Strategic Studies

U.S. Army Corps of Engineers
Water Resources Support Center
Institute for Water Resources

Environmental Activities in Corps of Engineers Water Resources Programs

Charting a New Direction

U.S. Army Institute for Water Resources
Policy and Special Studies Programs

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Environmental Activities in

Corps of Engineers Water Resources Programs:

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This effort began as a discussion between the author and Eugene Stakhiv. In that conversation, we recognized that, in recent years, the Corps has increasingly taken on assignments given by the administration and the Congress that fall under the general category of environmental activities. At the same time, the Corps long history in water resources management was not foreign to a broadly conceived environmental management program. Several questions followed. Was there a need for substantial revision in the Corps traditional approaches to decision making? Were there fundamental conflicts between the regulatory program administered under Section 404 of the Clean Water Act, the planning of new water projects and the management of existing projects? And, as other Federal and State agencies begin to pay increased attention to watershed management, what role was there for the Corps?

In developing the text of this report, which addresses these and other questions, I relied on my own professional experience, extensive interviews with people both inside and outside the Corps, professional literature and several reports that were prepared by IWR over the years. That IWR work anticipated many of the points that are made in this report. I also benefitted greatly from my recent service on the National Research Council, National Academy of Sciences, Committee on the Restoration of Aquatic Ecosystems. The experience of working with that committee influenced much of what is included here. Finally, the references at the end of each section are not presented as a comprehensive list. Rather they are suggested only as representative of the literature which can provide further insight into the material.

I also benefitted from reviews, discussions, and comments of IWR staff on numerous drafts. William Hansen, Lynn Martin Lamar, Kenneth Orth, and Eugene Stakhiv all make valuable comments. Myron Fiering's (Harvard University) comments were also helpful. Finally, substantive reviews of the draft were make by several individuals in HQUSACE. These were especially useful in focusing the report's themes and recommendations. Of course, all responsibility for the content of the paper ultimately rests with the author.

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EXECUTIVE SUMMARY

Corps of Engineers water resources projects have been a linchpin of the Nation's water resources management efforts. The significance of the Corps water projects development program was especially great throughout the 20th century, although in recent years, as measured by the level of the agency's budget, the program has stabilized.

Historically, support for the Corps program was rooted in a national commitment to controlling the variability in watershed hydrology as a key to the Nation's material prosperity. This commitment, originating with the progressive era conservation philosophy, also stressed the application of professional expertise in both the design and selection of water control projects, with that expertise centered in the Federal government in agencies such as the Corps.

Historically, support for the Corps program was rooted in a national commitment to controlling the variability in watershed hydrology as a key to the nation's material prosperity.

During the last three decades of this century, many challenges to the progressive era vision have affected Corps programs. First, the agency emphasis has shifted from creating new water control infrastructure to operating and maintaining the existing infrastructure. Second, Corps projects are often expected to restore or protect "natural" conditions in a watershed. New environmental restoration authorities, studies and projects now emphasize management of watershed hydrology to return hydrologic variability which was often reduced by past engineering works. The watershed protection theme is especially important in the administration of the regulatory program authority given by Section 404 of the Clean Water Act. This authority, as it has been interpreted, emphasizes minimizing alterations to existing wetlands.

New environmental restoration authorities, studies and projects now emphasize management of watershed hydrology to return hydrologic variability which was often reduced by past engineering works.

As the Corps moves ahead with these new environmental activities, more changes in national water policy are also occurring. There is a shift in responsibility from Federal agencies to the state and municipal government for planning leadership and financial responsibility. At the same time, decision making, which was once led by single agencies and directed by "experts," has become a process of group negotiation. Here, the role of the expert is to help participants in that process achieve the consensus which leads to a decision and its implementation.

Section II of the report describes the historical background for these many changes. Section III offers a definition of environmental activities for application to the Corps water resources programs. How that definition can be integrated into the planning, regulatory and operation and maintenance programs is the subject of Sections IV, V and VI. These same sections

also recommend reforms which will allow the Corps to better address the environmental concerns of the Nation. The last section of the report describes some of the actions necessary for renewing Corps leadership on water resources management within the Federal government.

The findings and recommendations of this summary reflect the dominant themes of the report. The details of, the logic behind, and the interrelationships among, these findings and recommendations can be best understood by considering the report in its entirety. Numbers in ( ) refer to the sections of the report where more detail on a finding or recommendation can be found. In this summary, the findings and recommendations are organized into five areas: mission clarification, plan formulation, plan evaluation, program integration and leadership opportunities.

Clarify the Corps Environmental Mission

Finding 1: The Corps leadership has moved aggressively in accepting a "new environmental mission." However, while environmental restoration now can be a planning problem or opportunity on a par with flood control and navigation, this is often not understood in field operating activities. Also, there is ambiguity about the evaluation and decision making protocols for the environmental mission that should be followed in the planning, operations and regulatory programs. This confusion has resulted from a number of separate factors arising from agency traditions, policy pronouncements and budget decisions of the past two decades (II, IV). *Therefore,*

... while environmental restoration now can be a planning problem or opportunity on a par with flood control and navigation, this is often not understood in field operating units.

- the ASA(CW) and the Director of Civil Works should cooperatively prepare and disseminate a detailed explanation of the Federal interest in environmental restoration and the planning and decision making philosophies that will be applied in the Corps (IV, V, VI, VII).

- the ASA(CW) and the Director of Civil Works should direct the preparation of field guidance for restoration project planning and its extension to all aspects of Corps water resources programs (IV, VI).

- the ASA(CW) and the Director of Civil Works should commit to training for field staff in the conduct of environmental analysis and in decision making for environmental programs.

- the ASA(CW) and the Director of Civil Works should demonstrate a commitment to watershed restoration projects by budgeting for appropriately planned restoration projects and then making those budget decisions widely known throughout the agency. This will make it clear that restoration projects may stand on their own and need not include traditional outputs in order to secure budget funds (IV, VI).

Plan Formulation for Environmental Problems and Opportunities

Finding 2: A defining feature of environmental restoration which is accomplished by the Corps is reintroducing

hydrologic variability into watersheds. The primary environmental outputs of the Corps programs are a variety of life support services, such as nutrient cycling; outputs that can be advanced by these variable flows. The current Corps definition of environmental outputs which focuses on fish and wildlife habitat is inappropriate because it reduces environmental outputs to a too narrow definition, and it potentially expands the Corps planning process into areas far beyond the agencies expertise in watershed hydrology (III). *Therefore,*

- the Corps should revise its definition of environmental outputs, which is now limited to fish and wildlife habitat, to include multiple outputs for formulating alternative environmental restoration plans (III, IV).

- the Corps should emphasize particular watershed features and processes in its environmental plan formulation -- hydrologic modifications and wetlands restoration and creation. These areas of emphasis consistent with the long-standing areas of Corps expertise (III, IV).

> The current Corps definition of environmental outputs which focuses on fish and wildlife habitat is inappropriate because it reduces environmental outputs to a too narrow definition ...

Finding 3: A watershed perspective on environmental activities provides a basis for establishing the linkage among the Corps construction, operations, and regulatory programs. A watershed

> A watershed perspective on environmental activities provides a basis for establishing the linkage among the Corps' construction, operations, and regulatory programs.

focus also assures that the alternative plans which are formulated for environmental outputs will have the highest probability of achieving technical success (III). *Therefore,*

- the Corps should more clearly define its current "linkage requirement" to emphasize Corps project relationship to watershed features and processes.

- the Corps should emphasize a watershed scale in developing guidelines for environmental planning and evaluation and in its training of agency personnel (III, IV, V).

Finding 4: Watersheds have been heavily altered through time by Corps projects. Environmental restoration will reintroduce hydrologic variability into watersheds which have been heavily regulated. This is a fundamental challenge to the Corps water control engineering tradition (II, III, IV, VI). *Therefore,*

- the Corps should issue guidance for plan formulation which stresses that existing project purposes and project operations should not be sacrosanct in the formulation of environmental restoration alternatives.

Finding 5: Engineering design rules can raise project costs and increase environmental impacts of projects. Alternative designs for the project and for project modifications in rehabilitation and operation may only modestly increase risk of

project non-performance and may promise significant gains in environmental restoration (IV, VI). *Therefore,*

- the Corps should expand current efforts to apply risk analysis of hydrologic variability during project plan formulation in order to realize the environmental restoration gains possible from application of this technique.

Plan Evaluation and Decision Making

Finding 6: The Principles and Guidelines (P&G) provides a well conceived framework for the planning and evaluation of environmental restoration projects and for the design of wetlands management plans during the advanced identification process under Section 404 (IV, V, VI) The P&G does not require that environmental restoration plans have measured, positive national economic development benefits to be justified as being in the Federal interest (IV). Indeed, there are numerous reasons to be skeptical of NED measures of the value of environmental outputs (IV). *Therefore,*

> The Corps should assure that all policy statements, guidance and training for field operating units makes it clear that an NED plan is not required to justify a Federal interest in environmental restoration...

- the Corps should assure that all policy statements, guidance and training for field operating units make it clear that an NED plan is not required to justify a Federal interest in environmental restoration and that money valuation of environmental outputs is not a precondition of budget support for an environmental restoration project (IV).

- the Corps should extend the P&G planning framework to wetlands classification and watershed restoration planning within the advanced identification process of Section 404. Also, assistance in watershed planning using the systematic P&G approach should be offered to non-Federal interests engaged in whole watershed planning intended to enhance wetlands management (V).

- The Corps should extend the P&G planning framework to the major rehabilitation and operations programs, including the long-term management of dredged material (LTMS) (VI).

Finding 7: Watershed alterations have provided many valuable services, including power production, flood hazard reduction and transportation improvement (II). In some instances, restoration may require some sacrifice of these services. Therefore, tradeoffs between alternative restorations and between the restored versus altered watersheds will be made (III). In this setting, the need for sound economic analysis remains important for the evaluation of individual restoration project plans, even as NED valuation of the environmental outputs themselves is not required. The analytical approach that will be required is to document the foregone level and distribution of current benefits which results from a given restoration project, as well as the required financial outlays of government. This is termed "incremental opportunity cost" analysis and the incremental opportunity costs of restoration are what is compared with the incremental gains in environmental services (IV, V, VI).

> In choosing the alternative to recommend, the comparison of money and non-monetary gains and losses from restoration will be done in a decision making process where the role of opportunity cost analysis is as an aid to negotiation among a variety of affected interests.

In choosing the alternative to recommend, the comparison of money and non-monetary gains and losses from restoration will be done in a decision making process where the role of opportunity cost analysis is an aid to negotiation among a variety of affected interests. In choosing among projects for funding, Corps budget authorities will need to use the results of the incremental analysis, in conjunction with other Federal interest criteria, to select a portfolio of projects which make optimal use of Federal expenditures (VII). *Therefore,*

- the Corps should expand its guidance and training programs to assure that the best available theory and methods are used in the estimation of the opportunity cost of restoration. Current analytical procedures, included in planning guidance and incorporated in the P&G, should be revised to reflect the dynamic adjustments that will made by economic entrepreneurs as restoration plans are put in place (IV).

- the Corps should place renewed emphasis on evaluation within the RED and OSE accounts in order to identify all the opportunity costs that might be considered by decision makers engaged in a negotiation process (IV, VII).

- the Corps should provide guidance and training to project managers, and to others with planning responsibilities, on strategies for effective involvement in negotiation-based decision making (VII).

- the ASA(CW) should initiate a review to define the criteria that will be employed to choose among projects competing for budget funds (VII).

Finding 8: The appropriate measures of environmental output from a restoration action are ecosystem resiliency and persistence (III). However, direct measurement of these outputs is not possible and indicators of these outputs must be traded off against opportunity costs of restoration. No single set of environmental output indicators is appropriate for all situations. Restoration indicators should be chosen with reference to the historic condition of the watershed or by comparison with a similar, but less altered, watershed. Present emphasis on the Habitat Evaluation Procedures (HEP) and similar tools may place planning emphasis on the use of a given tool, rather than on best choice of indicators (IV). *Therefore,*

- the Corps should continue to allow the use of HEP as an evaluation method for environmental restoration, but should encourage flexibility and creativity in the measurement of environmental outputs, especially when the outputs are not fish and wildlife habitat (III, IV).

> No single set of environmental output indicators is appropriate for all situations.

Program Integration

Finding 9: For historical reasons there are different views of the agency's environmental mission in the planning and regulatory programs. A resource protection theme for existing resources now encumbers the 404 program and denies both the opportunity for watershed restoration and for accommodating economic development (V). This resource protection approach is at odds with a resource management philosophy in

the planning program which emphasizes the management of resources to serve articulated ends (II, III). At the same time, project operations and rehabilitation efforts are too closely wedded to maintaining traditional outputs and opportunities for restoration may be missed (VI). As a result, the lack of consistency in approaches to the environment across agency programs means that the expertise and leadership of the Corps to serve watershed restoration is not being realized. This is often to the detriment of both the environment and the economy (V, VII). *Therefore,*

- the Corps should require that its evaluation of projects being considered for major rehabilitation include environmental restoration as a priority output and the opportunity cost decision making model should be applied for determining justified restoration (VI).

- the Corps should review the various agency practices and rules governing project operations with the purpose of applying the opportunity cost decision making model to project operations (VI).

- the Corps should advance wetlands mitigation banking, private wetlands credit markets and fee- based permitting as one means to realize whole watershed restoration goals (V).

Corps Leadership

Finding 10: The long tradition of Federal agency leadership for water resources management is no longer the reality (II, VII). However, the Federal role will remain significant and among the Federal agencies there is an opportunity for the Corps to seize leader- ship of watershed restoration efforts. The Corps engineering capability and strong tradition of analytical approaches to water management can make essential contributions to the national attention to watershed restoration. In addition, because the Corps retains it strong resource management orientation, as opposed to existing resource protection, the Corps is well positioned to advance watershed restoration as a resource management challenge (III). However, new approaches will be demanded (VII). *Therefore,*

- the Corps should assure discipline in the allocation of Federal funds within the negotiation-based decision making process by a careful review of intergovernmental financing and cost sharing rules as they apply to multiple outputs of restoration (VII).

- the Corps should develop and perfect adaptive management as a restoration program strategy by incorporating its R&D program directly into planning and project operations and management (VII), with particular emphasis on "environmental restoration hydrology" and on design standards for the restoration and creation of wetlands (III).

- the Corps should take leadership in the Federal Government in advocating whole watershed planning for restoration. This can be based upon active pursuit of existing legislative authorities, full participation on programs such as Coastal America, and aggressive implementation of the recommendations of this report (VII).

I. INTRODUCTION

The Corps of Engineers water resources management programs have changed in significant ways during the past two decades. First, there has been a shift in emphasis from new projects to the operation and maintenance of existing projects. During this period, expenditures for new construction, in real terms, have fallen, while operation and maintenance of existing projects is claiming a larger share of the total agency budget.

Second, when new construction funds are spent, there has been increased emphasis on environmental outputs relative to traditional flood control and navigation. The 1992 Corps budget guidance places environmental restoration on a par with flood control and navigation as project outputs which will receive budget priority. Recent budgets have included construction funds for such projects as fish by-pass facilities on the Columbia and Snake River Dams. In 1992, President Bush committed the Corps to the Kissimmee River, Florida, restoration project. This was one of the largest environmental restoration projects ever undertaken. Congress almost routinely is now adding authority for special environmental restoration studies and projects to Corps authorization bills. Now, under authority of Section 1135 of the Water Resources Development Act of 1986, existing projects can be modified to enhance levels of environmental outputs.

A third change has come in the Corps responsibilities for implementation of Section 404 of the Clean Water Act. That regulatory program was a significant expansion of the long standing permit authority granted to the Corps under Section 10 of the 1899 Rivers and Harbors Act. The Section 10 permit was to prevent hazards to navigation from placement of fill material in the Nation's waterways. The 404 focus is on preventing placement of fill in the waterways whenever that action will harm water quality. Further interpretations of the 404 authority have resulted in the program evolving into a Federal regulatory program on wetlands filling.

Overall, during Fiscal Year 1992, the Corps allocated $361 million (over 10%) of its budget to protection and restoration of environmental resources. This change in the agency programs follows a fundamental change in the national policy goals for water resources management. Watershed alteration by engineering works for hydroelectric power, navigation, and flood control is no longer considered a certain path to economic development. Today, there is a focus on protection and restoration of the "natural services" of heavily altered watersheds, many of the alterations being traceable to Corps water control structures.

Watershed alteration by engineering works for hydroelectric power, navigation, and flood control is no longer considered a certain path to economic development. Today, there is a focus on protection and restoration of the "natural services" of heavily altered watersheds, many of the alterations being traceable to Corps' water control structures.

The move toward a more extensive program of "environmental activities" for the Corps has not come suddenly, although the pace of change has accelerated in recent years. Coincident with decreased support for traditional water project construction in the late 1960s, the 1973 Principles and

Standards for Water and Related Land Resources Planning (P&S) authorized the Corps to formulate plans for the objectives of Environmental Quality (EQ) and for National Economic Development (NED). In 1979, the NED and EQ procedures of the P&S were revised and reissued in the Federal register as rules. By 1983, that planning guidance was modified with the publication of the Principles and Guidelines for Water and Related Land Resources Planning (P&G), and the rule making status of the P&S was removed. Of particular note, NED was identified as the single planning objective.

> The significance of the P&G's analytical requirements for the Corps environmental programs is rooted in the agency's long standing interest in, and commitment to, rules for the evaluation of its project plans.

However, in the P&G, attention to environmental quality still is expected. First, the priority of NED as the Federal objective of water project construction is constrained by required compliance with all environmental laws and statutes when plans are formulated. Second, EQ-oriented plans may be formulated in consideration of environmental goals, as long as foregone NED benefits from emphasizing EQ are described. Section 5(b) of the P&G (p. iv) states, "Other plans which reduce net NED benefits in order to further address other Federal, State, local and international concerns not fully addressed by the NED plan should also be formulated." EQ-oriented plans meeting a Federal interest test may be funded if the Secretary of the Army grants an exception to choosing the NED plan. However, the vagueness of the authority to emphasize environmental outputs offered by Section 5(b), the clear emphasis on the NED plan as the Federally preferred plan, and the failure to give funding priority to outputs other than flood control and navigation during the Reagan administration, left a strong impression throughout the agency that the plan formulation process required by the P&G cannot be used to evaluate environmental projects.

This is unfortunate. The significance of the P&G's analytical requirements for the Corps environmental programs is rooted in the agency's long standing interest in, and commitment to, rules for the evaluation of its project plans. In part, this Corps analytical tradition grows from the progressive era during which the Corps water project development program matured. The progressive era's water conservation philosophy emphasized engineering of watersheds in the interest of promoting the Nation's material prosperity, with plans for these engineering works developed by scientific experts. In turn, these expert evaluations would be the basis for choosing the highest priority projects. For example, in the 1930s, immediately after the passage of the Flood Control Act of 1936, there were numerous possible projects which could meet the Act's goal of reducing flood hazard. However, there were no well established procedures for establishing the relative merits of individual flood control projects. The challenge was to find some consistent and scientific basis to value flood hazard reduction outputs in order to have some basis for establishing project justification. As the Corps program grew beyond flood control to multiple purposes, a series of efforts was initiated immediately after World War II to improve evaluation procedures for water projects.

This commitment to evaluation continued to the P&G and now has extended to structured evaluation of the increasing share of the Corps budget being devoted to operations and maintenance of existing projects. As projects age, there is the challenge of determining whether more expensive major rehabilitation of the projects is warranted. A formal assessment protocol based on risk analysis has been developed in the agency for evaluation of major rehabilitation proposals.

