Center (NOAA, 1991) to begin to repair lost and injured trust resources within the principal coastal regions of the United States.

State actions to restore and enhance wetlands occur in a variety of settings -- under the federal aid to fisheries and wildlife programs, federal aid assistance to transportation agencies (highways, airports, and transit), and the Land and Water Conservation Fund grant program, to name some of the most prominent. Regrettably, no ready documentation exists of the collective contributions of these actions. In one instance in Massachusetts (US Army, 1989), the state assistance program of the Corps (Section 22) has been used in conjunction with wetland restoration (e.g., a survey of the success of a sample of mitigation projects). As of FY 1990, a new State Wetlands Development Grant Program was activated by EPA (USEPA, OWP, 1991). The sum of $1 million came available to help fund state wetland projects. Of the twenty-two states that received initial grants, one state (Delaware) elected to utilize its grant specifically for the restoration, creation, and enhancement of fresh water wetlands.

Special note should be made of the experience in one particular state, California. Here, a special agency has been established to carry out restoration and enhancement projects within California's coastal region (Grenell, 1986). Since 1976, the California Coastal Conservancy, using a combination of direct appropriations, general obligation bonds, negotiated contracts, and mitigation payments, has undertaken improvement work within more than sixty streams,

wetlands, and portions of watersheds in coastal California. Even more importantly, the Conservancy has come to serve as a recognized focal point for restoration planning, design, mediation, and implementation, a distinction no other state presently enjoys. As of early 1991, the Conservancy had entered into more than sixty-five working partnerships with non-profit organizations to achieve its program purposes. Although the setting for similar conservancies appears promising in several states (e.g., New Jersey, New York, and Massachusetts), the other political agendas are often so compelling, the resources available so meager, and the constituencies so divided that the California model has, as yet, been unable to be replicated elsewhere (McReary and Adams, 1988).

On the non-governmental side, wetland restoration does occur -- and with some frequency -- but the manifestations are often uneven. The Ducks Unlimited program, of course, is the shining exception (Ducks Unlimited, 1991). In addition to its historic effort to restore wetlands on the continental breeding and wintering grounds, DU has launched its Matching Aid to Restore State Habitat (MARSH) program, which provides for a rebate to the state fish and wildlife agency of 7.5% of the private funds raised by DU in that state. The moneys can be used for acquisition, restoration, or enhancement. More than $14 million was available nationally from such sources for FY 1992 projects.

But by far the most numerous wetland restoration projects are those conducted as a condition of a wetland permit. Only fragmentary information is available on the extent of that activity, and the nature of those investments, but it would be safe to assume that tens of millions of dollars are spent annually on mitigation. These costs range from $200 per acre in rural surroundings to $20,000 - $75,000 per acre in more urban Settings (Salvesen, 1990). As much as $500,000 per acre may be expended for mitigation in such areas as a highly accessible, urban shopping mall.

Conventional rhetoric targets development as the primary source of wetland losses. Yet, ironically, development activities are also the most likely prospect for restoring wetlands in the

immediate future. In many instances, developers have the resources and the infrastructure required to carry out the work in a least cost manner. As private entrepreneurs, they are accustomed to taking risks in order to gain significant returns.

The case for a positive engagement of the development community is strengthened by what few statistics exist. For example, in a survey of Section 404 permit issuance in ten southern and west coast states for the five year period 1982-86 (Holland and Kentula, 1991; Sifneos et al., 1991; Kentula et al., 1991), EPA investigators found that the nearly 500 permits issued affected 9300 acres of wetlands. Even after the required mitigation, there was a net loss of almost 1900 acres. The average loss per permit issued was just under four acres. If one accepts the conventional wisdom that only about 40% of the required mitigation projects are functionally successful, then the likely loss of functional wetlands rises to about twelve acres per permit issued. Using the Corps of Engineer's national reporting figures, it would seem that the Section 404 permit activity in itself, accounts for the loss of nearly 100,000 acres of wetlands each year. "Just saying no" is clearly not the answer.

Since society will continue to demand the use of some wetlands at some times for other purposes, the answer appears to lie in restoration for its own sake, as we have suggested earlier, and better approaches to any required mitigation. One such promising possibility involves an activity called "wetland banking"; another is the use of wetlands for wastewater treatment purposes.

Wetlands for Wastewater Treatment

The use of wetlands for wastewater treatment is certainly not a new idea. For many years, municipal and industrial wastes were dumped onto wetlands, in part because they seemed to possess an incredible capacity to assimilate wastes. Federal, state and local laws in the recent past have helped curtail the unregulated discharge of wastes into natural wetlands. However, the capacity of wetlands to reduce loadings of BOD, nutrients and toxics have been well documented

(Olson, 1990), and it is only logical to turn to wetland systems to treat wastewater. Interest in these almost self-managing systems has been spurred by the high cost of conventional municipal and industrial facilities.

Another area of potential use for wetland systems is in the treatment of non-point source pollution, which accounts for more than half of all the pollution in U.S. water bodies. This diffuse form of pollution, the result of runoff from agricultural and forested land and, to a lesser extent, from urban storm runoff and combined sewer overflows, is extremely difficult to treat using conventional methods. It is here that wetland treatment systems show considerable promise. A wetland acts as a detention basin, retarding the flow of water passing through it. Nutrients are used up by plants and microorganisms. The breakdowns of toxins is accomplished by the microbes that are sustained by oxygen provided by the plant roots. Heavy metals are also removed from the water flowing through the wetland. Because they serve as sinks for such materials, the plants may need to be harvested and disposed of occasionally.

Although most wetlands have water quality improvement as one of the many functions they serve, wetland treatment systems (WTS) are those for which wastewater treatment is a primary aim. WTS can either be freshly constructed systems or restored wetland treatment systems. Both systems can be used to treat point or non-point source pollution. Both systems can be designed to provide non-water quality benefits as well.

Constructed WTS may be free water surface systems or subsurface flow systems (such as gravel bed filters). Constructed WTS have the advantage in generally not being considered "waters of the United States" and hence discharges <u>into</u> the constructed WTS are not regulated by federal government. However, the discharge <u>from</u> the constructed WTS to other water bodies is regulated under the Clean Water Act. There is greater flexibility in trying different configurations, altering topography and drainage conditions, selecting soil type, planting a diversity of species of plants, and installing a liner to minimize groundwater contamination.

Restored WTS <u>may</u> be handicapped in being considered "US waters", and their use as

wastewater treatment facilities may be affected by legal roadblocks. As the aim is to restore the wetland to a new version of its original state, the flexibility of its design can be restricted. Groundwater contamination may also be a problem because liners are usually absent. However, the probability of success of a restored wetland is higher than that of a constructed one. Unless the site has been greatly altered, it should possess the geomorphological and hydrological characteristics appropriate for wetland persistence.

There has been a recent surge of interest in using wetlands as wastewater treatment facilities. There are currently more than 200 municipal and stormwater wetland treatment systems in North America, and more than 140 wetlands have been developed to control acid mine drainage in the eastern U.S., most of which have been constructed in the past seven years. Conventional wastewater treatment plants use well-tested physical/chemical/biological treatment processes. WTS are still experimental, and there is a scaling problem in transferring the scant results of small-scale experimental projects under specific conditions to real systems. Conventional plants can use real-time control of recycle rates, chemicals added, and add-ons to existing facilities to meet changing efficiency standards or respond to varying inflow characteristics. In WTS, the lack of any real control may pose a major problem. This may be minimized in well-constructed WTS with good control over the hydrology and the provision of storage sites.

More research is needed into the use of wetlands as wastewater treatment plants, and existing databases need to be improved, but many researchers feel that better analysis of past studies is more fruitful than constructing a few expensive new WTS. It is time that these studies were put to use on real WTS facilities.

The use of WTS shows real promise in the case of non-point pollution or in treatment of leachate or final treatment of municipal and industrial wastes. The incorporation of habitat functions into WTS would be an important step toward hastening the adoption of this new technology. Other non-conventional uses of wetlands could be as early warning systems for

monitoring leachate from landfills. They could also be utilized as leachate treatment systems on a regular basis.

Wetland Banking

Wetland banks are typically the invention of development entities -- private developers, corporate landowners, and public works agencies. They are designed to accommodate situations where many separate project impacts need to be mitigated, and when off-site and out-of-kind mitigation is allowed. The "bank" is formed by creating or enhancing an off-site wetland and thereby establishing a positive "balance" of improvement "deposits". As project wetlands are impacted, "credits" are withdrawn to compensate for the losses. The banker can be the agency or developer who performs the restoration work, the owner of the wetland, or an independent organization or agency. Much like the emissions banking and offset criteria included in the 1972 Clean Air Act, credits can be traded and sold. In a sophisticated situation (e.g., the Tenneco wetlands in Louisiana described later), the bank may be given a finite life (25 years in this case), and any annualized credits that remain unused revert to the public as earned "interest". The wetland usually becomes a permanently preserved area after its banking functions have been completed.