One lesson of these continuing efforts to improve project evaluation is that decision

making protocols are always under review and subject to change. A second, and more important, lesson is that the Corps has a rich heritage of commitment to systematic and uniform evaluation as a way of considering the social merit of its project actions. Of course, willingness of project beneficiaries to share project costs, and political log rolling, have always dictated the priority of funding for projects eligible for construction. However, projects always have needed to report an excess of measured economic benefits over costs in order to become part of the list of eligible projects. What needs to be established now, is how that tradition applies to environmental activities.

Extending this evaluation tradition is a special challenge in the regulatory program. A matter of some inconsistency in the agency is that the traditional planning model has not been transferred to a most significant environmental program of the Corps -- the Section 404 regulatory program. In developing the 404 program, the Corps has had to adopt a program philosophy in coordination with the United States Environmental Protection Agency (USEPA) and to a lesser extent with the United States Fish and Wildlife Service (USFWS) and with the National Marine Fisheries Service (NMFS), under the scrutiny of the states, the Congress and the courts.

> ...the Corps has a rich heritage of commitment to systematic and uniform evaluation as a way of considering the social merit of public actions... What needs to be established now, is how that tradition applies to environmental activities.

The differences are fundamental. First, while the traditional water project development programs made intentional changes to watersheds, the presumption of the permit review process is to deny such changes by both the private and public sector. Second, while the traditional Corps programs have used a planning approach which is expected to balance the pros and cons of watershed alteration, the permit program uses a "sequencing" test which stresses always avoiding wetlands filling if practicable.

Also, there is a need to recognize changes occurring beyond the Corps. If only the Corps program was changing, then the existing agency traditions in planning, evaluation and decision making could be marginally modified to accommodate a new environmental emphasis. However, there has been a rapid decline in the authority and ability of Federal agencies, such as the Corps, to lead water resources planning and management, with non-Federal governments assuming that role. Furthermore, there has been a rejection of the progressive era premise that professional agency experts are qualified to define objectives and then to make computations of, and tradeoffs among, planning objectives. The computation-oriented model, as represented by the traditions of benefit cost analysis and multi-objective evaluation, is questioned by professionals as well, as indicated by the title chosen for a recently published book: *The Myth of Scientific Public Policy*. (Formaini, 1990)

The professional criticisms are based upon a variety of different arguments: the declining public faith in governmental expertise; the rise of participatory decision making; the conceptual and technical limitations on value measurement; and, the ethical limits of value measurement. In turn, there is some consensus on a general direction for proceeding in lieu of traditional practice. The future will be one of relying on structured group negotiations, buttressed by strong technical analysis. That decision making approach may preserve many of the tools, but not the decision making powers, of traditional planners.

The report's primary objective is to answer this question: "What plan formulation, evaluation, and decision making approaches for environmental activities might be applied in the different Corps programs?"

Purposes and Objectives

This report reviews the evaluation and decision making challenge facing the Corps environmental programs. The report's primary objective is to answer the question: "What plan formulation, evaluation, and decision making approaches for environmental activities might be applied in the different Corps programs?" The answers to this question lead to specific suggestions for policy and program development and to analytical and decision making requirements that are consistent with field office capabilities and budgets. In making recommendations in this report, the special aspects of all the program areas -- new project construction, project operations and maintenance, and the regulatory program -- are addressed.

Ultimately, this report seeks to contribute to a policy dialogue within the Corps about its environmental activities. In so doing, the intent is to assure that the Corps will better serve the national interest in the development of its environmental activities in the next decade. Section II of this report is an interpretive history of the Corps water resources programs as they relate to the current emphasis on environmental activities. Section III explores the meaning of environmental restoration and develops an argument for focusing on watershed hydrology, wetlands, and riparian zones as the unifying theme for Corps environmental activities. Sections IV, V and VI describe opportunities to advance environmental activities within the project planning, operations, and regulatory programs. Yet, the differences between traditional project planning approaches and the regulatory mission of the Corps, as it is currently circumscribed by the rules of the 404 program, are also recognized. Section VII deals with changing relationships between and among agencies and levels of government, and between the agencies of government and non-government organizations. Section VII includes particular implications for the implementation of the findings of Sections IV, V and VI.

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II. CORPS OF ENGINEERS ACTIVITIES IN WATER MANAGEMENT: AN INTERPRETIVE HISTORY

There is a new emphasis on environmental activities in the Corps. Congressional initiatives promoting watershed restoration, administration policies encouraging spending by the Corps on these restorations and the continued leadership responsibility for the Section 404 program, are evidence. Of course, the Corps has a long history of involvement in the water resources management, and attention to "environmental matters" has been on the agency agenda since the beginnings of the environmental movement in the late 1960s.

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Yet, today, there is a sense that the new environmental emphasis offers a significantly different challenge. Societal demands for a new approach to water management have finally achieved precedence over patching statements of environmental concern onto traditional programs. And, the expression of these demands promises to change the decision making context for the agency in its planning, operations and regulatory programs. A selective and interpretive history of the Corps' water management program, presented in this section, offers a historical context within which to understand the challenges presented by emphasis on a new environmental mission. Indeed, it is not possible to either understand possible future directions for Corps' environmental programs, or to choose that future having the greatest promise of success, without understanding the experiences of the past.

Watershed Alterations for Economic Prosperity: An Early Foundation for National Water Policy

Throughout the Nation's history, Federal policy promoted alteration of watersheds. By the combination of energy, materials and human know-how, engineering works were planned, designed and constructed as part of a national water resources development effort. Early lock and dam systems were put in place to facilitate the primary means of transportation for bulk goods - the inland waterways. The Swamplands Acts of the mid-1800s granted vast tracts of wetlands, then in Federal ownership, to the states in the lower Mississippi River Valley. The condition of the grants was that the proceeds from the sale of the lands would be used to construct public works needed for the successful drainage of those lands for agricultural production. At the turn of the century, leaders of the progressive conservation movement advocated Federal leadership in the development of water and related land resource projects is essential for assuring the long- term material prosperity of the Nation. One notable result was the Reclamation Act of 1902 which began a Federal effort to develop water projects in the west to support the small communities and farms which were settling that region. Although the Corps' programs in navigation were already in place at this time, this general philosophy

ultimately led to the construction of water control projects for the multiple purposes of flood control, power, navigation, and others.

Whether the proposal was to bring water to arid areas or to control flood flows, the premise was that structural manipulation of watersheds' hydrology was warranted for economic prosperity.

Motivated by the perceived link between water development and material welfare, a widely accepted vision of sound water management for the 20th century was created. Early in the century, Gifford Pinchot, a leader of the conservation movement declared, "Conservation stands emphatically for the development and use of water power now, without delay ... [and] for the immediate construction of navigable waterways...". By 1950, President Truman's Water Policy Commission would state that integrated land and water management could lead the development of the Nation's economy:

> "...the American people are awakening to the new concept that the river basins are economic units; that many problems center around the use and control of the water resources...."

Toward this end, Federal responsibility was to be exercised in the planning and construction of engineering works of river control on a multi-state watershed basis, although Truman's Commission emphasized the necessity for increased state involvement in water development. In summarizing the thinking of this era, Gilbert White articulated what Norman Wengert later called the "pure doctrine" of river basin management which had these elements.

- Use water resources management, principally construction of multipurpose water storage projects and navigation channels, to direct regional economic development.
- Construct an integrated system of projects within river basins. Project construction should be phased as needs are identified in a comprehensive plan for the watershed, a plan developed by experts in the Federal water project construction agencies.

Consider these elements in detail. The engineering of the Nation's rivers through what has come to be called "structural alternatives" (channels, levees and dams) was expressly intended to alter the hydrologic regimes in watersheds in order to alleviate problems (control flood hazards to encourage economic activity) and realize opportunities for material growth and expansion (settle the west and assure navigation availability). Whether the proposal was to bring water to arid areas or to control flood flows, the premise was that structural manipulation of watersheds' hydrology was warranted for economic prosperity. In the 1930s, the National Resources Planning Board argued for water control structures as follows:

> "In the interests of the national welfare there must be national control of all running waters of the United States, from the desert trickle that might make an acre or two productive to the rushing flood waters of the Mississippi."

Planning for the implementation of these projects was oriented toward changing a watersheds' land and water resources. The expectation was that watershed alteration promoted human welfare. The ambition to alter and control water resources was to be directed by priorities included within plans for accomplishing river control. Water development projects would follow a sequence defined by expert water management planners, who would, by their basin wide focus, be able to foresee the optimal opportunities for using water development as the engine of economic prosperity.

The design and execution of the rationally determined plan assumed the presence of a

regional watershed organization to implement the actions dictated by the technical analysis. This focus on "rational" planning for watershed development could be traced to one of the central principles of the progressive movement: the faith in technical expertise. For example, Morrell reports that President Theodore Roosevelt, in a 1908 letter transmitting the report of the Inland Waterways Commission to the Congress stated:

> "The decision to undertake any project should rest on actual need ascertained by investigation and judgment of experts and on its relation to the great river system and the general plan, never on mere clamor."

In many states, smaller construction projects were undertaken by local governments and the private sector for intra-state waters, and most typically, for the single purposes of flood control, water supply, and at times, power production. A more comprehensive view was needed. The effort to rationally order river basin development projects supported those who had long called for a dominant Federal role in water development. Three rationales for Federal leadership were offered. First, the technical expertise to rationally direct watershed development was said to reside with the planners in the Federal government. Second, the Federal government was believed to have the greatest capacity to finance, and perhaps pay for, needed water projects development. For example, in western irrigation development, efforts to secure repayment of project costs from benefiting farmers were initially unsuccessful. Yet, the national commitment to development of these projects remained, so limitations were made on the required non-Federal cost sharing and on repayment obligations by the beneficiaries of Federal expenditures for irrigation water development. Cost burdens were not expected to delay warranted water development. A third justification for a Federal role was found in the commerce clause of the Constitution. Given that watershed boundaries crossed state lines, and given the multi-state regional benefits from water projects, only the Federal government was seen as able to lead a national river basin development program.

Responsibility and leadership for river basin development fell to the Federal government, where, during the presidency of Franklin Roosevelt, the National Resources Planning Board (NRPB) undertook the task of defining how the natural resources of the Nation could direct that era's weak economy to economic health. As a result, in the 1930s, the NRPB proposed Federal development plans for 17 separate river basins which would proceed from an initial policy making stage and culminate in "...detailed engineering, social, financial and legal studies of water projects..." Plans were drawn, but only the Tennessee Valley Authority was established to execute such plans.

Because river basin authorities were not created, the execution of the Federal water management program fell to the agencies with water project development authorities within the Federal government, first to the Corps and the Bureau of Reclamation, and in 1954 to the USDA's Soil Conservation Service. These Federal agencies became the "lead" planning agencies in watershed development with others reacting to those agencies' program priorities and decision making procedures for the formulation and evaluation of water projects. Today, the Corps continues to have a well established water project development role within the Federal government.

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The Corps Role Emerges

The result of the Federal construction agency leadership was that efforts to do comprehensive watershed scale planning were overtaken by individual Federal agencies' water project planning procedures and decision making rules. These individual project planning rules had a narrow focus on gaining authorization for construction of projects, and then securing appropriations for project construction. That funding process, which was legislatively dominated, was needed to maintain and enhance the Congressional support for the agency's program. Therefore, while the general policy logic for a Federal water projects development program was the perceived link of watershed management with material prosperity, the initiation and design of specific projects were in response to problems and opportunities which presented themselves at a more local level. A flood hazard problem in town X, or a port development opportunity for city Z, became the focus for formulating alternatives that would lead to water development projects.

This political environment for water project planning and development inexorably drove water project planners away from the river basin as a planning unit. The highly local basis for problem origination differed from the idealized river basin planning model. Meanwhile, the Federal willingness to bear the cost burden for project construction did little to discourage non-Federal interests from expressing a demand to the Congress for Federal water development projects in their local areas. Over time, river basin "plans" simply became lists of proposed, authorized, and constructed Federal projects, and the number of authorized projects grew more rapidly than the Nation's willingness and ability to appropriate funds to construct those projects. The states tended to retreat from an active role in water and related land resources planning, taking what David Allee termed a "let the Federal government do it -- and pay for it" attitude.

One More Attempt at River Basin Planning

In the 1960s, the belief remained that the national water development program would benefit from a more active state involvement and from greater attention to project development made in relation to river basin priorities. The last effort to organize Federal water project planning around the river basin unit was the Water Resources Planning Act of 1965. This act mandated the development of the evaluation guidelines (P&G) to better document the social justification for project investments. That act also created a Federal Water Resources Council and authorized a national system of river basin commissions for the major drainage areas. Also, there were regional authorities such as the Susquehanna and Delaware River Basin Commissions which were not created by the Act, but the Council was expected to include these organizations as a part of the river basin commission structure.

The Council, with members from several cabinet departments, was expected to coordinate Federal water project development consistent with priorities established within river basin management plans. The Council and the basin commissions sought to define plans for water management at different scales. Level A plans were national in scope, such as the National Water Assessment and the North Atlantic Regional Water Resources Study, and were expected to set the most general policy and program direction. Level C plans were detailed formulations for individual projects. Level B plans were the critical reform effort. Level B plans, the product of the deliberations of the river basin commissions, were expected to reduce Federal water project construction agency dominance of the planning process. In Level B plans, priorities were to be set for public action for all levels of government, extending beyond the narrow missions of the Federal water development agencies.

However, the Water Resources Council leadership was dominated by the Federal water project construction agencies.

Therefore, Federal water development projects and their justification captured the full attention of the Water Resources Council. An early task of the Council was to define the appropriate discount rate for water project investments. The Council was also given, at several different times, the responsibility to review alternatives to the existing sharing of costs between Federal and non-Federal interests, but only for traditional water development projects. Also, the Council had the mandate to improve the Nation's approach to flood hazard management. In this case, the Council approached the problem as one of controlling the economic consequences of natural hazards and spent little time, as is now done, articulating a floodplain management program in terms of the environmental values of riparian areas and wetlands in floodplains.

As noted, Level A plans were expected to identify and then describe emerging national water problems and opportunities. Toward this end two "National Water Assessments" were done by the Council. In both cases, significant amounts of effort were expended on developing hydrologic detail by river basin and in matching the resulting flows to demands in order to identify areas and frequencies of shortage and flood. Separate, impressionistic, qualitative descriptions of other water issues were included in the summary reports. Whatever the intent, the impression was clear: the Council's National Assessment process was oriented toward the traditional water project development agencies concerns about the control of river flows.

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Perhaps the most time consuming activity of the Water Resources Council over the years was its lead responsibility for development of the water project evaluation guidelines which became the Principles and Standards for Water and Related Land Measures Planning (P&S). However, those guidelines were not expected to apply to programs of all the Council members. As a result, interest in the activity was intense, but not broadly based. Consider the case of the United States Environmental Protection Agency (EPA).

For the EPA at that time, with its focus on regulation and control of point source water pollutants, the activities and concerns of the Council were of limited significance and initial efforts to have the P&S apply to that agency were abandoned. Of particular note is that the Council's commitment to operationalizing the planning framework of the progressive era, stressing the need to balance the pros and cons of alternatives, did not match the decision rules that were being required of the EPA. That agency was authorized to act under a Congressional mandate that was different from the ways in which agencies like the Corps were expected to behave. The EPA was given standards of performance to adhere to in the restriction of waste discharges, with the goal of "zero discharge" being a prerequisite for achieving the Acts' stated purpose of restoring the physical, chemical and biological integrity of the Nation's waters.

Effluent standards applicable to classes of polluters were to be developed, and enforced through the states, for all discharge points based upon the best technology available, after some consideration of what was economically achievable. Failure to enforce reduced discharge was subject to Congressional rebuke and possible litigation. For the EPA of the 1970s, there was no requirement to make an agency judgment on benefits and costs of different effluent standards for point source polluters, or on the best ways to restore water quality in individual stream situations.

An excellent illustration of the EPA view of evaluation was the agency's position within the Council on whether benefits could be claimed for a water project which used low flow augmentation to address a water quality problem. For the EPA, no matter what the costs of flow augmentation were relative to control of a discharge at the source, its statutory goal of zero discharge did not permit expanding of the assimilative capacity of a river to be a solution to a pollution problem. Therefore, the extended discussions in the Council about how one might best measure cost effectiveness and the benefits and costs of alternative ways to achieve a water management goal, which was the focus of the P&S exercise, were of little interest to the EPA.

Even where there was some expectation that EPA would promote watershed planning for water quality, as in the Section 208 program, the EPA found that the multi-purpose planning of the Council's river basin commissions was far more cumbersome than was needed for the limited 208 mandate to better control discharges of chemical contaminants to a water body. The 208 process itself, however, did not advance the control of non-point source pollutants because of limited funds for implementation and limited Federal authority to compel the local land use decisions which might lead to reductions in land runoff.

The Pure Doctrine of River Basin Development: The Collapse of Consensus

The Council failed to adequately incorporate the new needs of water quality management in its deliberations. But the environmental challenge to the water development agencies which dominated the Council was broader than a new national attention to water quality. Through the 1960s, the Nation had built a large capital stock of dams and water delivery systems mainly through Federal government investments. The achievements were impressive. Irrigated agriculture was established in the west, hydroelectric power production potential was harnessed, inland navigation on the Nation's rivers expanded with the improvement of the channels, and the construction of locks and dams and flood control projects held the line on damages (in real dollar terms), while making original flood plains available for agriculture and commercial uses.

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As the nation moved into the 1970s, the concept of a "capital stock" in water resources expanded beyond engineering works to include the remaining free flowing rivers, nearby uplands, wetlands and the environmental attributes associated with them. The result was the steady redirection of public support from Federal water project investment programs to water quality and natural resource protection programs. However, efforts to patch these new environmental concerns onto

traditional water project construction programs were met with opposition. In the early 1970's, immediately after the passage of the National Environmental Policy Act (NEPA), many lawsuits were brought against Federal water development agencies for failure to adequately report the loss of environmental values that would occur from allegedly questionable expenditures to alter river flows. Consider the following illustration. In the 1960s, the Corps had proposed sixteen reservoirs on the Potomac River for low flow augmentation, as the best way to assure water quality in the river. These projects were vigorously opposed and were never funded, not because they wouldn't work (a matter of debate), but because the low flow augmentation strategy was in conflict with the zero discharge goal articulated in Federal water pollution control policy and because the reservoirs were a major alteration, suddenly seen as unwarranted, of the river's hydrology.

The agencies on the Council were not oblivious to these changes. The 1972 P&S authorized the traditional construction agencies to formulate plans for maximizing environmental quality, often "non-structural" plans. These plans were to be offered for authorization, and funded in competition with plans for the traditional engineering structures. In effect, the Council began an experiment to fine tune the water project planning framework to address newly emerging social preferences for environmental outputs from the Nation's water resource programs.

The Corps responded to these changes in its traditional planning environment. In the past two decades, the Corps has been asked to seek out, and at times has independently sought out, new roles, particularly those linked to water related environmental activities. In the late 1960s and early 1970s the Corps made an effort to turn its engineering expertise to the waste water management challenge. Several districts began region-wide water quality planning efforts for sewage treatment plant location, but the Corps was unable to develop that mission, as the newly formed EPA and the massive construction grants program created by the Federal Water Pollution Control Act Amendments of 1972, short-circuited that effort. In the early to mid- 1970s, emboldened by the authority to plan for environmental quality given by the Water Resources Council's P&S, some Corps districts made efforts to develop environmental plans, but often new legislative authorities were required to execute those plans. However, the momentum of Corps environmental planning under WRC impetus was stopped during the next several years for a variety of different and unrelated reasons.

The Reagan administration used the Council to publish the revision to the P&S, called the Principles and Guidelines (P&G).