As might be imagined, wetland banking often becomes enmeshed in the tangled web of permit policies and procedures. For example, the regulator may require the bank to be created and the restoration completed before any work is started on a project site. Agreement must be reached on the functions to be provided by the banked area, the parameters of value, and the numbers of credits to be earned by the account. Even then, the approach may encounter skeptics. There are those who feel that wetland banks offer developers an easy way out of the permit process, de-emphasize preservation, lead to regulators getting into bed with developers, and run the risk of large-scale failures. But at its best, wetland banking represents an imaginative, incentive-based form of mitigation; it helps

streamline the development process, yet still affords regulators critical control; it allows developers to plan in advance and obtain a better handle on a project's economic viability; it prompts a fuller understanding of wetland values; it allows regulators and developers to work in a proactive rather than a crisis mode; and by hooking many small mitigations together into a single project, economies of scale and chances of success are heightened (Snyder, 1991).

For these reasons, the wetland banking concept continues to attract attention. As examples, a subsidiary of Tenneco pioneered the approach in 1983 in Louisiana (Zagata, 1988), establishing a 5,000 acre wetland bank and obtaining credits from state and federal regulators. State highway departments are eyeing the use of wetland banks with increasing interest as a way of ameliorating their problem of unavoidable, right-of-way impacts. In a recent inquiry, New Hampshire's Department of Transportation uncovered evidence of fifteen state highway departments actively considering such an approach. The California Coastal Conservancy is currently engaged in establishing a wetland bank to restore 260 acres of the degraded Ballona salt marsh in the Los Angeles area.

Our own view is that wetland banking, though not a panacea, should be included as an element of national wetland restoration policy. It can be an appropriate tool to counteract the effects of both man-made and natural wetland losses. The controversy surrounding the current form of mitigation banking has escalated concerns needlessly. Slight changes in policies and approaches could address these uncertainties readily. For example, wetland banking should focus on restoration rather than creation. Renovating degraded wetlands is generally less expensive and more successful than starting from scratch. Second, wetland banking needs to be undertaken at least regionally, and possibly state-wide, to accommodate the system characteristics of wetlands we described earlier. This would enable a mix of mitigation measures, both on and off-site, that would be sensitive to the actual functions of the impacted wetland. Third, in most cases, the "bankers" should be public or quasi-public institutions, so

that they are a step removed from the developer or regulator. As a public entity, the wetland bank is in a better position to absorb risk and stay the course; as an independent agent, it can operate with maximum objectivity and credibility. Finally, rather than just undertaking restoration work, the wetland bank should be fully equipped to perform other management, research, monitoring, evaluation, and educational services and to thereby advance the state of the scientific and technical knowledge base surrounding this largely unproven but promising restoration approach.

Financing

Much of what has been discussed will require money, currently in short supply at both state and federal levels. With the economy at a standstill, the prospect of private funding in any abundance is also conjectural. Yet, in a way, the financial circumstances are fortuitous, for time will be required to get the nation's wetland program properly focused and organized. At some point, however, funding needs will have to be addressed.

Prior wetland conservation programs have depended heavily on special excises. Stamps sold to duck hunters, for example, have been a traditional source of revenue for waterfowl wetlands. Pittman-Robertson and Dingell-Johnson funds, derived from excises on sporting arms and ammunition and equipment, have supported federal aid to the states for years. To provide the financing for the new Coastal Wetlands Planning, Protection, and Restoration Program, Congress utilized a five cent increase in fuel excise taxes and a special tax on non-highway, small motor equipment such as lawnmowers, chain saws, and snowblowers.

To the extent possible, we believe that wetland conservation should continue to carry its own costs. For example, the fee structure for permit applications could be raised to a meaningful level -- calculated perhaps as a percentage of the value of the proposed project rather than a flat fee. This would not only help cover the costs of servicing the request, but also put applicants on notice that wetland alteration is serious business. Wetland enforcement should be stepped up, too.

Environmental credit funds derived from enforcement case settlements should be recycled directly to restoration and enhancement projects. A get-tough policy of this sort would not only produce revenue but act as an incentive to wetland enforcement and a disincentive to wetland scofflaws. We would also urge consideration of a system of exactions in cases where the right to use a publicly-controlled resource -- in this case wetlands -- will yield substantial private returns. A portion of any such windfall should rightfully accrue to the public's benefit as well. There are ample precedents for exactions in the urban development field (Alshuler et al., 1990) and, for the most part, they are accepted as a proper cost of doing business. All such revenues should be channeled to wetland trust funds, preferably at a state or regional level, where they could be used to strengthen local wetland conservation programs. Incentives should be provided to encourage the protection and enhancement of wetlands under private auspices. The recommendations of the National Wetlands Policy Forum for a system of non-profit, wetlands preservation trusts, now pending before Congress, should be adopted promptly. The tax benefits associated with such provisions could provide important incentives and constitute the equivalent of an indirect revenue source for wetland conservation. Tax-deductible investment credits should also be available for restoration and enhancement activities conducted by private developers and landowners in cooperation with public wetland agencies. There is ample evidence at hand now to show that public-private partnerships of this sort work effectively.

On the appropriations side, there is a need for modest but steady funding to help the states bear the primary burden of carrying out the Section 404 permitting. EPA's state development grant program, for example, should be level-funded at or above the $5 million mark. Additional appropriations will be needed to implement two of our earlier recommendations. First, since state wetland conservation plans are so crucial in developing a nationwide program and operating strategy, a one-time appropriation of at least $10 million will be needed to help the states and/or regions complete a full set of plans within two years' time. And, second, we favor a

one-time appropriation of $50 million to seed a system of wetland banks at state or regional levels that would serve as revolving funds to collect and redirect developer-derived mitigation payments into high priority restoration and enhancement projects.

For these assignments and the larger job ahead of acquiring or otherwise securing the nation's highest value wetlands, the existing mechanism of the Land and Water Conservation Fund (LAWCON) would appear to be the logical instrument. By law, the sum of $900 million is authorized to be transferred each year from off-shore oil and gas and other revenues into the Fund annually. With LAWCON appropriations recently running at a modest $200-300 million, the accumulated account balance has risen to more than $8 billion (Budget of the U.S. Government, FY 1992). Appropriations for the wetlands acquisition portion of the LAWCON program can and should be increased, but serious consideration should also be given to establishing a distinct National Wetlands Trust Fund through a one-time transfer of possibly $1 billion from the accumulated LAWCON revenues. The income on that sum could be devoted to supporting federal, state, and local actions that would secure the high value areas designated in the National Wetlands Priority Conservation Plan.

Institutional Changes

To avoid a further proliferation of individual wetland program initiatives, we recommend a modest restructuring of the system that currently exists. Tempting though a major overhaul might be, we do not favor scrapping the presently multi-agency approach for a centrally administered, single agency, comprehensive, wetlands effort. We find merit in the use of existing program authorities and the special skills the individual agencies possess, and we are fearful that any attempt to consolidate will merely set back a conservation effort that is already running out of time.

Instead, we recommend the development of a formal structure that would institutionalize the present interagency format. Our suggested model is a version of the earlier Title I Water

Resources Council (WRC), -- in this instance a National Wetlands Council. This could be authorized directly by Congress; it could be activated administratively as a part of a reconstituted WRC, whose statutory authorization has never been repealed; or it could be created through provisions of an amended Executive Order 11990.

The Council should, of course, incorporate the capabilities of the Domestic Policy Council's present Wetlands Task Force. But unlike the earlier WRC, the Council should include non-federal representatives, too. We would favor a Council consisting of fifteen members: five federal (EPA, Army, Interior, Agriculture, and NOAA), five state, and five private (including nominees of the National Academies of Science and Engineering). Decisions of the Council should be by consensus. To reduce interagency rivalries, there should be an independent chairman and a small, independent staff.