Beginning in 1977, the Carter administration used the Council as the focal point for its Congressionally unpopular efforts to curtail the water development agencies' programs (the "hit list"). Then, Carter used the Council as a vehicle to publicize his water policy reforms. His reform goals were many, but of particular note was the effort to use the Principles and Standards to redirect the Corps program. Reforms were put in place at that time, and remain in some form today. A highly restrictive set of procedures on economic benefit measurement was mandated. In the area of navigation development, irrigation and other areas which had been traditional project outputs, the burden on the planner to demonstrate economic justification was increased. The Carter Administration intent was to deny the justification for traditional projects, as much as it was to improve the formulation and promotion of projects which stressed environmental outputs. In a further effort to discourage the traditional project construction, Carter's P&S reforms stressed the need to first consider water conservation and non-structural alternatives to traditional engineering works. And, when engineering works were put in place, the expectation was that full mitigation of project environmental effects

would be made. Although Carter stated that he would support "good" environmental projects if they were formulated, the Council and Corps spent most of their effort during these years on evaluation and cost sharing reforms intended to diminish the scope of the traditional project construction programs, not in finding ways to advance environmental plan formulation.

The Reagan Administration took office in 1980. That Administration's agenda included reducing the size and spending of the Federal government. For water resources, that agenda meant a shift of cost responsibility for water projects to non-Federal interests through significant intergovernmental cost sharing reform. Through that lens, the Administration was unable to see a use for the Council, not because of the WRC budget, but because WRC's operation might increase the demand for Federal spending on water resources.

The Reagan Administration used the Council to publish the revision to the P&S, called the Principles and Guidelines (P&G). Although motivated by the intent to eliminate the regulatory status the P&S had been given during the Carter administration, the P&G did give the appearance of diminishing the authority of the Federal agencies to formulate plans for environmental outputs. While the P&G is permissive about formulation of plans for "... other Federal, state, local and international concerns not fully addressed by the NED plan ...", the removal of the specific P&S requirement to develop environmental plans, the expressed skepticism of the administration about environmental programs, and the formal assignment of low budget priority to environmental outputs meant that the Corps would, for the next decade, not actively pursue environmental planning for new projects.

After using the Council to publish the P&G, the Reagan Administration eliminated funding for the Council, and a Congress with a recent memory of how Carter had used the Council, offered little resistance. By the 1980s the Council, the basin planning effort and the Federal commitment to the basin commissions were gone, although the authority to reform the Council remains in place under the Water Resources Planning Act of 1965.

New Efforts on Environmental Activities

When the Reagan Administration took office, the Corps program already had begun a decline dating from 1970 when the last water projects authorization act was passed. That administration agreed to rejuvenate the program only if the efforts were focused on traditional outputs of flood control and navigation, and if there was a substantially increased share of project cost borne by project beneficiaries. With the passage of the Water Resources Development Act of 1986 (WRDA 86), the financial reforms were realized. That law also included environmental sections and authorities that could lead to a new era of potential growth for the Corps. However, these new authorities were discouraged by the Reagan Administration.

A new environmental emphasis was reinforced in 1990 when the budget message of President Bush stated:

> "Today a consensus is emerging in our society. Investments in maintaining and restoring the health of the environment can now be seen as responsible investments for the future..."

Change began to occur during the Bush Administration. Indeed, even though Section 1135 of WRDA 86 instructed the Corps to consider how operation of existing projects might be altered to achieve environmental purposes, it was only in fiscal year 1991 that this section began to be fully implemented. Now, special legislative provisions and project authorities of WRDA 86 and subsequent acts have authorized environmental projects to mitigate for past

damages and to restore areas that had been degraded in the past. A few examples illustrate this new legislative attention to environmental matters. Section 306 of WRDA 90 authorizes "environmental protection" as a central mission for the Corps. Section 307 calls for the development of a wetlands action plan. The Coastal Wetlands Planning, Protection and Restoration Act of 1990 (PL 101-646) authorized the Corps to cooperate with other agencies and the state of Louisiana to identify and construct wetlands projects. Another significant project which was promoted through legislative concern for environmental restoration is the restoration of the Kissimmee/Everglades watershed. A new environmental emphasis was reinforced in 1990 when the budget message of President Bush stated:

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The budget message was part of a new attention to environmental restoration that was being encouraged government-wide, and from numerous sources. A recent review of USEPA programs faults that agency for historically underestimating ecological risk in the setting of agency priorities. The report in part states:

> Natural ecosystems like forests, wetlands and oceans are extraordinarily valuable. ... The value of natural ecosystems is not limited to their immediate utility to humans. They have an intrinsic, moral value that must be measured in its own terms and protected for its own sake....
>
> However, over the past 20 years, and especially over the past decade, EPA has paid too little attention to natural ecosystems. The Agency's relative lack of concern reflects society's views as expressed in environmental legislation; ecological degradation probably is seen as a less serious problem because it is often subtle, long term and cumulative.
>
> EPA's response to human health risks, as opposed to ecological risks, is inappropriate, because, in the real world there is little distinction between the two.

Following President Bush's budget message, the Assistant Secretary of Army for Civil Works [ASA(CW)] issued a "Statement of Environmental Approaches". This June 1990 statement was transmitted to the Chief of Engineers with the instruction to disseminate it widely throughout the Corps. The ASA(CW) statement was an effort to give a programmatic structure to the suite of environmental activities of the Corps. That statement, and the further elaboration on its content as provided by the ASA(CW) Congressional testimony for 1991, are described here.

The central theme of the statement is that environmental activities would be pursued with existing expertise and authorities. The message was that environmental activities of the Corps must be grafted onto the existing programs and will not be a totally new dimension for the agency. This requirement for a linkage between either an existing Corps project which has caused the degradation, or for modification of a Corps project to be demonstrably the most cost effective means to reverse a degradation, is expected to focus the scope of Corps environmental efforts.

However, the motivation behind the linkage requirement was not to restrict the Corps program; instead it was to force the agency to recognize that there was much work to be done in relation to historical effects of its projects. A careful reading of the Congressional testimony makes it clear that the ASA(CW) finds that changing social values require that existing Corps projects be given a review. Major new initiatives are anticipated to reconsider the operational rules for systems of projects to determine if new environmental considerations should alter the operating regimes. The navigation program is faced with an environmental challenge in dredged material handling and, as projects age, abandoning of some projects when there will be significant environmental benefits that may need to be considered along with rehabilitation of those projects. All this is in the spirit restoring altered watersheds.

Still, in no place in the ASA(CW) statement was restoration of the environment defined, although the environmental program is expected to be about this theme. For example, budget priority will be given to projects that avoid and then fully mitigate adverse environmental effects. Certainly, from a watershed perspective, the first and dominant effect of Corps projects has been to alter the hydrologic regime. While there are occasional references to hydrologic regimes being restored (for example the Everglades), the most common assertion about the Corps programs is that they are expected to restore fish and wildlife habitat.

The ASA(CW) statement and testimony also speak to evaluation criteria and decision making for environmental activities. Evaluation and justification are said, in several places, to be based on a form of benefit cost analysis, giving consideration to both monetary and non-monetary effects. But, no further elaboration is to be found. Furthermore, how this general theme relates to the specific requirements of the P&G is left unclear.

The Chief of Engineers has responsibility for both conceptual and operational policy guidance for field activities. In this role, HQUSACE has made three recent efforts to assist field activities in implementing a new environmental mission. In a February 1990 memorandum, "Strategic Direction for Environmental Engineering," which preceded the ASA(CW) statement, the Chief described his vision of the Corps future in environmental activities in more philosophic terms than did the ASA(CW) statement. In that memorandum, the field agencies were instructed to give environmental aspects of projects equal standing with engineering and economics in all the decisions made by the agency.

By March 1991, the Director of Civil Works issued Policy Guidance Letter No. 24, Restoration of Fish and Wildlife Habitat Resources. This letter was intended to follow on the HQUSACE and ASA(CW) memoranda, as well as to clarify budget guidance that had established environmental restoration as a priority project output.

In the memorandum "Strategic Direction for Environmental Engineering", the Chief reviewed the Corps tradition as a willing respondent to changing national needs over two centuries. With this as a backdrop, the memorandum challenged the agency to make the new concerns for the environment a central part of its day-to-day business.

In the memorandum "Strategic Direction for Environmental Engineering", the Chief reviewed the Corps tradition as a willing respondent to changing national needs over two centuries. With this as a backdrop, the memorandum challenged the agency to make the new concerns for the environment a central part of its day-to-day business. But more was called for--the environment was not simply to be considered, but environmental matters were to be part of the "go-no-go" test applied to all Corps decisions. Unlike the ASA(CW) statement, in no place is there reference to the need for a linkage to an existing Corps project. Indeed, the possible limitations imposed by legal authority are not addressed, but rather the implication is left that if new authority is required, it will be sought.

Maintenance and restoration of the environment are not defined in the memorandum, but the scope of activities used to illustrate the concerns (wetlands, farmlands, hazardous waste) suggests a broad conception, one that may extend beyond the traditional attention to hydrologic regimes. The Chief's memorandum does not address how valuation might be done, but does appear to recognize the issue in promising to explore the need to update the P&G as a basis for project plan formulation.

Ultimately, Corps environmental programs will be best defined by how the agency chooses to spend its budget. Therefore, the Corps budget guidance is an important basis for exploring the nature of the agencies environmental programs. Here, it is necessary to define terms more carefully so that program implementation decisions can be made. Definitions are offered for the terms mitigation, restoration and enhancement, so that legislative authorities and cost sharing rules can be applied. The budget EC was summarized and clarified by the policy letter so the following observations are taken from the policy letter.

One aspect of the policy is the requirement to demonstrate linkage between the environmental problem or opportunity and a Corps project. The linkage can be established by showing that a past project was responsible for an environmental loss, or by showing that modifying a Corps project is the most cost-effective means to address a problem or opportunity.

Problems and opportunities are identified for mitigation (more generally defined as maintenance) and restoration. The terms are defined along two dimensions: time and the nature of the output. In terms of time, the restoration definition refers to a return to some modern historic condition. Mitigation is defined with reference to the reversal of adverse environmental effects as soon as they occur. In terms of the nature of the output, the focus is on fish and wildlife habitat, as a single aspect of the watershed system.

The justification requirements for environmental outputs are left ambiguous, although it appears that the P&G framework is expected to be applied. There is no recognition of how non-Corps interests will be included in the decision process except as required by the usual public participation approaches. Finally, cost sharing for restoration is expected to be 25% non-Federal, mitigation costs will be assigned to project purposes.

The Regulatory Program: A Different Mission, A Different Philosophy

In the late 1960s, a series of court interpretations of the 1899 Rivers and Harbors Act required that the U.S. Army Corps of Engineers expand their review of applications to build structures in navigable waters to include not only possible obstructions to navigation, but also the effects on wildlife habitat. This judicial action was intended to bring that Corps permitting program into compliance with the requirements of the Fish and Wildlife Coordination Act of 1958 (FWCA). However, the FWCA required that the habitat effects only be considered in decision making; there was not a mandate to protect habitat. In this way the Corps slowly began to develop a program of regulation over the filling of wetlands.

Indeed, questions about the permit program arose continuously. Did the jurisdiction of the Corps permit program on the navigable waters of the United States include wetlands adjacent to the water bodies? Were the effects on habitat to be only those at the immediate site of the filling, or did the effects to be considered include possible indirect (off site) consequences of the filling activity? Meanwhile, the passage of the National Environmental Policy Act (NEPA) of 1969 served to expand the required review of permits to environmental concerns beyond wildlife habitat, a permit decision was deemed to be a "significant" Federal action. However, NEPA, like the FWCA, only required that consideration be given to environmental impacts and carried no substantive statement of environmental requirements.

Although legislative action to clarify the national policy on regulation of wetlands filling would have been desirable, the actions of the Congress in the 1972 Amendments to the Federal Water Pollution Control Act (FWPCA 72) did not establish a national wetlands policy. Yet, it is Section 404 of the Act which is the basis for the existing Federal program of regulation for

placement of fill material in wetlands, and the starting point for many state programs. The goal of the FWPCA 72 was to lead the Nation in the "restoring the chemical, physical and biological integrity of the Nation's waters." Although USEPA was charged with this mission, the Corps was given special responsibility within the Act for the regulation of filling and disposal of material in navigable waters of the United States. The Corps, under the 404 program, was expected to review the merits of private and public sector proposals to place fill material in the navigable waters of the United States, whenever fill activities might adversely affect either navigation (under the 1899 Act) or water quality. (Some activities were made exempt from regulation.) Only upon receipt of the permit could the filling proceed.

The Corps regulatory program for wetlands filling, as authorized under Section 404 of the Clean Water Act, grew in historical sequence with the rest of the Corps increased attention to environmental concerns. However, the conceptual linkage between the project planning program and the regulatory program is a weak one.

Proponents of aggressive wetlands protection subsequently filed a series of court cases, arguing that there was a demonstrable link between wetlands and adjacent water quality and that, therefore, it was the intent of the Congress, in framing Section 404, that the Corps be responsible for review of proposed development in all wetlands. At the same time the NEPA process and the FWCA requirements remained in effect, and the conclusion often was made that an overall national wetlands protection strategy for all wetlands functions had been pieced together. However, there was no concurrence among the Federal agencies, among the states, or within the larger public, that Section 404 was intended as a comprehensive wetlands protection program. For example, the Congress left unaddressed issues of jurisdiction--e.g. whether wetlands were included as a part of the navigable waters. This jurisdictional issue remains unresolved, manifesting itself as an apparent technical debate over procedures for delineating wetlands boundaries.

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The particular authority for the 404 program is within the Clean Water Act and the intent of that Act is toward resource protection, more than toward planning for future resource management. Given its planning tradition, it is not surprising that the Corps initially approached the regulatory program with some intent of applying an evaluation model that considered the pros and cons of granting a permit. Each permit decision appeared to require a balancing of effects for making a choice. In the regulatory program, the Public Interest Review Process (PIRP) was the framework that was described. However, because the time allowed for a decision was only a few weeks, there was no opportunity for the permit review to be based upon detailed technical evaluations. Instead, a series of possible categories of effects were articulated, almost as a "laundry list", and the permit decision was to be based on that list. While in the spirit of the traditional planning model, the review criteria were far less formalized in their application. For example, matters as simple as the application of with- and without-analysis in the determination of relative environmental and economic impacts were not addressed.

In the early stages of the regulatory program, the Corps made a judgment on the extent of development value that might be

realized by the wetlands permit applicant and if that was deemed to be "large", relative to the environmental harm, the permit was granted. Where practical and cost effective, the permit conditions may have required that the applicant restore or create wetlands of a similar type (in-kind) and as near to the current wetlands site (on site) as possible as a form of mitigation.

However, the Corps explicit balancing process was not willingly accepted by the Federal agencies responsible for the review of the 404 permit decisions - the U.S. Environmental Protection Agency, Fish and Wildlife Service and the National Marine Fisheries Service. For those agencies only those activities deemed "water dependent", in the judgment of the permitting agency, should be considered eligible for a permit. Whenever it was "technically practical" to avoid the wetlands (i.e. no water dependency), the permit was to be denied.

The reason for stressing avoidance was these agencies' skepticism about the difficulty of mitigation through wetlands creation or restoration. The emphasis on avoidance was justified by reference to the U.S. Council on Environmental Quality's "sequencing" guidelines for implementing the National Environmental Policy Act of 1969. Applying those sequencing guidelines to the wetlands permit application meant that every effort had to be made to 1) avoid the wetlands 2) minimize the impact on the wetlands, if avoidance was not possible due to the water dependency of the activity and then 3) compensate for those effects that were not avoided after impacts were minimized.

Today, the regulatory program is geared to preservation of existing wetlands under regulatory jurisdiction. The result is that the regulatory program was moved from one of balancing of pros and cons, to the sequencing approach in which the premise is that economic development outputs from wetlands conversion are to neither be maximized nor traded off against the environmental values of wetlands.

The resulting implementation of Section 404 reflects the water policy era which began in the 1970s. This time period has been termed the environmental era because it focused the Nation's attention on water resources as more than an engine of material prosperity. But more changed with this era than just the purposes of resource management. A fundamental shift, alluded to earlier, was from a planning model of resource management to one of resource protection through regulation. Early in this century, resource agencies were expected to contemplate manipulations of the watersheds to bring about a desired mix of services. Resource management was about goal setting and about plans to achieve a mix of purposes and to serve multiple goals.

Whatever the success of planning as an endeavor, there is no doubt that the planning model began with a premise -- that management was expected to bring about change over time in the Nation's watersheds. In contrast, the resource protection model is suspicious of human activities that are directed toward changes in natural systems. A watershed system left alone is a watershed system best "managed." Not surprisingly, the 404 program, a product of that era, is about constraints on change more than it is about balancing the pros and cons of change.

The language of the 404 program is indicative of its intent. The program is frequently referred to as one of "resource protection". The sequencing rules, which set priority on "avoiding a wetlands" if possible, are telling. The phrase often used in permit reviews is to assure that the permitted alternative is the "least environmentally damaging" alternative. This particular decision framework is not entirely a result of agency discretion. A recent court case still on appeal for a 404 permit for a reservoir on Ware Creek in Virginia makes this clear. A local water supply storage project on Ware Creek was proposed that would destroy wetlands, although the applicant did offer to compensate for the loss. After a series of reviews the Corps issued a permit, but the EPA chose to exercise its veto power. The EPA found serious environmental harm, and argued that this harm was avoidable because there were alternatives available for the applicant.

The EPA did not take the position that the tradeoffs were unacceptable; it took the position that avoidance was possible. A court review of the EPA ruling found that EPA had no information about alternatives for the applicant, but of interest here, the court ordered EPA to render a judgement on the environmental impacts without reference to available alternatives. EPA then made its decision solely on environmental impacts of the particular proposal and denied the permit even if there were no alternatives. The court is now reviewing the EPA position that they can deny a permit which they find environmentally unacceptable even if the applicant has no alternative water supply source.

Today, the Corps has within its authority two programs which are inconsistent on fundamental matters of philosophy. And, the reality is that the Corps has only limited ability to bring the regulatory program into the planning framework, for the ability to direct the design and execution of the program extends well beyond the agency's walls.

Operations, Maintenance and Repair

As of 1992, the Corps had over 500 projects under its management. Spending for operations and maintenance now is the largest element in the Corps budget. Given the nature of the projects and the Federal responsibility, much of the spending is for dredging of navigation channels. The age of the projects is increasing and repairs and major rehabilitation of the structures are of increased concern. Of course, the costs for operation of locks, control gates, recreation areas, and the like also claim resources. What is significant about the operations, maintenance and repair of projects is that each type of action has its own particular relationship to the environmental activities efforts of the Corps.

The most obvious linkage is in the disposal of dredged material from the maintenance of navigation channels. There is concern about the water quality impacts of open water disposal, either by suspended sediments or release of toxic materials. These effects must be considered under state and Federal water quality laws. There is concern that disposal in confined locations may result in filling and degradation of wetlands habitats. In these instances, the regulatory program of the Corps might come into play in reviewing a fill disposal alternative. Meanwhile, there is also some promise that dredged material may be used for land creation for development purposes and, most significantly, may be used for beneficial environmental purposes of wetlands restoration and creation. In considering the beneficial use of dredged material, there are a variety of analytical and cost sharing requirements which must be considered. In reality, while these various problems and opportunities are coincident with the management of dredged material, the decision making processes and legal requirements for the same material can be contradictory. In particular, the possibility of this material being used as fills in navigable waters triggers the need for section 404 review, with its own unique regulatory requirements which stress avoidance of harm to existing resources, and pay far less attention to the philosophy of the planning frameworks under which the projects were developed. Yet, these planning frameworks are often expected to be used in decision making for budget purposes, especially when there is a need to justify additional expenses for making beneficial uses of dredged material.