In our judgment, the Council's principal assignments should be carried out in three areas. First and foremost would be the task of initiating and overseeing the preparation of state and/or regional wetland plans, the inventory .of restorable sites, and updating the Wetlands Priority Conservation Plan at suitable intervals. In so doing, the Council would also be responsible for chartering the proposed regional wetlands councils and distributing federal-aid funds to them. The second task would be the development and maintenance of a proper data base for wetlands, including periodic assessments of the state of the resource and forecasts of trends and needs. The third set of functions would be to serve as a forum to address policy and procedural issues. The Council should be empowered to mediate conflicts among agencies, adjudicate disputes, and formulate binding interagency and intergovernmental agreements. For example, it could properly administer the proposed advance consent of Congress for interstate wetland compacts. Situated within the Executive Office of the President, and reporting directly to the Domestic Policy Council, the Council would be ideally positioned to provide the one-stop, wetland policy capabilities that have been needed for so long.

To bring about these positive developments, we urge two levels of implementing action. The first would be a reauthorization of the Section 404 provisions within the Clean Water Act, but recast as a separate title concerned specifically with wetlands. This would ensure a consolidated, comprehensive set of program authorizations with minimum disturbance to the operating structure now in place. It would also signal Congress' intent to elevate wetlands beyond merely a Clean Water add-on to a program status of its own with purposes beyond simply water quality enhancement. The second step would be an extension of Executive Order 11990 beyond simply the protection of wetlands. Included should be the net gain program objective recommended by our group and others, and a new program of wetland restoration, creation, and enhancement. We favor starting with the executive actions immediately and confirming them, if necessary, through Congressional action at the time of the Clean Water Act reauthorization. The target should be the issuance of a revised Executive Order 11990, and the institution of the National Wetlands Council, by the early part of 1992.

Appendix A Dahl, T.E. 1990. Wetland losses in the U.S. 1780s-1980s. USFWS.

TABLE 1: WETLAND LOSSES IN THE UNITED STATES 1780'S TO1980'S

STATE	SURFACE AREA (ACRES)[4] LAND	WATER	TOTAL	WETLANDS ESTIMATES OF ORIGINAL WETLANDS CIRCA 1780'S	SOURCE	% OF SURFACE AREA	ESTIMATES OF EXISTING WETLANDS CIRCA 1980'S	SOURCE	% OF SURFACE AREA	% OF WETLANDS LOST
AL	32,544,640	485,120	33,029,760	7,567,600	5	22.9%	3,783,800	5	11.5%	-50%
AZ	72,680,320	221,440	72,901,760	931,000	9	1.3%	600,000	10	0.8%	-36%
AR	33,392,000	594,560	33,986,560	9,848,600	11	29.0%	2,763,600	12	8.1%	-72%
CA	100,183,680	1,379,840	101,563,520	5,000,000	13, 14	4.9%	454,000	15, 16	0.4%	-91%
CO	66,428,800	289,920	66,718,720	2,000,000	17	3.0%	1,000,000	18	1.5%	-50%
CT	3,116,800	88,960	3,205,760	670,000	9	20.9%	172,500	19	5.4%	-74%
DE	1,268,480	48,000	1,316,480	479,785	20	36.4%	223,000	20	16.9%	-54%
FL	34,647,040	2,831,360	37,478,400	20,325,013	21, 22, 23	54.2%	11,038,300	24	29.5%	-46%
GA	37,246,080	434,560	37,680,640	6,843,200	11	18.2%	5,298,200	25	14.1%	-23%
ID	52,906,880	563,200	53,470,080	877,000	9	1.6%	385,700	10	0.7%	-56%
IL	35,761,280	334,720	36,096,000	8,212,000	27	22.8%	1,254,500	28	3.5%	-85%
IN	23,160,960	65,280	23,226,240	5,600,000	29	24.1%	750,633	30	3.2%	-87%
IA	35,867,520	158,080	36,025,600	4,000,000	31, 32	11.1%	421,900	31, 33	1.2%	-89%
KS	52,515,840	133,120	52,648,960	841,000	9	1.6%	435,400	10	0.8%	-48%
KY	25,504,640	348,160	25,852,800	1,566,000	34	6.1%	300,000	35	1.2%	-81%
LA	28,899,200	2,155,520	31,054,720	16,194,500	11	52.1%	8,784,200	36	28.3%	-46%
ME	19,797,120	1,460,480	21,257,600	6,460,000	37	30.4%	5,199,200	38	24.5%	-20%
MD	6,330,240	439,040	6,769,280	1,650,000	11	24.4%	440,000	39	6.5%	-73%
MA	5,013,120	271,360	5,284,480	818,000	37	15.5%	588,486	19	11.1%	-28%
MI	36,363,520	894,720	37,258,240	11,200,000	40	30.1%	5,583,400	10	15.0%	-50%
MN	50,744,960	3,058,560	53,803,520	15,070,000	11	28.0%	8,700,000	41	16.2%	-42%
MS	30,309,120	229,120	30,538,240	9,872,000	42	32.3%	4,067,000	12	13.3%	-59%
MO	44,189,440	409,600	44,599,040	4,844,000	11, 43	10.9%	643,000	44	1.4%	-87%
MT	93,185,920	982,400	94,168,320	1,147,000	9	1.2%	840,300	10	0.9%	-27%
NE	48,974,080	451,200	49,425,280	2,910,500	11	5.9%	1,905,500	10	3.9%	-35%
NV	70,328,960	416,640	70,745,600	487,350	45	0.7%	236,350	46	0.3%	-52%
NH	5,781,120	173,440	5,954,560	220,000	9	3.7%	200,000	47	3.4%	-9%
NJ	4,820,480	194,560	5,015,040	1,500,000	10	29.9%	915,960	48	18.3%	-39%
NM	77,724,800	141,440	77,866,240	720,000	9	0.9%	481,900	10	0.6%	-33%
NY	30,636,160	1,092,480	31,728,640	2,562,000	9, 49	8.1%	1,025,000	49	3.2%	-60%
NC	31,283,200	2,371,840	33,655,040	11,089,500	42	33.0%	5,689,500	12	16.9%	-49%
ND	44,339,200	886,400	45,225,600	4,927,500	50	10.9%	2,490,000	51	5.5%	-49%
OH	26,251,520	130,560	26,382,080	5,000,000	52	19.0%	482,800	10, 52	1.8%	-90%
OK	44,149,760	598,400	44,748,160	2,842,600	53, 54, 55	6.4%	949,700	53, 54, 55	2.1%	-67%
OR	61,573,760	494,080	62,067,840	2,262,000	9	3.6%	1,393,900	10	2.2%	-38%
PA	28,816,000	197,120	29,013,120	1,127,000	56	3.9%	499,014	39, 56	1.7%	-56%
RI	671,360	105,600	776,960	102,690	57	13.2%	65,154	58	8.4%	-37%
SC	19,379,200	496,000	19,875,200	6,414,000	42	32.3%	4,659,000	12	23.4%	-27%
SD	48,611,840	698,240	49,310,080	2,735,100	59	5.5%	1,780,000	51	3.6%	-35%
TN	26,474,240	561,920	27,036,160	1,937,000	42	7.2%	787,000	12	2.9%	-59%
TX	168,300,800	2,796,160	171,096,960	15,999,700	60	9.4%	7,612,412	61	4.4%	-52%
UT	52,723,840	1,622,400	54,346,240	802,000	62	1.5%	558,000	63, 64	1.0%	-30%
VT	5,935,360	214,400	6,149,760	341,000	65	5.5%	220,000	19	3.6%	-35%
VA	25,498,240	624,640	26,122,880	1,849,000	10	7.1%	1,074,613	39, 66	4.1%	-42%
WA	42,664,320	978,560	43,642,880	1,350,000	67	3.1%	938,000	67	2.1%	-31%
WV	15,413,760	62,080	15,475,840	134,000	68	0.9%	102,000	39	0.7%	-24%
WI	34,856,960	1,081,600	35,938,560	9,800,000	69	27.3%	5,331,392	70	14.8%	-46%
WY	62,259,840	405,120	62,664,960	2,000,000	10	3.2%	1,250,000	71	2.0%	-38%
SUBTOTAL (CONTERMINOUS U.S.)	1,899,526,400	34,672,000	1,934,198,400	221,129,638		11%	104,374,314		5%	-53%
ALASKA	362,516,480	12,787,200	375,303,680	170,200,000	6	45.3%	170,000,000	7, 8	45.3%	-0.1%
HAWAII	4,112,000	3,200	4,115,200	58,800	26	1.4%	51,800	16, 26	1.3%	-12%
TOTAL U.S.	2,266,154,880	47,462,400	2,313,617,280	391,388,438			274,426,114		11.9%	-30%

NOTE: Surface area – There are some discrepancies between the total surface area of states. These differences are probably due to shifting river channels forming state borders. The area given is that presented by the U.S. Geological Survey, National Atlas of the United States, 1970.

Wetland distribution and changes vary dramatically within states dependent on both geographical and /or land use patterns.

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