In the operation of projects, the Corps is defining a different set of issues. In WRDA 86, Section 1135, the Corps was authorized to modify the operation of its projects to promote environmental restoration. Section 1155 of the same law specifically authorizes environmental restoration with the MR&T project area of the Lower Mississippi River. Section 1135 has only recently been implemented, and the guidelines for making decisions on when operational changes are warranted are unclear. However, there is little doubt that the "planning model" of the project development program, which considers tradeoffs, is to be applied in some

form. On a larger scale, the operation of whole systems of projects are being studied for the Missouri and Columbia River Basins. In both cases, the stated purpose of such system operation reviews is to optimize the benefit stream flowing from the projects already in place. This planning concept still is being refined in those cases where environmental outputs may be part of the optimal mix.

At many projects, managers of the Corps operations program have made significant efforts to improve environmental quality through water control management and reservoir lands management. This has often been in response to legislative and regulatory requirements, but has also been undertaken opportunistically at projects where authorized project purposes are not encumbered by operational changes. However, in all instances, advancement of environmental outputs at particular projects has not been directly incorporated into plans for project operation.

A third area is major rehabilitation. As projects age, there is a need to make significant alterations in the project either to maintain the reliability of the service flow, or to "modernize" the project by enhanced service flow. As a budget decision, major rehabilitation has been incorporated into the construction account and is expected to compete with new project starts for limited funds. This means that planning requirements are to be similar to those required under the P&G for new starts. In the course of rehabilitation, one type of project modernization may be to improve the level of environmental outputs from the project or minimize the environmental harm. For example, a recent study found that rehabilitation at the Bonneville First Powerhouse will increase the power output of the project and will also reduce the loss of juvenile salmon who pass the dam on the downstream migration. There are recent guidelines that have been issued for major rehabilitation evaluation. However, the place of environmental outputs in that evaluation is yet to be established.

As a practical matter, the Corps has not needed to develop an approach to environmental issues within the operations, maintenance and rehabilitation area until recently. Projects were new and repairs not needed. In the case of navigation, channels were often more shallow than now authorized and dredging requirements were less. And, of course, attention to environmental outcomes, with the exception of dredged material handling, was limited. These factors have changed as attention to environmental matters has increased and as the pressures to allocate the now limited funds in this part of the budget have increased with increased demands. Finally, the need to address environmental issues in both the regulatory and planning contexts, often at the same project, has confused matters. The future will be one of exploring alternative approaches.

Lessons and Legacies

The recent changes to the Corp water resources program to stress environmental activities may be the most profound in its entire history, because the changes are rooted in fundamental shifts in what the society seeks from its watersheds. Environmental restoration, a concept still under definition, will define radically different problems and opportunities for the Corps program. And, of special significance, the changes will demand a new attitude toward the desirability of engineering water resource systems. This argument will be explored in more detail in the next section.

At the same time the Corps programs are now rooted in both a planning tradition and a newly emerging regulatory model. These two approaches cannot be easily reconciled. Within the Corps water resources programs, the umbrella of "watershed restoration" (landscape design), may offer a basis for the integration of programs. These two approaches and the possibility for their integration will be explored in Sections IV, V and VI.

The Corps will not be alone. There now exists a vacuum of leadership in the Nation with respect to water resources management. Shifting social priorities about

water resources, shifting inter-governmental responsibilities, shifting attitudes toward expertise and the role of participatory decision making and limited budgets at all levels of government will spin off new institutional forms to address watershed and water resources management in the future. The Corps contribution to, and place in that process, is described in Section VII.

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III. ENVIRONMENTAL ACTIVITIES: WATERSHED RESTORATION AS A UNIFYING THEME

Much of the emerging professional literature in ecology and environmental management is referenced to watersheds. The importance of a watershed accounting stance, often termed a "landscape perspective", an "ecosystem perspective" or an "aquatic system perspective", for the design of successful environmental restoration and mitigation projects has been stressed in a recently published National Academy of Sciences report.

Adoption of the watershed accounting stance for describing Corps environmental activities in its several programs is warranted. First, a watershed perspective is central to defining environmental problems and opportunities. Second, a watershed perspective is central to developing program strategies and project designs that will assure the successful implementation of those environmental projects which are warranted. Of course, a watershed perspective is a familiar one for the Corps. The traditional agency focus on hydrologic manipulations and attention to hydrologic extremes requires a watershed orientation. Indeed, Corps district boundaries for water resource activities follow watershed and not political boundaries.

There has been some attention to the need for a watershed perspective in successful policy and program implementation. Recommendations for achieving wetlands no-net-loss and net-gain goals for wetlands functions within the Section 404 program have stressed a watershed perspective. The watershed approach would be implemented through the advanced identification program or the Special Area Management Plans of the Coastal Zone Management Act. The U.S. Council on Environmental Quality's 1990 Annual Report devoted a full chapter to landscape scale planning as part of a report on biodiversity. At present, there are several interagency working groups at the Federal level, led by USEPA, which are exploring "watershed approaches" and "multi-objective river corridor management" as a means to better achieve their environmental program goals. And, some proposed reauthorizations of the Clean Water Act include titles on watershed management.

Watersheds, or aquatic systems, can be described by a complex of natural physical, chemical, and biological features and processes, in relation to human influences on these features and processes.

Watershed Features and Processes

Watersheds, or aquatic systems, can be described by a complex of natural physical, chemical and biological features and processes, in relation to human influences on these features and processes. Features of the watershed are descriptions and measurements of physical, chemical and biological states. Physical features include the hydrologic regime of the system (timing and volume of flows), as well as the acres and cover types of upland, wetland and riparian zones. Chemical features of a watershed can be broadly construed to include ambient measures of sediments, temperature, dissolved oxygen, nutrient concentrations and the like in surface and ground waters. Watershed land use and economic activity, in relation to the hydrologic regime, determine the chemical features of the aquatic system. Biological features are the living plants and animals within the aquatic environment and related lands. These include microorganisms as well

as the larger forms of aquatic and terrestrial life.

The interactions of physical, chemical and biological features give rise to watershed processes. Among the processes are soil building, nutrient availability, carbon storage and hydrologic cycles, which together characterize "life support". For example, a wetlands position in the landscape may determine the timing and volume of surface water flows. Or, the areal extent of wetlands may determine waterfowl numbers. Biochemical processes such as nutrient cycling are the product of interactions of the features of the watershed system.

A description of these features and processes is the basis for defining watershed boundaries. This same description will be used to characterize the aquatic system at a particular time. However, watershed systems change continuously through time in response to human actions and as a result of the dynamic interrelationships among features and processes. Thus, a characterization of a watershed system today might be thought of as a snapshot of a moving train.

Watershed Services

At any time, a watershed's features in relationship to one another, and the watershed processes, together yield a vector of watershed services which may be valued by people. The services of the watershed depend upon the social and economic activities that exist in the watershed. Thus, the flood control service of a wetlands requires that there be human settlement downstream of the wetlands.

The services of the environment (here of watersheds) valued by humans have been described in the economics literature with the materials balance framework. Table III-1 includes illustrations of four types of watershed services. Use of the environment as a production input and for direct use most closely aligns with the types of services that were the focus of the traditional water development programs. In those programs, these services were expected to be captured or enhanced by the construction of water control works. The waste assimilation services may be used by intention, but often they are simply the inevitable result of the economic activity in the watershed. When use of that service results in a reduced level of the other watershed services, pollution is said to exist. However, the mere presence of pollution may not warrant its reduction. As a social decision problem, the desirable extent of pollution will depend on the

Table III-1
An Illustration of Watershed Services

Production Input for Market Valued Goods and Services
- transportation
- power generation
- land productivity for food and fiber production
- water input in commercial and industrial production
- land productivity for commercial and industrial purposes
- production and harvest of commercially marketed fish and wildlife

Direct Consumptive and Non-Consumptive Use
- recreation
- municipal and home water supply
- aesthetics

Waste Assimilation
- processor or sink for human waste products
- trap for eroded soil

Life Support
- nutrient cycling
- carbon cycling
- aerobic and anaerobic processes
- habitat (food chain, nursery, etc.)

relative value of using the waste assimilation service versus the other services. Of course, this particular logic of choice appears to be prohibited by the "zero discharge" goal of the Clean Water Act which suggests that the waste assimilation service is not to be used at all.

The life support service is the most difficult to define, but most closely represents the new emphasis in environmental management. This service may be diminished by use of the environment for waste assimilation, but may also be diminished by alteration of the watershed to secure production inputs and for direct uses. Any new emphasis on environmental activities in the Corps, and in the society generally, is likely to be oriented toward increasing the level of life support services. However, there are no goals or standards to be achieved and, the meaning of, and measures for, the life support service are still being developed.

...watersheds can yield different mixes of services at any time and each combination of watershed services has a particular value to people.

Watershed Service Values

As suggested by the preceding discussion, watersheds can yield different mixes of services at any time and each combination of watershed services has a particular value to people. The value to people may be found in expressions of individual preferences (this is the basis for economic values) or expressions of collective preferences (social norms often expressed in multiple forums of collective decision making). Both these perspectives envision natural systems as having value as instruments to serve human ends. While people may value simply the existence of the natural world, to speak of its "existence value" still is to speak of the natural world's contribution to the human welfare.

An alternative value perspective suggests that the existence of elements of the natural world has an intrinsic value beyond its relationship to human welfare. This is a view associated with the proponents of "deep ecology". The deep ecology value perspective is not considered any further in this report, because without regard to the philosophical validity of that value benchmark, its representation will be through human choice institutions.

The features and processes of a watershed system may be thought of as a physical asset which, in combination with existing human management activities (that is, the direction of energy, materials and know-how to the watershed) gives rise to a vector of services.

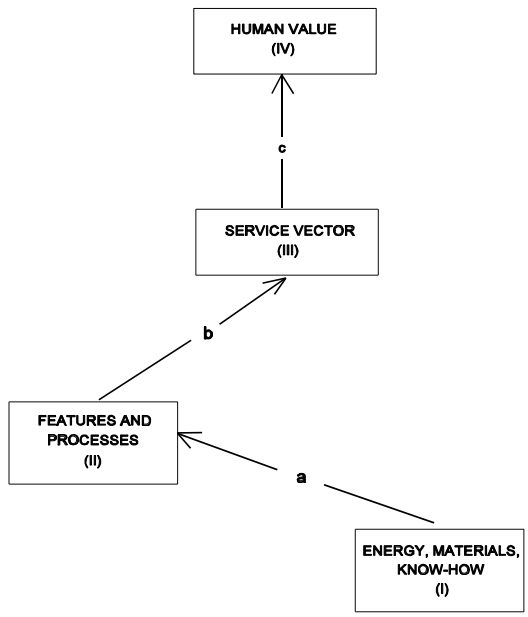
This human basis for valuation differs from the use of the term "value" often used to describe hydrologic or ecologic processes that occur within aquatic systems. For example, the wetlands literature uses the term "value" to describe wetlands detritus production as it supports the estuarine food chain. In that case, the term "value" refers to the interactions of the wetlands area with the upland and open water environments. However, with regard to human valuation, the term "value" refers to the degree to which the well-being of people is affected by the wetlands areas in the system; the values to people are built from the functioning of the aquatic system as it provides services people value.

Figure III-1 illustrates the relationship of human valued services to features and processes of an aquatic system. The features and processes of a watershed system may be thought of as a physical asset which, in

combination with existing human management activities (that is, the direction of energy, materials and know-how to the watershed) gives rise to a vector of services. Path *a* from Box I indicates that inputs of energy, materials and know-how applied to watershed features and processes (Box II) give rise along path *b* to the services potentially valued by people. These services, along path *c*, take on value (Box IV).

FIGURE III-1

THE CREATION OF WATERSHED SERVICES



Environmental Activities: Toward a Conceptual Understanding

Current Corps guidance on environmental activities equates environmental outputs with fish and wildlife habitat, and gives only the most general interpretation of the policy design, program and project evaluation requirements and decision making rules that will direct environmental activities in the agency. Three implications of Figure III-1 provide greater insights into the definition, evaluation and decision making challenges to the Corps in executing an environmental program.

Environmental Activities Means Watershed Management: A focus on watershed services means that an environmental activities program requires a choice between all the alternative services of watersheds when investment and regulatory decisions are made. Consider the service categories introduced earlier: waste assimilation, life support, production input and direct services. Some level of all these services may exist at a point in time. Within a service category, tradeoffs may be possible. Using an example, a cold water trout fishery (recreation service) may be created at the loss of a warm water small mouth bass fishery (recreation service). Of more relevance to contemporary attention to the environment is this general tradeoff situation: reductions in the life support service will result from increases in the other watershed services.

As a decision heuristic, it is useful to think that the desirable tradeoff will be determined by an assessment of pros and cons of changes in the mix of services, using some systematic framework for that evaluation. That assessment is to facilitate a social judgment about the values of services gained and the values of services lost as the combination of services is changed from the existing situation. This balancing would also include the costs of making the change. Thus, the choice to modify an existing power dam to allow downstream passage of young fish has a financial modification cost and a cost as foregone value of electric power.

A focus on watershed services means that an environmental activities program requires a choice between all the alternative services of watersheds when investment and regulatory decisions are made.

Implied in the emphasis on tradeoffs is that human actions will be applied to the management of watersheds. Yet, there has been a social and policy rejection of the historical equating of watershed management with watershed control through engineering works to limit hydrologic variability in river and adjacent wetlands; the "resource protection theme" of programs such as 404 is evidence.

In the traditional view, a system may be managed by humans who continuously monitor and apply energy, materials and know-how to change watershed features and processes. This suggestion of management is one key implication of Figure III-1. The figure suggests the possibility of substituting energy, materials and know-how for the watershed features and processes in providing valued services. There may be some limits on this substitution possibility. Indeed, the possible limits on substituting human "technology" for "nature" are aspects of the current debate over the meaning of sustainable economic development. Some argue that natural systems are too complex to be successfully managed; surprises, unintended consequences and "unsustainable" systems may be the inevitable result.

An equally strong objection to the thesis that humans have altered and will continue to alter watershed systems may be that admitting the necessity and reality of alteration is surrendering an idea. The idea, which is said to represent a core value, in this case is nature, a concept McKibben describes as "the wild province apart from man, under whose rules he was born and died." What is at stake for some is the idea that humans and nature are separate. McKibben observes:

> "The problem is that nature, the independent force that has surrounded us since our earliest days, cannot coexist with our numbers and our habits. We may well be able to create a world that can support our inhabitants but it will be an artificial world - a space station."

It is the threat of human management to the idea of the natural world, combined with a skepticism about human ability to manage natural systems, which often motivates a call for environmental restoration, a return to some prior "pre-disturbance" condition for the watershed, or other biological system. The spotted owl issue has been admitted to be a surrogate for the preservation of old growth forest. Closer to the challenges faced by the Corps, the restoration of the salmon runs on the Columbia River has been admitted by some groups to be a surrogate for returning the larger Columbia-Snake river system to its pre-disturbance condition.

Still, the reality which must be recognized is that watershed restoration is a watershed management problem. Watersheds have been heavily "altered" from some original condition through time. Today's watershed features, processes and services are a human creation, whether by intended or unintended alterations. The challenge is to redesign watersheds. And, as ecologist René Dubos has intimated, this is not beyond human capabilities.

> "It is not true that nature knows best.... By using reason and knowledge, we can manipulate the raw stuff of nature and shape it into ecosystems that have qualities not found in wilderness. Many potentialities become manifest only when they have been brought out by human imagination and toil."

Watersheds have been heavily "altered" from some original condition through time. Today's watershed features, processes and services are a human creation, whether by intended or unintended alterations.

The important implication of the position expressed by Dubos is that degraded watershed systems command future management to bring about their redesign. Simple preservation of what we have is not enough of an environmental program for the new social priorities that are concerned about the life support services of

watersheds. In the design of its programs the Corps should promote this perspective, but be cognizant of the current skepticism about "management."

Corps Environmental Activities Means More Than Habitat: In the past, for the Corps, addressing problems and opportunities typically involved making alterations to watersheds for the purpose of promoting material welfare. These activities were represented in output categories such as flood control and navigation, served by the management of water flow regimes with the development of multipurpose water storage projects. Among the purposes might have been some that were considered "environment." Management of a reservoir for a striped bass fishery, or for cold water releases to create a trout fishery, is an example of what in the past might have been termed environmental outputs. The premise was that the loss of the pre-project condition--a warm water system--was more than compensated by the creation of these new fisheries which could not have existed in nature at that site without the project. Whatever the merits of this definition of environmental activities, the historical discussion makes clear that in the current socio-political environment this type of action is unlikely to be viewed as environmental activity.

Two centuries of a national water policy that promoted engineering the Nation's rivers have resulted in diversion works, storage facilities, and channel modifications which allow us to move water into and out of watersheds and regulate annual and seasonal patterns of flow. The results of this policy direction have been impressive: a water transportation network, a renewable source of electric power, reduced flood hazard for agricultural and urban lands, reliable water supply for municipal, industrial and agricultural purposes and expanded recreational opportunities. At the water's edge, past public policy encouraged clearing, drainage, and cultivation of land for increased food and fiber supplies.

Although human alteration of watersheds has yielded many benefits, the current condition of the Nation's estuaries, rivers, lakes and wetlands has been of increasing public concern. Waste products from human activities are delivered to the aquatic system as chemicals, nutrients and sediments, while dredge and fill activities, shoreline modifications and changes in land cover redirect flows, change the quality of the waters and reduce fish and wildlife habitat. Despite massive investments in waste water treatment, desired improvements in the chemical conditions of the Nation's water have yet to be realized. Meanwhile, there have been declines in fish populations, waterfowl numbers, species diversity and other indicators of the life support services of watersheds which are not noted in Figure III-1. It is these life support services -- biotic indicators -- which are the emerging focus of environmental concern.

In turn, the emerging consensus is that some of the traditional forms of watershed management must be reconsidered. As a result, the definition of environmental problems and opportunities will be made in relation to the past alterations of watershed features and processes, which created the existing service vector. Current Corps guidance equates environmental activities with fish and wildlife habitat creation or improvement. That habitat perspective may be a diversion from the real restoration linkage to past Corps projects, which has been the alteration of hydrologic regimes, specifically the volume and timing of flows in rivers, and the reduction of overbank flooding into riparian areas. Restoration that is linked to the effects of past Corps projects demands an initial focus on hydrologic and riparian zone modifications. If these modifications are "reversed" or the original flow regimes are mimicked by development and operation of engineering works, then fish and wildlife habitat may follow, but so should water quality improvement and natural valley flood storage and other outputs. At present, the current Corps restoration policy and concept seem to suggest an emphasis on "producing" ducks or "producing" habitat

units, just as the agency still "produces" kilowatt hours of power or ton-miles of traffic.

> Current Corps guidance equates environmental activities with fish and wildlife habitat creation or improvement. That habitat perspective may be a diversion from the real restoration linkage to past Corps projects, which has been the alteration of hydrologic regimes, specifically the volume and timing of flows in rivers, and the reduction of overbank flooding into riparian areas. Restoration that is linked to the effects of past Corps projects demands an initial focus on hydrologic and riparian zone modifications.

> A focus on the whole aquatic system and on the life support service which arises from that system (given by the matrix of chemical, hydrologic and biological processes) defines environmental activities.

No longer are population levels of a limited number of fish and wildlife species and enhanced recreational opportunity the services to be equated with environmental management. A focus on the whole aquatic system and on the life support service which arises from that system (given by the matrix of chemical, hydrologic and biological processes) defines environmental activities. Achieving life support services means i) reestablishing flooding and flow regimes and rehabilitation of wetlands and riparian areas, ii) managing the delivery of sediments and chemical contaminants and initiating their removal from the waters and sediments, and iii) revegetating areas and reintroducing native species. The Corps, as an agency, has extensive expertise in hydrology and a history of making modifications to the hydrologic regimes of watersheds. Environmental activities can build on that experience.

Defining Success Will Require A New Attitude Toward Watershed Control: The representations in Figure III-1 are time dependent; they are a snapshot of a system in constant change. Change comes from intended human management to alter the existing features and process of the watershed, for example the construction of new water control structures or the removal of an old water control structure. Alteration occurs when energy, materials and know-how are employed to cause the features and processes of a watershed to be less like they were in some previous time period. Many valued watershed services are realized by altering the aquatic system features and processes in an intentional way.

Watershed change also comes from the evolutionary processes in the "natural" system in response to external and often random climatic events, and the evolutionary dynamics of biological systems. Watershed system features and processes vary through time in response to these forces. This variability in watershed features and processes may occur within ranges where the range may be described, but the frequency and timing of that range may not be. Consider, for example, the areal extent of a wetlands area. In some time periods, areas of wetlands may be dry; in others quite wet. This may occur seasonally, and may vary across seasons as drought occurs. In turn, this variability has influence on the biological life cycles of plant and animal life in the system, as they adapt to the possibility of such change.

Hydrologic variability is ecologically desirable....
...The reality of change and variability as the essential and desirable characteristics of a watershed's life support services is in contradiction to the historical desire to equate water management with water control and hydrologic predictability...

Hydrologic variability is ecologically desirable. Variability creates the mix of features and processes which gives the watershed system resilience and persistence, allowing a mix of life support services to exist over time without extensive application of human energy, materials, and know-how. Resilience is the measure of the ability of the system to survive by recovering from time-limited perturbations arising from weather or human actions. Persistence is the ability of the system to undergo natural succession, or to achieve and maintain a climax state, without significant human management. Variability results in resilience and persistence by assuring predator-prey balance, diversity in plant and animal populations, etc.

The reality of change and variability as the essential and desirable characteristics of a watershed's life support services is in contradiction to the historical desire to equate water management with water control and hydrologic predictability, even if within a known band of variability. It was the drive for predictability in the hydrologic regimes of watersheds that in turn led to equating management with water control. The new environmental activities may require relaxing this goal of certainty, if the biotic communities indicative of the life support service are the goal. Willard and Klarquist comment on this possibility:

> Our lack of understanding about the self-regulatory properties of complex natural ecosystems frustrates our attempts to manage watersheds. We have confused the mechanical and stochastic properties of physical systems with the adaptive, often counter intuitive homeostatic processes of biotic systems. Many watershed/wetland systems require spatial and temporal variability of external stimuli to support the diversity of organisms which allow the system to adapt. ...
>
> We have attempted to manage this disconcerting inconsistency out of the system. In the process of making watersheds predictable and consistent, we have lost the biotic parts.

To the extent that the biotic parts of the watershed can be equated with the meaning of life support services, the goals for, and success of, environmental programs require a focus on creating the landscape spaces where biological processes can move along successive equilibrium paths without collapse from the pressures of human perturbations. However, the particular mix of features, processes, services and values that will exists in that landscape space at a point in time or over time cannot be predicted.

Willard and Klarquist explain this phenomena using wetlands as the illustration. In this context they criticize the regulatory programs emphasis on in-kind and on-site compensation for unavoidable wetlands losses. (Willard, 1992)

> Our regulatory philosophy stems from these same roots. Often we attempt to recreate or preserve a specific wetland type with a particular species mix and precise geography. Now we accept that wetlands are living systems and some types do change. They grow, change species and become other systems. Yet we prescribe mitigation plans which dictate constancy and attempt to construct a particular kind of wetland in place forever. Recent work in fresh water systems (e.g. potholes, western riparian streams, mid western floodplains and elsewhere) have awakened new interest and understanding of systems that must change to persist. In some cases the wetlands complex survives

> because various portions of the system continually change from one type to another, but the sum of each habitat type more or less balances. This dynamic balancing, which may destroy a particular type on a subunit, also creates this type elsewhere in the wetland system. This principle of dynamic balancing is not new, but merely adds a temporal dimension to the concept of spatial heterogeneity. Simply stated, some wetlands persist by balanced change over time and space.

Environmental Activities: Definitions

Often, the adjectives "natural" and "managed," are used without qualification to describe watershed systems. Natural is used in a way which suggests watershed features and processes which are unaltered by any intended or unintended human actions. Natural systems tend toward unimpaired variability in water flows and well mixed areas of wetlands, uplands, and transitional riparian areas. Few such watersheds of significant size remain in the Nation. On the other hand, few, if any, watersheds are so totally altered by human actions that no remnant of variability remains and there is no diversity of species. In fact, "natural" and "managed" are adjectives that describe conceptual extremes on a continuum. All watershed systems are at some intermediate point between these extremes.

One possibility for describing points on this continuum might be to acknowledge that some watershed features and processes may be the direct and obvious result of human management intended to advance a particular service. In this case. the stocking of a lake with the young from a fish hatchery might be described as an "unnatural" process to promote one species at the expense of others. In this case, for classification purposes, a lake with a reproducing trout population would be a "natural" fishery. But what if this "natural" fishery required that the lake temperature be manipulated by reservoir releases from an upstream impoundment, making the reproduction possible? In a world of watersheds which all have human inhabitants, activity, and management, there is no clear way to draw the line between a "natural" and "managed" system. Indeed, to do so is to deny that humans have a place in a "natural" world.

A recent National Research Council report on aquatic ecosystem restoration concludes that "... restoration is defined as the return of an ecosystem to a close approximation of its condition prior to disturbance"; restoration is a time-dependent concept.

By using a prior time period, when the watershed had less "management," or by reference to a comparison watershed which has had less human perturbations, "natural" can take on meaning. In turn, moving back to a particular past configuration of life support services, futures and processes can be deemed natural system restoration. A recent National Research Council report on aquatic ecosystem restoration concludes that "... restoration is defined as the return of an ecosystem to a close approximation of its condition prior to disturbance"; restoration is a time-dependent concept.

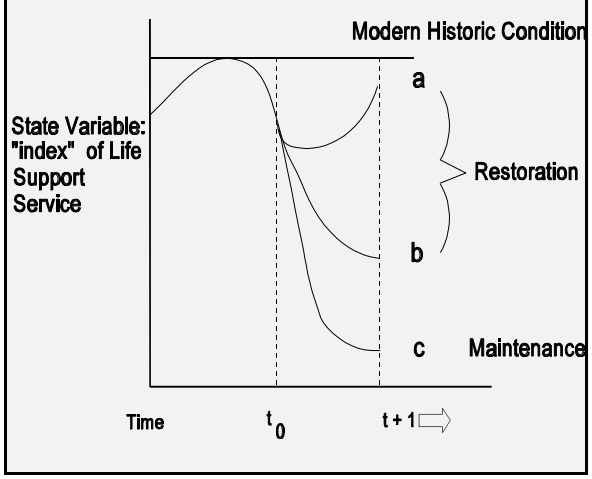
This also has been the approach taken by the Corps in developing its definition of environmental restoration. The Corps defines restoration as the return of the attributes of the system (at present the Corps focus is only on habitat) to some "modern historic condition". In turn, the Corps defines mitigation, or maintaining the environment, as a replacement for disturbances caused to habitat from a current, without action, condition.

The definitions of "maintaining" and "restoring" the environment can be best understood by considering Figure III-2. Time is measured along the horizontal axis, and the vertical is an "index" of the life support services of the watershed - a state variable (more on the state variable definition follows). Three particular points in time

are represented. At the origin of the diagram is the point at which an alteration by human action occurred. The current time is t_0 and t+1 is a time period in the future, after some Corps action has been taken in t_0. This action may be implementation of a Corps project or a regulatory decision made on a private permit application. The heavy line traces the historical and expected future path of the post disturbance index value *without* the Corps action. The dashed lines represent possible alterative patterns for the index value *with* the Corps action. Point b is reached with a Corps action that *maintains* the index value. Point a, and all points above b, represent *restoration* of the index value. Point c (and all points below b) represent alteration of the watershed, as a reduction in the index value. Consider, then, the definitions and conditions for environmental activities that follow.

Maintaining the environment is the result of actions expected to offset changes in the index value which would be caused by a new development activity in the private or public sector. The without-action condition of the watershed is presumed to be worthy of retention, hence there is the need to offset the effect of development activity. However, the off-setting action may not reverse the continued decline in the index value.

FIGURE III-2
MAINTAINING AND RESTORING THE ENVIRONMENT



Restoring the environment is the result of management actions which seek to recreate watershed features and processes which (i) were altered by past development actions, and (ii) for which no mitigation was deemed warranted and/or (iii) for which the mitigation was not deemed successful. Some historic condition of watershed life support services may not have been considered worthy of retention at the time, but those services are now desired due to changing social values or changes in scientific knowledge. The current effort to reflood areas which were once wetlands, but were drained as nuisances, is an example of changes brought by new values and new knowledge.

Indicators of Environmental Outputs: The State Variable

Figure III-2 uses a single state variable for representing the level of life support services. It is the prospective level, persistence, and resilience of life support services which defines environmental outputs. However, persistence and resilience are highly abstract concepts. Defining the state variable for environmental outputs in terms this abstract offers little guidance for describing alternative restoration levels. What is needed are variables where a change indicates an unambiguous directional change toward, or away from, more abstract concepts of level, resilience, and persistence. Unfortunately, there is no single indicator of the watershed's ability to provide life support services over time.

However, because restoration and maintenance are time dependent concepts, choosing indicators to judge the extent of restoration or maintenance can be made with reference to a historical "template," or reference may be made to a similar watershed which has had less alteration, but for which there is some evidence that at a prior time the reference watershed and the target watershed were similar.

This means there are no standard indices of environmental outputs (restoration or

maintenance) applicable to all watersheds; indices need to be taken from a reference condition. Realistically, a historical reference will be limited by gaps in the historical data, if the past chosen for restoration is very distant. It is more likely that some combination of historical and reference watershed features and processes will define the restoration indices.

In effect, the template for designing restoration or maintenance is given by the natural system itself. The challenge is to find and understand the relationships which may have been altered in the past in order to put the system back together. This challenge pushes the state of the science, demanding a learning-by-doing management approach, termed adaptive management, which will be discussed in some detail later in this report.

Therefore, in choosing indicators of environmental outputs, the state of restoration science is not sufficiently well developed to give more practical guidance than the following from the National Research Council.

> ... selecting an appropriate subset of indicators from the universe of possible indicators is a skill and an art --in essence, a separate decision problem that is of great importance to the feasibility, cost, and validity of the evaluation.

However, there are truisms that apply to choosing indicators of environmental outputs and which demand a watershed focus. First, the spatial extent of the project area is important for many reasons. Willard and Klarquist assert that for simplicity, and based on considerable theory, we can assume that life support service levels increase geometrically with area. Increasing area supports additional species and diversity and heterogeneity is the key to resilience and persistence. And, given that restoration will occur only in limited areas with human development at the boundaries, a project area needs to be large enough to limit deleterious effects that boundary conditions may impose on the interior aquatic system processes.

Related to the size criterion is the corollary to minimize fragmentation of systems, for example by isolating wetlands from the associated upland habitats. Of course, the limits to project size imposed by the limits to socially warranted restoration lead to design rules that emphasize connectivity through corridors that connect patches of landscape which are restored or have not been substantially altered. This allows species migration and the opportunity of plants and animals to move about the landscape in order to survive external perturbations to the system by man or natural forces. In other words, connect aquatic, riparian and upland habitat areas over large geographic spaces. A 1991 report to the administrator of the EPA from a specially commissioned forum of scientists noted the following:

> ...many wetland functions and values depend upon wetland characteristics that are not measured by simple statistics such as acreage. Wetland configuration, connectivity, location in the watershed, and the landscape context within which the wetlands occur are at least equally important considerations for many wetlands functions. Although certain functions such as aquifer recharge may be maintained by numerous small isolated wetlands, protection of characteristics such as biological diversity will only be ensured by a watershed or landscape level of analysis and monitoring. Life history requirements of hundreds of aquatic and wetland species are dependent upon seasonal migrations between aquatic environments, among different zones along the stream or river continuum between landscape components, such as wetlands and uplands....
>
> We must minimize obstructions within and among floodplains and mitigate those which already impact wetland related species. We must maintain and/or restore riparian buffer strips along streams and rivers such that aquatic organisms can move as freely as possible and complete essential life cycle stages. We must maintain and/or restore natural interconnections between ecosystem types throughout the watershed.

In essence these perspectives on the state variable make two points: there are many features and processes that are central to

restoration and the consideration of these needs to be on a watershed scale; that is, at a landscape level that considers more than just particular river segments or wetlands and certainly more than the immediate project site. Perhaps the second lesson to be especially emphasized, given the traditional approaches to "habitat management," is to avoid increasing management effort to enhance a particular species (for example ducks or deer). This is farming, not restoration of a system likely to have highly time variable populations of different species. And don't emphasize one feature, for example wetlands acreage.

Watershed Design for Environmental Outputs: A Unifying Theme for Corps Programs

Environmental restoration (and maintenance) must be planned and executed on a watershed basis. This is a lesson of the emerging discipline of landscape ecology. Restoration is any planning effort intended to mimic a matrix of chemical, hydrologic and biological processes which have been compromised by human modifications to the aquatic system. Restoration is expected to reproduce and replicate some aspects of the predisturbance processes in order to better support the services received from the aquatic system. Restoration is more than replacing what was there--going back in time as it were. Restoration is more than preserving the existing landscape. Human manipulation of the existing, already altered landscape is needed, using an understudy of historic conditions as a "design manual." For example, the reestablishment of wetlands at critical points in the landscape can cost effectively reintroduce essential parts of the physical/biological system in an effort to reestablish the services that have been lost.

Fundamentally, restoration means redesign of a watershed around engineering and regulatory decisions directed toward the future, but informed by the past. In that sense it is about planning for change.

When restoration means manipulation of the existing hydrologic regime and structural features of the landscape, it is an "engineering" problem. When restoration means discouraging further alterations of the watershed it is a regulatory problem, emphasizing protection of existing resources. Fundamentally, restoration means redesign of a watershed around engineering and regulatory decisions directed toward the future, but informed by the past. In that sense, it is about planning for change. A restoration focus sheds, for example, a different light on wetlands management, shifting the attention from protection of a point in the landscape to integrating these points, called wetlands, into a larger context. Wetlands sites are not the concern. Concern is for the role that wetlands play in the in support of watershed functions and the services that follow within targeted geographic areas.

Watersheds cover both large and small areas. However, watershed restoration is about the smaller spaces on the landscape where self-maintaining, evolving ecosystems would be expected to function. Restoration is not a goal for every location, in every watershed, of every size. However, where restoration is attempted, there needs to be a spatial and temporal scale to the design of the restoration project which reflects a watershed perspective; that is, the design of environmental restoration and maintenance projects must emphasize the interdependence of hydrologic, biologic and chemical processes, within uplands, rivers and wetlands. Simply put, the attention to a spatial and temporal scale larger than the

restoration site itself is required to assure the success of the restoration project.

The watershed restoration theme can be the underlying unifying approach to integrating elements in the Corps program. The need for a watershed perspective is especially well illustrated by the decisions made in the regulatory program, although the example could be extended to project planning and operations activities. In that program, wetlands sites have become the focus of regulation, instead of the role wetlands play in support of aquatic system services: clean water for recreation, flood storage and fish and wildlife habitat are examples. The value of an existing wetlands type in a given location is established by its contribution to a larger aquatic system. This most basic point is often not considered in the management process, where existing wetlands acreage is assumed to have value as a point on the landscape simply because it represents "nature". But the existing wetlands are not necessarily in the optimal locations or of the optimal types for the aquatic system. Also, not all wetlands types have equal aquatic system value. Failure to recognize this leads to much confusion about how wetlands of management concern should be identified. Those wetlands which remain today are residuals from the development process as much as they are in ideal locations for the natural system. A wetlands management program must acknowledge this reality.

> ...the design of environmental restoration and maintenance projects must emphasize the interdependence of hydrologic, biologic and chemical processes, within uplands, rivers and wetlands.

A wetlands management process that elevates its sights to the watershed level will take a landscape perspective -- a lesson that is derived from landscape ecology, but which has been lost in a regulatory process that too often defines wetlands management as isolated parts of the landscape and places preservation of existing wetlands above the goal of enhancing aquatic system functions. Wetlands management should be expected to enhance the contribution of wetlands hydrologic and ecologic functions to their associated aquatic systems.

For both project planning and regulatory program design, the watershed planning ideal of the early years of this century needs to be reinvented with new goals of restoration and with ways to make the reality come closer to the ideal than was the case in the past. Program execution and design should be made with attention to watershed scale, because only in this spatial scale can projects and programs be designed for success.

Conclusions

Over time, watersheds change and are changed. Change also occurs in the services humans most value from watersheds. While the alteration of the features and processes of the Nation's watersheds has yielded many benefits, the current alteration of the Nation's estuaries, rivers, lakes and wetlands has been of increasing public concern with perceived losses of certain life support and aesthetic/ recreation services of watersheds at a time when the demand for such services is on the increase. Examples include declines in fish populations, waterfowl numbers and species diversity. This has made environmental restoration a central theme for the next decade.

There now appears to be support for using an expanded understanding of the predisturbance condition as a basis for describing, planning and restoring many watershed's features and processes. This sentiment is now being reflected in a new Corps commitment to environmental activities. Of course, the Corps has long been involved in watershed planning and management as an arm of Federal policy. What is different is today's water management problems and opportunities are defined by the desire to, in many ways, back

away from the types of watershed alterations and fish and wildlife management practices that were desired in the past.

Because restoration is a landscape redesign problem, watershed restoration is about making tradeoffs between alternative actions that can be taken to achieve desired watershed services. Trade-offs may needed to be made within watershed features, for example when making a decision on which wetlands might be permitted for development and where, in turn, restoration of wetlands-uplands complex might be initiated. Another tradeoff may be about whether the most effective non-point source pollution control approach would be to restore riparian zone wetlands or to require non-point source best management practices on the uplands. And, of course, tradeoffs will always be about the desirable degree of landscape restoration in relation to the opportunity costs of foregone services from past watershed alterations. The next section explores this reality of decision making.

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IV. EVALUATION AND DECISION MAKING FOR ENVIRONMENTAL PROJECTS

The traditional engineering project was expected to alter the existing watershed features and processes in order to promote the Nation's material welfare. Today, an environmental project might well be one which undoes the results of a past project, restoring some prior watershed condition. However, when considering the merits of projects, whether to manage or restore a watershed, the analytical question is similar: "How much should the watershed be altered in relation to some existing condition?". Therefore, there is every reason to expect that the planning approaches of the past might be adapted for evaluating projects emphasizing new environmental outputs. This possibility is considered in this section.

...when considering the merits of projects, whether to manage or restore a watershed, the analytical question is similar: "How much should the watershed be altered in relation to some existing condition?" Therefore, there is every reason to expect that the planning approaches of the past might be adapted for evaluating projects emphasizing new environmental outputs.

Valuation and Decision Making Protocols for Project Planning: The P&G

The project evaluation protocol now in place, the Principles and Guideline (P&G), was based upon the predecessor Principles and Standards (P&S). These two frameworks are described together so that the differences and similarities can be understood. This attention to both the P&G and P&S is warranted because there is a perception that the P&G planning requirements stand in the way of execution of the environmental activities in the Corps. This was explicitly stated in the Chief of Engineers memorandum, "Strategic Directions for Environmental Engineering" (reviewed in Section II).

The P&S and the P&G are multi-objective evaluation systems where the effects of a project may be represented in four accounts. In the words of the P&G,

> Four accounts are established to facilitate evaluation and display of effects of alternative plans. The national economic development account is required. Other information that is required by law or that will have a material bearing on the decision-making process should be included in the other accounts, or in some other appropriate format used to organize information on effects.
>
> (a) The national economic development (NED) account displays changes in the economic value of the national output of goods and services.
>
> (b) The environmental quality (EQ) account displays non-monetary effects on significant natural and cultural resources.
>
> (c) The regional economic development (RED) account registers changes in the distribution of regional economic activity that result from each alternative plan. Evaluations of regional effects are to be carried out using nationally consistent projections of income, employment, output, and population.
>
> (d) The other social effects (OSE) account registers plan effects from perspectives that are relevant to the planning process,

but are not reflected in the other three accounts.

One distinguishing feature of the P&S, relative to the P&G, was that the P&S mandated that the planner develop alternative plans which included at least one which maximized NED, as well as one which maximized EQ. In the P&G, the Federal objective is more narrowly construed, although EQ concerns are not ignored. The P&G states:

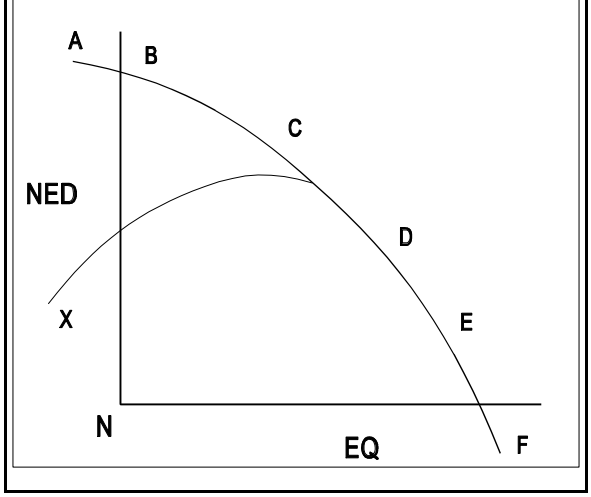
> The Federal objective of water and related land resources project planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.
>
> (a) Water and related land resources project plans shall be formulated to alleviate problems and take advantage of opportunities in ways that contribute to this objective.
>
> (b) Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the Nation. Contributions to NED include increases in the net value of those goods and services that are marketed, and also of those that may not be marketed.

Neither the P&S nor the P&G required plan formulation for the RED and OSE accounts. Therefore, these accounts are not included in the conceptual discussion of the two planning frameworks which follows. The use of the OSE and RED accounts is discussed later in this Section. A second difference between the P&S and the P&G was that the measurement procedures for effects within the NED and EQ accounts were changed in various ways. However, these differences are not germane for comparing the P&S and P&G as planning frameworks. Therefore, it will simply be asserted here that there are two vectors of "value" -- NED and EQ. EQ might be thought of as state variable in Figure III-2.

A graphical representation of the two objective evaluation model is depicted by a set of points on a frontier which represents the choices of alternative projects that give different combinations of NED and EQ. A project is defined as a combination of energy, materials and know-how applied to the features and processes of the watershed with the intent of achieving a particular service vector. This tradeoff framework is displayed in Figure IV-1. First consider the function along A to F. Point N is the future without-plan condition, so that all plans - A to F - are improvements over the without-plan condition in terms of NED, EQ or both. Movement from plan A to plan F requires a willingness to sacrifice NED to achieve more EQ. With reference to the without-action condition (point N), plan A gives up EQ to get NED. This might be the NED maximizing plan called for in the P&S. Conversely, Plan F gives up NED to get more EQ. This might be the EQ maximizing plan. The function along XCF is another possibility. In that case, the set of plans from X to C all result in positive contributions to both NED and EQ. Tradeoffs only become necessary between C and F. The function XCF is plausible, but for the remaining discussion here, reference is made to the function AF.

Figure IV-1

NED AND EQ TRADEOFFS



Plan B maximizes NED subject to the constraint that EQ be maintained at the pre-project level. The design of Plan B

would likely include specific mitigation measures. This suggests that Plan B, or one close to B, is the most consistent with the plan expected to be recommended to serve the Federal objective under the P&G. The P&G states:

> Various alternative plans are to be formulated in a systematic manner to ensure that all reasonable alternatives are evaluated.
>
> (a) A plan that reasonably maximizes net national economic development benefits, consistent with the Federal objective, is to be formulated. This plan is to be identified as the NED plan.
>
> (b) Other plans which reduce net NED benefits in order to further address other Federal, state, local and international concerns not fully addressed by the NED plan should also be formulated.
>
> (c) Plans may be formulated which require changes in existing statutes, administrative regulations, and established common law; such required changes are to be identified.
>
> (d) Each alternative plan is to be formulated in consideration of four criteria: completeness, effectiveness, efficiency, and acceptability. Appropriate mitigation of adverse effects is to be an integral part of each alternative plan.
>
> (e) Existing water and related land resources plans, such as state water resources plans, are to be considered as alternative plans if within the scope of the plan.

While the P&G apparently calls for formulation of alternative plans to address a variety of objectives, including environmental restoration, serious attention to formulating these plans has been discouraged by other P&G language on plan selection.

> A plan recommending Federal action is to be the alternative plan with the greatest net economic benefit consistent with protecting the Nation's environment (the NED plan), *unless the Secretary of a department or head of an independent agency grants an exception to this rule.* Exceptions may be made when there are overriding reasons for recommending another plan, based on other Federal, state, local and international concerns (emphasis added).

The central feature of plan selection under the P&G is to assure that EQ is not reduced with versus without the plan. With reference to Figure III-2, the EQ state variable is maintained. This means that plan B in Figure IV-1 is the preferred plan because NED is maximized subject to no reduction in EQ attributable to the Corps project. Again, recall that mitigation components may be necessary to assure that EQ remains at level N.

Unlike the P&S, in the P&G no EQ maximizing plan must be formulated. However, the language of the P&G on alternatives and on plan selection is permissive enough to allow both the formulation and recommendation of environmental restoration plans such as C, D, E, and F in Figure IV-1. As long as a plan is addressed to matters of "Federal concern", a choice to deviate from the from the NED plan may be made. To make this choice, alternatives to the NED plan will need to be formulated, but these will only be formulated by planners if they have a reasonable expectation that EQ plans will be selected for implementation, as an exception to the NED plan. During the 1980's there was little in Corps policy and budget guidance, or in actual allocations from the budget, which suggested that exceptions from the NED plan to serve environmental purposes would be granted whenever Federal expenditures were required. Now, as was noted in Section II, projects which emphasize environmental outputs can have funding priority equal to that for flood control and navigation projects.

...the language of the P&G on alternatives and on plan selection is permissive enough to allow both the formulation and recommendation of environmental restoration plans....

However, despite such recent policy developments authorizing a new Corps attention to environmental activities, many in the agency feel that the P&G denies the Corps the opportunity to formulate EQ plans as a priority output, if EQ comes at the expense of NED. Despite the new budget guidelines and the various policy statements that all seem to suggest that EQ can be advanced (as restoration) as a priority even if other outputs are to be foregone, many see this as an apparent contradiction to the P&G.

Consider once more the P&G language, "Other plans which reduce net NED benefits in order to further address other Federal ... concerns not fully addressed by the NED plan should also be formulated." Certainly, the current emphasis on environmental restoration and maintenance fits this opportunity for plan formulation. Apparently, the concern about incompatibility is over the likelihood of an exception being granted.

Measuring EQ Value in the NED Account: A Way to Proceed?

The decision making structure of the P&G seems to permit the consideration of environmental projects. With this recognition, how should environmental projects be evaluated within the P&G framework? One possibility is to monetize environmental services for their direct inclusion into the NED plan. That possibility is reviewed in this section. Then, an alternative approach, based on an "opportunity cost" based decision framework, is presented. The opportunity cost framework deemphasizes the money measurement of environmental outputs and emphasizes the display of foregone NED as EQ is pursued.

The NED evaluation account measures the contribution of the project to the economic efficiency of the Nation's economy. Changes in economic efficiency with versus without the project define NED benefits and costs. What is not well recognized is that NED is expected to be a measure of the value (not prices) which people attribute to all the services of a watershed. The economic efficiency standard for measurement of human based value is derived from neo-classical economic theory. Economic value is described as beneficiaries willingness-to-pay (WTP) for changes in watershed services. [An alternative value basis, willingness-to-accept compensation (WTA), can also be derived from the economic models of value. The differences between WTA and WTP are attributable to differences in the assumed initial entitlements to a particular state of the watershed resources.] There is no apparent reason why NED value measurement could not be applied to all watershed services, a single accounting of pros and cons of alternative plans developed, and the NED plan, which would then incorporate environmental outputs in computed money equivalent benefits and costs, chosen.

The WTP standard for NED benefit measurement is described in the P&G (and P&S) as follows:

> The general measurement standard of the value of goods and services is defined as the willingness of users to pay for each increment of output of a plan. Such a value would be obtained if a "seller" of the output were able to apply a variable unit price and charge each user an individual price to capture the full value of the output to the user. Since it is not possible in most instances for the planner to measure the actual demand situation, four alternative techniques can be used to obtain an estimate of the total value of the output of a plan: Willingness-to-pay based on actual or simulated market price; change in net income; cost of the most likely alternative; and administratively established values.

... how should environmental projects be evaluated within the P&G framework? One possibility is to monetize environmental services for their direct inclusion into the NED plan.

This basis for NED value can be best understood by reflecting upon the nature of economics as a subject of study. Economics is first the study of how society organizes itself through exchange (markets). As a corollary, economics involves the study of how people allocate resources among competing alternative uses to maximize their own well being in the market context. Thus, by interpreting the allocative choices people make in exchange relationships, economists try to determine the relative value people place on different goods and resources (hereafter referred to as products or services) as revealed in market exchange. The argument is that individual preferences are revealed through market choice behavior and that analysis of market prices provides the foundation and empirical data for value measurement.

Under certain circumstances, market prices can be used to determine values, as values are revealed by people's resource allocation choices. Within well-functioning markets, sellers and buyers exchange money for products. The amount of money that must be exchanged for each unit of a product is its market price. In a market, buyers are willing to pay money for a product if they value that product more highly than other products that may be purchased for the same amount of money. Conversely, sellers will sell a product for money if they value the other products the money could buy more highly than the product they have for sale. The price at which a product or service is voluntarily exchanged is, therefore, a basis for measuring the value of the product to the buyer; it can also reflect value to the seller since the market price cannot fall below the value to the seller. Market prices reflect the revealed value of a service or product in question to buyers and sellers.

However, prices for products and services revealed through market exchange cannot be a basis for establishing value if the exchange process is absent or flawed--as is often the case for many of the watershed services provided by Corps projects. These "market failure" problems are best characterized as the result of unclear property rights to the use of environmental assets and/or high costs of engaging in market exchange. And, at times polices of government may render it impossible for market exchange to occur. One example is the case where government provision of flood control services at no charge to beneficiaries makes it impossible to discover the willingness-to-pay for flood control through any preference revelation system.

A particular case of the failure of market exchange to reflect willingness to pay is for some life support services of watersheds. For example, the wetlands service of water quality enhancement is not considered by either the buyer or seller of a wetlands site in a market transaction. As a result, the market price for wetlands will not reflect the value of this service; so, if a wetlands is altered to realize an economic return, it will be with little or no recognition by private buyers and sellers of the economic value of the water quality improvement service foregone. Another aspect of the possibility that market transactions will not reflect full value is the possibility that people who may not directly use an environmental service may also have a value for it. These are termed option and existence values. Option value is the willingness of a person to pay to prevent the irreversible loss of a service, in order to preserve the prospect of uncertain future use. Existence value is the possibility that a person who has no intention of making a direct use of the service might still be willing to pay for its continued existence, if the loss of the service was not reversible. These concepts were introduced into the literature over three decades ago. Today, the theoretical validity of the concepts and the practicality of their measurement is under scrutiny.

When the market prices cannot provide appropriate money value measures, the economic analyst must develop "shadow values" for some environmental services. A shadow value should be based upon the supply and demand that would exist, if such a market were able to function under ideal conditions. Thus, the search for shadow prices is a search for a measure of peoples' values for those goods and services not

While money valuation of "environmental services" has received support in the economics profession there are critiques of its conceptual merit. And, many who would support its conceptual validity cite practical limits to empirical measurement. Still others question the underlying philosophical premise of the NED concept, as it applies to environmental services. Acceptance of any one of these criticisms would make collapsing environmental values into the NED account an unsuitable evaluation approach for making decisions on environmental restoration.

traded in well functioning markets. The methods of estimation provided for in the P&G, simulated market price; change in net income; cost of the most likely alternative; and administratively established values, are shadow value estimation methods.

One further point needs to be emphasized. NED values are not equivalent to the prices used in national income accounts which record cash transactions in the economy. At the national level, these cash expenditures are represented as the gross domestic product (GDP). At the regional level, direct expenditures are the cash included in a regional economic impact analysis. Willingness-to-pay as a measure of value is not included in measurement of GDP. For some of the measures, people cannot spend the surplus which is measured by willingness-to-pay.

Traditional Corps outputs have long been evaluated in NED terms. This NED valuation has been possible because many of the traditional outputs, while not traded in markets, have close substitutes (e.g. power or railroads) which can be used as a benchmark for establishing values. The presumption is that NED measurement of traditional outputs will continue. But the life support services expected from watershed restoration have no close market analog.

Can NED be Used as an Evaluation Standard for Environmental Services? While money valuation of "environmental services" has received support in the economics profession there are critiques of its conceptual merit. And, many who would support its conceptual validity cite practical limits to empirical measurement. Still others question the underlying philosophical premise of the NED concept, as it applies to environmental services. Acceptance of any one of these criticisms would make collapsing environmental values into the NED account an unsuitable evaluation approach for making decisions on environmental restoration.

Conceptual Critiques of NED Value for EQ Services: The argument that individual preferences are revealed through market choice behavior, and that analysis of market prices provides the foundation and empirical data for value measurement is derived from the neoclassical economic model. An alternative view of the role of price in the economic system, which is gaining some favor, is that of the **Neo-Austrian** school of economics. These economists argue that market prices cannot be interpreted as revealed values, therefore invalidating all attempts at value measurement using these prices. In this view, individual preferences (values) are empirically unknowable in advance of the choice decision to an analyst and, indeed, even to the choice making individual. Measurement of values is not possible by interpreting market prices. Instead, the role of prices is to signal scarcity and encourage individual entrepreneurial adjustments to these price signals. A founder of this school of thought, Frederick Hayek, made this point early in this century in his writings on the

impossibility of achieving efficiency in resource allocation through central economic planning. For the neo-Austrian, the possibility of value measurement for any outputs, even those with close market substitutes, would be questioned. Without the possibility of value measurement, public policy needs to focus on creation of market-like bargaining systems which create and mimic the allocative power of the price system.

The **Institutional** economists critique focuses attention on the dependency of economic values on the initial property rights assignments to the environment. The institutional economists' concern is that the measured values represent an existing distribution of power and values in the economy, but the essence of public policy is to redistribute power and to form new values. The distributional concern directs the institutionalist to favor "economic impacts" analysis over economic surplus measurement, and to advocate a open political dialogue in which the society sorts out the values that should count. The institutionalist, like the neo-Austrian, is a skeptic of measurement for any services, but unlike the neo-Austrian will not advocate market-like organizations as being always the best way to make social choices. The institutionalist literature on appropriate choice mechanisms tends to stress the importance of power relationships between interests and the presence of external standards to restrict the range of political and market choices. However, unlike the neo-Austrian, the institutionalist might accept market prices as a way to interpret values for those services if distributional issues are of minor concern and if there is some social consensus on the legitimacy and validity of preferences of the current population.

The appropriateness of using the preferences of the current population to establish value is the focus of the **ethical** critique. While accepting that some services of watersheds (e.g. transportation) may be appropriately valued as if they were traded in markets, this critique places limits on what might be acceptably made a subject of trade. Some values are not to be traded or treated as they would if they were traded (for example, the right to vote). The life support services of the environment are classified as these types of services. For these critics, as with the institutionalist, value measurement and relegating environmental decisions to market like institutions which elevate the values of current individuals as the touchstone of decision making are unacceptable. Instead, decisions must be made with open consideration of property rights distributions and moral absolutes about rights of future generations.

The **information** criticism also is about the validity of relying on existing preferences as the basis for valuation. This criticism notes that NED values are based upon the preferences and knowledge of the current population. People's values may change over time as people gain knowledge about the certain goods and services (such as natural environments) and, as a result, they may be willing (or unwilling) to pay more of their money income for the services of the natural environment relative to other goods. As this occurs, shadow prices can be expected to change. However, the NED analyst accepts the existing structure of individual human values as the basis for calculating shadow prices. For this critic, the measurement of values without allowing for learning about the good being valued may be in error. Nonetheless, the critics may accept NED valuation of watershed services with which people are more familiar, such as transportation. When there is reason to expect a dearth of information for making judgments of value, such as for life support services, the best way to proceed is not with measurement, but with a process of open dialogue where new preferences might emerge. This view can be consistent with the ethical and institutionalist critics, but also can be reconciled with the neo-Austrian argument that we need to have people learn and express their preferences in a market-like decision making setting.

The **sustainability** critique is to some degree derivative of the ethical and information critiques, but is more fundamental because it finds that market like organization cannot, by its structure, adequately

represent the "value" of natural systems to the long- term welfare of the earth and its inhabitants. Human preferences cannot be the touchstone of value. Instead, there must be some way to recognize that the dependence of all economic activity on the physical world. However, how are money values to be established?

One approach, largely rejected by the economics profession several decades ago, seeks to find the source of value in one particular factor input such as labor or land. This "input" theory of value has recently been proposed again, where observed market prices are linked to "embodied energy" of inputs. Stated in its most simple terms, a fixed relationship between energy embodied in a product and its market price is asserted. Therefore, determining the energy embodied in any product permits the analyst to convert such energy measurement to money valuation by using a conversion factor that relates money prices to energy. This conversion has been used to value environmental services. The authors argue for this approach to valuation, an approach they call "the life-support method," because it avoids the need to identify and value the individual services that may arise from a watershed and for them denies the relation of value to human preferences.

The arguments by economists against the energy valuation approach focus on the role of price in a market economy. The life-support method simultaneously implies that the ultimate objective of people in the society is to maximize net energy and that the economic system will seek this energy goal through a mechanism that ties market prices for goods to the energy necessary for their production. If maximum net energy is the goal of economic agents, then the prices of all goods would be determined by their energy content, but maximum net energy is not the goal so prices must reflect considerations other than the energy content of the goods they represent. Therefore, insofar as relative prices of products (which are the basis for calculation of gross domestic product (GDP)) do not reflect energy alone, the imputing of all GDP to caloric use following the life-support method is fallacious. However, while the calculation may be flawed, the essential point that is made by the sustainability criticism may be valid. The NED model which ascribes values in terms of human preferences, rather than the contribution of ecosystem services, may provide value estimates for natural services which do not reflect their importance for long-term survival.

Technical Critiques of NED Valuation of EQ Services: Figure III-1 relates the features and processes of a watershed to services and then to value, in this case to NED value. That figure also shows that the creation of the services is by the application of human management to the features and processes of the watershed. It is the merits of these management actions which will be judged by the public decision making process. To judge these management actions requires an ability to trace back from the value of the services to the contribution to these values of the management action. The **absence of a well defined "production function"** relating EQ features and processes to EQ services that might yield human values is an obstacle to NED measurement. While this problem of an uncertain production function is not unique to EQ services, it is an especially difficult problem for those services. To illustrate, the response of crop yields to irrigation water is uncertain, but can be approximated because we are able to do controlled experiments and/or use historical farm production data. On the other hand, we have only the most rudimentary knowledge of how the size, location, and biological structure of a wetland affect water quality in a nearby stream, and in turn how water quality parameters affect stream bio-diversity and population levels of target species. Indeed, our inability to describe the relationship between the conditions in a watershed and the services it provides, in precise terms, means it is unreasonable to expect restoration decisions to turn on the NED estimates of EQ value.

The **difficulty of verification** of NED value estimates for environmental services is a second technical problem. In most cases, the

services being valued have no close market counterpart, so there is no basis for establishing the reasonableness of the estimated results as measures of willingness-to-pay. Those tests which are made compare one shadow value estimate with another, and in these cases variability of estimated values is common.

Recent research examining the verifiability of results achieved from the contingent valuation method (CVM) (the simulated market approach authorized by the P&G) as it was used to estimate the economic costs of the Exxon Valdez oil spill suggests that the CVM tool is far from perfected. The general conclusion is that the method is easily misapplied and often the CVM survey respondents are unable to understand the simulated market. For example, in the Exxon Valdez studies people often made "bids" in the simulated markets which were more closely associated with "moral outrage" and the desire to punish Exxon, than with their assessment of the economic losses from the diminished life support services of the spill.

Legality of Use: Some environmental laws and Corps authorities may prohibit the use of the NED calculus. This would appear to be the case for the regulatory program, and is unambiguously the case for endangered species recovery plans. This later situation confronts the Corps in its planning efforts on the Columbia River. As a result, there are many environmental decisions that can not be made using estimates provided by an NED analysis.

Political Utility: At times, there is a lack of political credibility accorded to an NED evaluation of project plans. To be sure, this limited credibility extends to NED valuation of traditional project outputs, as the various cases of local interests seeking exceptions to the NED plan shows. With some skepticism of money measures of outputs such as navigation and flood control, there is every reason to expect even more skepticism about NED valuation of environmental services. One problem is that NED value is not always about what most people consider to be economic effects: jobs, tax revenues, and national and regional economic activity. As noted, people can't always spend the economic values derived from the NED method. Because NED is an abstract concept, its measurement and advocacy often has limited political importance. While an NED estimate may have some decision value, stopping an analysis with an NED measurement will not provide adequate support to the choice making process.

> There is a limited place for NED measurement of EQ services.... However, this is not meant to diminish the need to advance NED analysis for the traditional outputs of Corps water projects.

Summary: NED Measurement of EQ Services is Fraught with Problems: There is a limited place for NED measurement of EQ services. That place is described later in this section. However, this is not meant to diminish the need to advance NED analysis for the traditional outputs of Corps water projects. In Table III-1 four classes of watershed services were listed: a production input for market valued goods and services, the provision of direct services to users, waste assimilation and life support. Moving down this list, the services become more closely associated with environmental values. NED valuation of the first service would be for transportation, power, flood control, drainage, commercial and industrial water and irrigation. These traditional outputs are closely tied to market processes by their evaluation, and, in these cases, the application of NED measurement would command acceptance on conceptual, technical, legal and political grounds. Recreation and aesthetics and municipal and home water supply are less closely tied to market exchanges, making NED valuation less acceptable. However, there is some precedent for using NED valuation of these services in Corps decision making. The NED valuation of the following services will command limited acceptance on conceptual,

technical, legal and political grounds: a processor or sink for human waste, a trap for eroded soil, bio-diversity, nutrient cycling, carbon cycling, aerobic and anaerobic processes and habitat for endangered species.

As the watershed service is more closely tied to EQ and less to material welfare, the NED valuation effort will have less utility and acceptance for decision making. Limitations on the credible NED valuation of EQ services have been recognized within the Corps. For example, current Corps policy will not permit the extent of justifiable mitigation at a project to be determined by an NED analysis of EQ values gained and lost. In this decision making setting, efforts to improve NED analysis as a decision making aid should be focused on the traditional outputs. This point will be further defended in later sections.

Toward a New Conception of the P&G: Impact Tradeoffs Made Through Negotiation

Since the early 1970's, other agencies and interests have come to share in making decisions which used to be reserved solely for the Corps, limiting the ability of the Corps to make decisions using its own internal, and presumably expert, decision criteria. Today, more than ever, for all public agencies, groups directly affected by resource use decisions, or having an interest in such decisions, increasingly engage in bargaining and negotiation as a means of making choices on the use of water resources. Therefore, instead of trying to measure preferences of individuals by interpreting market negotiations, a new emphasis has been placed on initiating and structuring interest group negotiation as the way to establish tradeoffs groups are willing and able to make in matters such as restoration of habitats for endangered species. Value is established as a consequence of group negotiations in political forums, instead of by individual negotiations in market exchanges.

The reality of this new, negotiation-based decision process was driven home to the Corps in the Pacific Northwest in the late 1980's. The Corps completed an NED analysis of spilling of water and construction of some juvenile salmon by-pass facilities and found that neither was warranted. However, the region and the Congress were not persuaded by the traditional NED analysis, and increased spill has occurred and by-pass construction is underway.

In the early 1990's, the ASA(CW) and HQUSACE directed a new analytical and policy posture for the Corps Pacific Northwest office. This new posture was directed with a recognition of the new reality of planning in the region and the lessons of the spill and by-pass analysis. Today, the Corps is executing an open analytical process of the full range of alternatives for operating and modifying the system of dams on the rivers of the region. The Corps is viewing its analysis as an unbiased source of intelligence to aid negotiation among regional interests, more than as a contribution to its own internal decision making protocols under the P&G. Within limits of its authority, the Corps has committed itself to full cooperation with the decisions made in the region on the operation of its dams.

The realities illustrated by the Pacific Northwest salmon studies mean that the Corps water resources planning studies must be designed to contribute to agreements by multiple agencies and interests on the allocation of watersheds to different mixes of services. By treating planning as a aid to negotiation, particular and important analytical responsibilities for the Corps emerge. Analysis should be in the service of the parties to a negotiation. There will be a need for continuing to develop biological, chemical, physical, economic and engineering analysis of water resources, but now the findings of those efforts need to be made accessible to all parties to a negotiation. The types of information that will build agreement will vary with the situation, but in general, analysis is intended to help the various participants in the decision process form and reveal their preferences so that a basis for negotiation, and then agreement, can be established.

> Analysis should be in the service of the parties to a negotiation. There will be a need for continuing to develop biological, chemical, physical, economic and engineering analysis of water resources, but now the findings of those efforts need to be made accessible to all parties to a negotiation.

As the attention to restoration increases, the decision making challenge is for interests to consider tradeoffs not only between restoration alternatives and the current state of the aquatic system, but also between alternative restorations. No computational procedure by itself will establish how far restoration should proceed or establish the relative priority for funding of alternative restoration efforts. This is a negotiation challenge.

What is not needed in a negotiation process is for analysts to tell participants the values to them of the watershed services over which they are bargaining. This is why economic valuation of environmental services and their comparison through benefit cost analysis is often rejected as a basis for decision making. Economic valuation of environmental services of a water resource through hypothetical markets is a substitute for, not a complement to, the bargaining process and appears to be a throw back to the now suspect expert planner model. It would be as if analysts argued that the outcomes of a market process would be improved if people acted on the values that were calculated for them in a shadow value exercise, rather than acting upon the price ratios that emerge from the market's operation.

The most useful analysis for supporting the negotiation process will be an evaluation of "net incremental opportunity costs" of restoration. An opportunity cost analysis can be used to address the central question posed by the new emphasis on environmental restoration, "How much environmental restoration is enough?", where the answer to that question will emerge from a negotiation process which it builds upon foregone NED as the cost information. Continually focusing the restoration question on whether an increment of restoration is "worth" its cost, is the most practical way to answer the question "how much is a restoration worth?" In reference to Figure IV-1, the question posed is which movements away from point A toward point F are warranted.

Net incremental costs to be considered would include: (1) direct (life cycle) financial outlays by government and individuals; (2) the benefits derived from the existing services of the watershed which would be foregone with restoration; and, (3) the measured NED benefits gained from the restoration. These NED benefits gained might include money measures of environmental services. However, such measures should, as will be discussed, be reserved as a "side calculation." Also, these benefits and costs will be perceived from the different accounting stances of individuals, groups, regions or the Nation. In that sense, the two dimensional representation of Figure IV-1 is a highly simplified analysis. In the language of the P&G, opportunity costs are computed within the NED, RED and OSE accounts. The adoption of the opportunity cost decision making model would be an open acknowledgement of group bargaining as an accepted tool to make tradeoffs among watershed services over time. It is these bargaining processes, informed by opportunity cost analysis, which will establish whether a restoration might be warranted.

At present, the opportunity cost approach is the way the Corps determines the extent of justifiable mitigation for environmental damages done by a water development project. The Corps mitigation analysis policy prohibits the use of solely economic measures of environmental values. Instead, the required analysis is expected to describe different mitigation levels and alternatives to achieve each level. The

most cost effective of the alternatives for each level is defined and then the justifiable level of mitigation is chosen through a negotiation process with affected interests and other Federal agencies in consideration of the incremental costs of different mitigation levels.

Such an approach is not unique to the Corps. All agencies now engaged in the Columbia River Salmon restoration program have adopted a "opportunity cost versus restoration effect" framework for decision making. This approach to describing the consequences of alternatives has been developed in response to the realization that no rigid computational procedure, which describes a "best" restoration alternative, is going to be accepted by all affected interests. As another example, The United States General Accounting Office (GAO) in a 1991 report, "Hydroelectric Dams: Costs and Alternatives for Restoring Fisheries in the Elwha River", reviewed the tradeoffs between foregone hydroelectric power and fish restoration potential from removal or alternative management of two dams on a river in Washington state. Two comments of the GAO are of particular note because they support the opportunity cost decision framework.

First, in commenting on the value of the restoration, GAO observed that the Federal agency in charge, the Federal Energy Regulatory Commission (FERC), did not place dollar values on some of the restoration effects.

> Because of the absence of generally accepted methodologies, FERC staff did not attempt to assign dollar estimates to non-developmental values such as fish production, recreation use, terrestrial resources, or aesthetics.

Therefore, a cost/benefit analysis was not done by FERC.

The FERC analysis did include an estimate of the cost of dam modification and abandonment, as well as the power benefits foregone (measured as the cost of replacing lost power currently generated at the dams). The GAO then made an observation about these opportunity costs which lends further support to the opportunity cost based decision making model.

> Given that the costs and benefits of various alternatives could not be fully quantified, we believe that the selection of one alternative over another is essentially a public policy decision in which value judgments must be made about the costs, benefits, and any tradeoffs.

Needed Reforms to Advance a New Decision Making Model

Net opportunity cost analysis can be applied within the P&G structure; however, there will need to be several steps taken to make the P&G serve this decision making approach. These steps include: 1) a policy statement clarifying the interpretations of the P&G framework for environmental restoration; 2) further elaboration on the environmental restoration as a project output; 3) guidance for the improved evaluation of opportunity costs within the NED, RED and OSE accounts; and, 4) a new approach to plan formulation which is sensitive to issues of risk and uncertainty.

Issue a Policy Statement to Clarify the Application of the P&G to Environmental Restoration: The original P&S directed project planners to formulate one alternative to maximize NED and one to maximize EQ. The presumption was that a plan which increased EQ, even at the expense of NED, might be chosen. At the time the P&S was published, there was limited authority in the Corps to implement EQ alternatives, although a few EQ plans were developed for some watersheds. Among the barriers to implementing EQ plans was the Corps reluctance, as an engineering agency, to design and choose the type of plan necessary for EQ - non structural. And, during the 1980's there was little commitment in the Reagan Administration to choose and budget for EQ plans.

... the ASA(CW) and the Director of Civil Works should cooperatively prepare and disseminate to field offices, a detailed explanation of the expectations for evaluation of environmental restoration projects under the P&G.

In this setting, the conclusion that the P&G emphasized the NED plan and discouraged EQ-NED tradeoffs seemed warranted. But, the P&G does permit plan formulation to identify EQ-NED tradeoffs, although this opportunity to consider tradeoffs is not as explicit as in the P&S. Today, as was noted in Sections II and III, there is a new emphasis on environmental activities in general policy guidance. Therefore, the ASA(CW) and the Director of Civil Works should cooperatively prepare and disseminate to field offices, a detailed explanation of the expectations for evaluation of environmental restoration projects under the P&G. The content of memoranda and accompanying guidance could be based on the material in this report, as expanded after further review. The central themes should be:

- the P&G tradeoff framework is adaptable to, and has utility for, planning environmental restoration
- the Federal objective for plan selection will not be the NED plan when restoration is a project output
- the recommended restoration project may be justified through a negotiation process focusing on incremental opportunity costs
- the listing of the Federal interest criteria in restoration of watersheds which will be used to set budget priorities

Issue Planning Guidance on Formulating and Evaluating Environmental Plans: The economic theory and measurement techniques for NED valuation of many traditional Corps project outputs are well developed, and the resulting estimates are acceptable to decision makers. This allows these effects to be aggregated into a single dollar measure of net benefits. This has not been the case for measurement of environmental services in the NED account. The recognition of this situation was partly responsible for the development of the EQ account in the P&S and, as modified, for the P&G. The expectation is that environmental impacts which are not assigned monetary values will be displayed in non-monetary terms.

The P&G includes suggestions on the types of EQ effects to be measured. Using the perspective of Section III of this report to interpret the P&G suggests that EQ effects be measured as changes in watershed features or processes. However, in the P&G there is no suggestion on how to choose the "correct" measure for any situation, because the EQ account was constructed without any reference to an EQ value framework. Instead, the P&G (3.4.4(d) requires the planner to establish, for the EQ indicators they choose, a guideline. Later (Section 3.4.14), the planner is instructed to apply the guideline to establish adverse and beneficial effects. The P&G states, "Guidelines should be based on institutional, public or technical recognition." Institutional recognition means legal standards for a parameter (e.g. water quality); public recognition would be a locally valued landscape; and technical recognition might be a dissolved oxygen which is necessary for brown trout survival. The P&G requirement for free-standing guidelines illustrates that whole watershed restoration, as the concept was described in Section III, was not envisioned when the EQ account was drafted. As a result, there is no general evaluation standard analogous to WTP to judge the direction of change in the EQ account or the magnitude of change. Unlike the NED account, the absence of a general evaluation

standard occurs because there is no theory of value underlying the EQ account. Therefore, what constitutes the appropriate set of EQ indicators in any situation is established by the planner.

The absence of a general evaluation standard has led to several EQ evaluation techniques being proposed, but most of the techniques have an application limited to habitat and/or limited to species. This is not surprising given the influence of the fish and wildlife agencies in the development of the EQ valuation tools and the orientation of those agencies to the production of certain species of fish, animals and waterfowl, usually having some recreational value. One technique explicitly mentioned in the P&G is the Habitat Evaluation Procedure (HEP). HEP relies on describing features and processes in a watershed, but only as they are necessary for the support of a particular indicator species. HEP scores called HSIs, or habitat suitability indices, may be computed for different species, but there is no acceptable way to unambiguously aggregate different scores into a single index. Furthermore, the HEP scores are built on the judgment of the evaluators and are often not firmly rooted in a research base. Other procedures, derivative of and similar to HEP, have been developed recently as well.

None of the "habitat only" techniques is adequate for representing the potential for success of a restoration plan in a watershed context. The techniques are intended to establish the suitability of the environment at a point in time for certain species. They are not intended to be indicators of the persistence and resilience of a watershed ecosystem. The restoration framework of Section III stressed the goals of resilience and persistence of a watershed ecosystem, specifically emphasizing the evolutionary possibility of the system. Particular indicators of persistence and resilience likely would be included within the P&G's EQ account. However, as discussed in Section III, only after establishing a reference condition for defining environmental restoration for a specific watershed, can the necessary indicators be chosen. These indicators will not be the same in all situations.

In the near term, defining the indicators of environmental restoration and the measurements for those indicators will not be quantitatively precise procedure.... Still the Corps can take leadership in developing new tools which reach beyond the species habitat focus of tools such as HEP.

In the near term, defining the indicators of environmental restoration and the measurements for those indicators will not be a quantitatively precise procedure. The science base for restoration ecology is still being developed. And, the very meaning of restoration itself is in flux. In this situation, tools such as HEP may need to be admitted for the short term. Corps guidance for environmental restoration should document how to best use such tools in the incremental opportunity cost framework. This means stressing that restoration can be multipurpose and may require many indicators, that the watershed context determines restoration success no matter how small the project area, and that it may not be possible to aggregate the indicators into a single state variable. There will be no analytical "cookbooks" for measuring broader goals of environmental restoration. Still, the Corps can take leadership in developing new tools which reach beyond the species habitat focus of tools such as HEP.

Particular features and processes of watersheds should be chosen as indicators of restoration potential (i.e., resilience and persistence) and planning guidance should make clear that deviations from HEP are desirable and encouraged. The guidance should include the conclusion cited earlier from the recent National Research Council

report, that "... selecting an appropriate subset of indicators from the universe of possible indicators is a skill and an art - in essence, a separate decision problem that is of great importance to the feasibility, cost, and validity of the evaluation." In so doing, the field planner will be encouraged to think broadly about restoration.

Issue Planning Guidance to Improve the Evaluation and Representation of Opportunity Costs: Since restoration may be financially expensive and mean giving up some current project outputs, it is essential that the Corps does credible opportunity cost analysis. Only in this way can there be the necessary information base for deciding whether any restoration action is worth its cost. There are several ways to improve opportunity cost analysis that should be emphasized in the promulgation of field guidance for environmental evaluation.

First, the opportunity costs which should be considered in a negotiation process will be established, in part, by who is represented in the negotiation and by who might have power to block a decision even if they are not a party to the bargaining. This means that "stake holders" (groups interested and able to advance or veto a decision) must be identified and then the costs imposed on those stake holders from each alternative should be clearly identified. This cost analysis is the starting point for reaching agreements and for seeking out compensation mechanisms for those who might stand to lose from a restoration decision. (The premise is not that all losses can be or will be compensated. More discussion on forms of conflict follows in Section VII.)

There are several ways to improve opportunity cost analysis that should be emphasized in the promulgation of field guidance for environmental evaluation.

Using the language of the P&G, there will need to be a new priority given to evaluation within the RED and OSE accounts if multiple interests and accounting stances are to be adequately considered. To do otherwise is to presume that the only decision makers who can influence an outcome are those who care only about NED and EQ. The negotiation orientation to decision making and evaluation admits that there are a variety of interests with a variety of impacts of concern. As a result, the trade off displays can become quite complex with the environmental state variable being represented by several indicators which may be internally in conflict.

Second, the traditional tools of economic assessment can overestimate opportunity costs in the private economy. Opportunity cost are impacts on economic entrepreneurs, but these economic agents are constantly in the process of adjusting to unexpected shocks within the economic system. The reality is that this economic environment leads to a creativity in adjusting to all types of changes, changes which are far more creative than the one water project planners imagine in their impact models.

Examples of this argument are many. Commercial fishermen will switch species, use lower cost harvest methods and find new sources of employment if fish harvest quotas are enforced. If navigation capacity is reduced, shippers will find alternative modes and alternative origins and destinations; the shippers may produce other goods which are more suited to alternative modes and markets; processors of goods which are shipped may move closer to raw material supplies to minimize transportation costs. If power generating capacity is curtailed as a result of a restoration project, there will be changes made within the power generation firms, in power marketing and on the demand side, which will minimize (not eliminate) the cost of replacement power. The effects on the agricultural industry from wetlands restoration will be meager if the foregone outputs due to restoration are crop surpluses, or if rising crop prices and production costs due to restoration induce

technical change to realize more yield per acre.

The ability to conceptually describe the dynamic adjustment which can occur does not make computation of opportunity costs in the private economy any simpler. But, the recognition that adjustments will be made (in P&G planning jargon the "with-project" condition will cause adjustments to be made) must be better recognized than is often the case at present.

Third, the NED evaluation might include NED valuation of EQ services. The opportunity cost approach established net values given up to achieve restoration. The negotiation is then over whether that opportunity cost is justified. For example, a wetlands restoration may be as costly (financial outlays alone) as $20,000 per acre. As another example, expenditures for fish passage at Corps dams that increase the survival of a small number of anadromous, hatchery reared fish have been as substantial as several hundred dollars per fish, even without considering the foregone benefits from changed project operation. While acknowledging the problems of the willingness-to-pay concept of value for EQ services, and of the techniques for its measurement, the economic value estimates for services of environmental restoration may aid discussions about the merits of such expenditures. Economic value estimates of EQ services can be made as a "side calculation" and be presented as one point of reference in any negotiation where large expenditures for restoration are contemplated.

Issue Guidance on Plan Formulation: There are three aspects of plan formulation which must be addressed in field guidance if a full range of restoration alternatives is to be developed and considered. The first relates to the effect of agency authority on the scope and alternatives defined for analysis. The second and third relate to different aspects of risk and uncertainty in plan development. Formulating plans in consideration of risk and uncertainty will also have consequences for evaluation.

The P&G allows the Corps to formulate and evaluate plans which may fall outside the authority of the agency to implement. This has not been practiced as widely as it should be in planning within the Corps, but may need to be done more often for restoration. For example, freeing up water rights markets and power marketing arrangements may do more to synchronize the flows of water and the passage of anadromous fish in the Columbia-Snake Basin than the reconfiguration and operational changes now being considered for that system of dams. Non-passage alternatives, including habitat restoration and control over the harvest of adult salmon, might prove far more cost effective in increasing the salmon life-support services of the Columbia-Snake system. Yet, these actions receive little attention in Corps plan formulation because they fall outside the agency's implementation authority. To assure that all necessary alternatives are identified may require new inter- and intra-governmental arrangements (Section VII). One recent restoration effort illustrates this leadership and authority problem. The Truckee-Carson, Nevada, Stillwater Wildlife Area restoration was achieved because a plan was formulated (not a Corps project) which included the purchase of water rights from farmers for enhanced flows into the wetlands, among other actions. However, to bring all the agencies with authority to act on different parts of the plan together required Congressional leadership.

A related aspect of plan formulation, often considered to be a constraint on Corps plan formulation, is the linkage requirement of current Corps policy. That requirement says that the Corps may not consider planning for environmental restoration unless the watershed alteration is directly attributable to a Corps project or unless modification to a Corps project is the most cost effective means to achieve the desired restoration. The task of proving that the second linkage test is met is not likely to be taken up unless the linkage rules are clarified. The attention to watersheds and not just a project site means that the second test of the linkage requirement is especially important and may be easily demonstrated in many instances. The most

straightforward case is where a Corps project can be shown to be a part of a larger watershed plan and the hydrologic modifications for which the Corps has the expertise, will increase the probability of a successful restoration. Thus, a Corps project plan which is embedded in a larger watershed plan might be presumed to meet the linkage test.

A second aspect of restoration plan formulation is the relationship of plan formulation to engineering design standards. No matter how planning problems or opportunities were identified in the past, and no matter what social objectives were described for project evaluation, an important test of any project alterative was a judgment on risk of project "failure," usually from hydrologic extremes. This came to mean, for example, that non-structural flood control efforts which did not address the 100 year flood might be rejected on that basis. It also meant that structural projects were designed against the most extreme and low probability events - (whether for flood control, navigation channel depths and widths, power reliability or water supply (design drought), design and performance standards stressed fail-safe projects). Indeed, the objective of water development was to reduce hydrologic variability as much as could be justified.

If we return to flood control channels to illustrate this point, we will see the commitment to minimum protection levels for flood control - often for storms of record - encouraged large volume channels that only are used in extremely low probability events (say the 1/500 year storm). This design had a large economic cost for little expected benefit, but also had extreme effects on the aquatic system because of the reductions in variability required in the hydrologic regime and in their riparian areas along a channel's edge. At times, Federal cost sharing for capital, but not for operation and maintenance, encouraged increased size of a project which was paid for by Federal funds. For example, by increasing the depth and flow velocity of the channel initially (at Federal expense), the channel scours itself and future O&M is reduced. A less altered channel might have lower initial Federal costs and higher non-Federal maintenance costs.

> If restoration was undertaken to down size the projects or to use alternative engineering approaches (for example, soft meandering channels versus rip rapped straight channels), the foregone benefits may tend to be at the low probability hydrologic extremes of low flows and flood flows.

Once project performance and design criteria, imposed by engineering judgment (often in response to cost sharing rules), were selected, a search for benefits to justify the favored plan would be undertaken. A successful search was one which resulted in reported positive net benefits. A credible net benefits calculation was necessary for a project to become eligible for funding, providing an externally defendable rationale for proceeding with "good" projects, and for the resistance of political support for "bad" engineering projects. The reality of project justification was that the analysis of projects in accord with planning objectives was done in response to a "ritual" dictated by internal needs of the Corps. For the field units, justification analysis was done to promote those projects which they felt were in accord with good engineering practice and met the local political support. In the agency hierarchy and in the administration, justification was severely constrained in order to maintain budget control. As long as Corps projects were Corps decisions (little cost sharing and little concern for natural watershed services), the internal logic of the justification strategy was acceptable. This is no longer the case.

The traditional Corps engineering approach to watersheds can raise both costs and

environmental disruption, as risk avoidance attitudes in the agency have directed project design to "handle" the most extreme and low probability events. As a result, projects have been developed at scales that were quite costly and that meant substantial environmental disruption. This possibility needs to be more openly considered in restoration plan formulation. Toward this end, the opportunity cost analysis should include a risk assessment of alternative engineering designs. Creativity in defining restoration plan alternatives should not be construed by the hard and fast application of engineering standards. If restoration was undertaken to down size the projects or to use alternative engineering approaches (for example, soft meandering channels versus rip rapped straight channels), the foregone benefits may tend to be at the low probability hydrologic extremes of low flows and flood flows. Risk assessment is warranted.

Another aspect of risk is that there remains a fundamental scientific uncertainty about the theory and tools of environmental restoration. Further, the success of a particular restoration may not be assured without experimenting on the restoration site itself in order to better understand the relationships among features and processes and in order to secure the data needed to build the necessary models of the system. Recognition of this uncertainty about restoration may have an effect on the way plans are formulated and on criteria used for the evaluation of alternative plans.

Also, the decision making approach itself may need to be accommodated to the reality of uncertainty. This accommodation has been termed "adaptive management." Adaptive management recognizes the limitations of current knowledge and data as a guide to decision making. Adaptive management makes knowledge creation an objective for restoration (Lee and Paulsen). Adaptive management is especially important for restoration where random evolutionary processes will determine the time path of restored ecosystems and where our knowledge base in restoration ecology is meager. In the P&G context, the adaptive management perspective makes the creation of knowledge about the watershed a co-equal objective with NED. Indeed, in the face of pervasive uncertainty, the adaptive management approach may emphasize formulating a plan with the objective of creating new information over formulating a plan to achieve a restoration, when the success of the particular restoration strategy is uncertain.

Adaptive management is akin to the research process, where the purpose of the activity is to learn about relationships among variables which are currently not known. But more than this simple notion of research is applicable, because the very questions being asked will change based on shifts in social priorities and the knowledge gained in the past. Indeed, a more complete description of the research endeavor, as a social enterprise, incorporates these ideas (Chalmers).

Gaining information through adaptive management means that there will be a restoration planning process that has a long time horizon and in that time actions will be taken, monitoring will occur and, based on that feedback and the new insights gained, adjustments to the restoration plan will be made. Adaptive planning and management is a learn-by-doing approach to decision making and plan formulation and evaluation is affected by this reality.

Plans will be formulated which are directed toward the generation of new knowledge. However, because of the uncertainty about the watershed system, a second dimension is introduced -- adaptive management places a premium on avoiding irreversible decisions. Yet, there is an evaluation of alternative plans which is suggested by this perspective. Adaptive management means more than spend and hope for some desired outcome. Funds are not unlimited (or at least should not be perceived to be so), therefore there must be some rules for decision making which apply when managing watershed systems under uncertainty. Lee and Paulsen, in describing an adaptive management approach for the Columbia River salmon restoration, suggest five concrete steps to choosing alternatives

to implement. What is striking is that the criteria of choice are more oriented toward learning than toward achieving a particular restoration goal in the near term. What is also of note is that there is a need for a continuous review and revision of the steps as a restoration program advances through time. This is argued by Lee and Paulsen as follows:

> ...Five concrete steps can be taken to define desirable adaptive strategies. First, identify fundamental hypotheses that provide the conceptual underpinnings for the [restoration] program. From these, certain "critical" hypotheses can be identified based on the uncertainty associated with the hypothesis and the biological and economic costs that would result if each hypothesis is untrue. Second, identify management actions (and their costs) that can provide sufficient information to resolve the uncertainty. Third, identify the means (and costs) of monitoring the effects of the management actions and assessing the validity of the hypotheses in question. Fourth, use the information described in steps 1-3 to identify alternative adaptive strategies that combine mitigation and enhancement actions with monitoring. Finally, choose an alternative that maximizes increases in understanding at minimum economic and biological cost. The concept of the value of information combined with cost effectiveness analysis can help here.

Indeed, in the face of pervasive uncertainty, the adaptive management approach may emphasize formulating a plan with the objective of creating new information over formulating a plan to achieve a restoration, when the success of the particular restoration strategy is uncertain.

Adaptive management means that decision making must proceed as sequential adjustments in response to new insights about social and economic priorities, given by the interplay of interest groups in the decision making process, and by a new appreciation of scientific understanding of watershed systems. Numerous authors on policy making have long advocated this concept of decision making as the best description of both the possible and the desirable. This will be noted again in Section VII.

Establish Budgeting Criteria

To this point, the recommended planning and evaluation reforms have been for the level of individual project planning. However, there are numerous possible projects which will compete for limited budget funds. These projects will come from different areas of the Nation, have different characteristics and different costs. The central budget authorities must have criteria that will be used to select the optimal portfolio of projects for any given budget year. These criteria must in turn be measured (represented) at the individual project planning process and included in the project reports.

The challenge of selecting from among competing projects for budgeting is not a new one for the Corps. All of the standard criteria which have applied in the past should also apply to restoration projects. For example, the participation of a non-Federal sponsor will continue to be a part of the requirements for budget priority. However, there is one significant difference between restoration projects and traditional projects and one new element that needs attention.

The restoration project will not have a net benefits calculation. Therefore, the possibility of using net benefits as one ranking criterion is not available. Of course, even though projects were not ranked by net benefits in the past, the NED analysis did contain some useful information that would help in budget decision making. However, of most importance, the failure of a project to demonstrate a credible estimate of positive net benefits would

eliminate it from further consideration in budgeting. This was why, in the past, such attention was paid to the credibility of the NED estimate--the NED screen was especially useful as a way to say no to enough projects so that the budget would be adequate to meet many of the requests for funding.

One new aspect of restoration projects is the need to embed such projects in a larger (and often multi-agency) watershed management program to assure the success of the Corps project and to leverage that project's contribution to environmental restoration. Therefore, a criterion for budgetary priority would be a demonstration that the project is a part of a larger effort at restoration.

A second aspect of restoration projects is the uncertainty of their success. Therefore, a credible and funded adaptive management plan might be another criterion for budget priority. In this way, projects which have high priority on other grounds, but which have uncertain outcomes, can more effectively compete in the budget process.

Conclusions

Defining and choosing Corps restoration projects through better analysis might have been the desire several decades ago. Reforms would have included improving the analytical approaches of the P&G. But there is another premise implied in this option, even if not directly acknowledged. That type of effort implies that the Corps will be the lead agency, so that its internal analysis (now much improved) can be used to define the best restoration choices. Another direction is needed. To be a leader in environmental restoration there must be a corporate willingness to recognize that the Corps needs to adopt a new perspective on analysis and to stress negotiation as the vehicle for decision making. New field guidance which describes this planning reality, as well as reinforcement of this guidance by budgetary decisions on submitted projects, is needed.

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V. MATCHING THE REGULATORY PROGRAM TO THE NEW EMPHASIS ON ENVIRONMENTAL ACTIVITIES

A watershed restoration focus can be used to better integrate the regulatory program with project planning and with the operation and maintenance of existing projects. In turn, by linking the regulatory program decisions to whole watershed management, permit decisions can better serve watershed restoration. The central challenge for the 404 program will be to adopt a new regulatory program philosophy which shifts the program from protecting particular wetlands sites to proactive wetlands and watershed restoration. Leadership for this shift may have to come from the Corps, perhaps at the behest of the states. The EPA, the Corps' partner in administration of the 404 program, retains a strong existing resource protection position consistent with its historical mandate. This perspective is reinforced by the other resource agencies -- Fish and Wildlife Service and the National Marine Fisheries Service -- which have responsibilities in the 404 program. However, there are some signs of change in the resource agencies views and new state approaches to wetlands regulation may encourage change in the current Federal system. Indeed, whatever the decisions being made at the Federal level, it will be necessary for the Section 404 program to become more closely aligned with the rapidly evolving wetlands management programs of the individual states, especially where nationwide permits on non-Federal jurisdiction wetlands have motivated state actions to manage these unprotected areas. Indeed, in the longer term, the wetlands permitting philosophy and program described in this section would need to be developed in cooperation with a lead non-Federal agency.

The central challenge for the 404 program will be to adopt a new regulatory program philosophy which shifts the program from protecting particular wetlands sites to proactive wetlands and watershed restoration.

Valuation and Decision Making Protocols: The Current Situation

The Federal executive and legislative branch statements of support for the goals of "no net loss" and "net gain" of wetlands acreage and function, follow two-decades when no net loss became an implied, but not stated, objective of wetlands management. Consider the Corps public interest review process (PIRP). The PIRP is, to a degree, rooted in the strong planning and evaluation tradition of the Corps. Early in the 404 program's implementation, the Corps would use PIRP to make a judgment on the extent of development value that might be realized by the wetlands permit applicant, and, if that was deemed to be "large," the permit was granted as long as the applicant agreed to restore or create wetlands elsewhere. This replacement requirement only applied for significant acreage. In effect this created a "one for one" replacement requirement as a condition for a permit and the implicit no-net- loss goal was achieved. The applicant was expected to make the compensation of a wetlands of similar type

(in-kind) and as near to the current wetlands site (on-site) as possible.

However, the Federal agencies responsible for the review of the Corps 404 permit decisions argued that only those activities deemed "water dependent" should be considered eligible for the PIRP review. These agencies argued for strict application of the U.S. Council on Environmental Quality's "sequencing" guidelines which had been developed for implementing the National Environmental Policy Act of 1969. In the 404 permitting program this meant that every effort had to be made to 1) avoid the wetlands, 2) minimize the impact on the wetlands if avoidance was not possible due to the water dependency of the activity, and only then 3) compensate for those effects that were not avoided after impacts were minimized. The avoidance test is applied by the regulatory authority which determines if, in its own judgment, the activity is water dependent. If no water dependency is determined, the permit is expected to be denied.

The strict sequencing test with in-kind and on-site compensation derives from a site protection philosophy, as opposed to a whole watershed restoration perspective.

Over time, successful challenges were made to the to Corps relying on PIRP in permit review. Now there is increased emphasis on the water dependency test and the sequencing process in permit review. At present, the Corps regulatory program rules still include the PIRP evaluation process for permits, although the PIRP review is expected to follow after the water dependency test. However, when applied, the PIRP follows an imprecise process and is expected to consider and balance a long list of biological, chemical, physical and socio-economic criteria in judging the merits of permit application. What did survive through all of the 404 implementation debate was the Corps premise that when compensation was made, it should be in-kind and on-site, if at all possible.

The strict sequencing test with in-kind and on-site compensation derives from a site protection philosophy, as opposed to a whole watershed restoration perspective. Such a site protection approach can be defended. In the early years of the 404 program, advocates of wetlands protection were not certain about either the ability of the regulatory effort to slow wetlands filling or about the scientific basis for restoration and creation success. Prudence seemed to suggest always seeking to stop wetlands filling if at all possible, limiting the PIRP as a decision making framework.

Even if we ignore the current structure of the 404 permit review process, the PIRP has limitations as a decision aid. Still the PIRP has virtually no detailed evaluation guidelines on what the listed impacts are supposed to mean or how they are to be compared. Further, the PIRP does not suggest a unified theory of value in which the many listed effects of a permit might be aggregated or traded off. For the PIRP to overcome these limitations would require adoption of an evaluation protocol like the P&G, which, in turn, would require extensive analysis unique to the circumstances of each permit application. Such analysis is far more time consuming and expensive than is acceptable within the 404 program. Public agencies are not willing or able to spend the funds necessary for the analysis of each permit application. Meanwhile, the private applicant is unwilling to wait for the time that will be necessary to conduct such an analysis. Indeed, there is an expectation that the permit decision process will not normally take more than 90 days.

... an alternative is to rethink the regulatory program within a watershed scale restoration framework, and then seek to administer the program through the development of watershed plans and fee-based or market-based permitting.

Therefore, even if the PIRP concept is used within the permit decision process, it must be a rapid assessment process of matters including wetlands hydrologic and ecologic functions and the economic value of development to the applicant, the region and the nation. This is what motivates recent efforts to develop rapid assessment methods, for example the Wetlands Evaluation Technique. However, an alternative is to rethink the regulatory program within a watershed scale restoration framework, and then seek to administer the program through the development of watershed plans and fee-based or market-based permitting. The design for these alternatives is described in the rest of this section.

Wetlands Regulation: The Setting for Reform

Wetlands protection and management programs have expanded dramatically from only two decades ago when the Federal Water Pollution Control Act Amendments of 1972, including Section 404, were enacted. New interpretations of that law, combined with state and Federal programs then in place and developed since, slowly are redefining the wetlands management challenge from one of simple wetlands protection to integrating wetlands rehabilitation, creation, and protection into watershed restoration.

Looking backward, the Nation has succeeded in sharply reducing the principal source of wetlands loss throughout the nation's history - wetlands drainage and filling for agriculture Some of the reduction in agricultural drainage is related to public policy changes. Some of the reduction has occurred as the economic returns to agricultural conversion have become unfavorable. Meanwhile, Federal programs are addressing both large scale restoration of watershed systems -- the Corps Kissimmee River project -- and more modest scale restorations of wetlands sites -- such as under the Corps program for beneficial uses of dredged material.

Today we are no longer disputing whether most wetlands functions are worthy of protection and even enhancement from the current levels. Rather, the persistent debate is over the programs which regulate land development by filling for urban uses -- commercial, industrial and residential purposes and public infrastructure -- where that land continues to have wetlands characteristics according to some delineation procedures.

Over time new delineation procedures and court interpretations of Corps jurisdiction for the 404 program have expanded the geographic scope of wetlands regulation and sequencing from coastal riparian areas to isolated wetlands and to (possibly) areas where water may seldom reach the surface of the soil. An expanding geographic scope of the 404 program has caught more land in the regulatory net, and highlighted three points of debate about wetlands regulation: inflexibility, economic burden, and environmental loss.

An expanding geographic scope of the 404 program has caught more land in the regulatory net, and highlighted three points of debate about wetlands regulation: inflexibility, economic burden, and environmental loss.

What is meant by inflexibility? In the sequencing review there is little concern

for the costs of the foregone development opportunity to the applicant, the region or the nation. And, no matter how degraded the wetlands, or no matter how isolated they are from a larger watershed, the current regulatory program insists on avoidance for all activities not deemed to be water dependent.

Inflexibility leads to the economic burden argument. The reality is that the sequencing and compensation requirements of current wetlands permitting are implicit taxes on land development. This assertion can be understood by imagining that the whole Nation was delineated as wetlands. Then every development action would be subject to a permit and sequencing would be applied. Since no non-wetlands sites existed, all land development then would bear a compensation cost for the environmental functions lost. This compensation cost is an environmental damage tax on land development. Now relax the extreme assumption about the program's geographic scope.

Those land owners whose parcels fall into the jurisdiction of the program pay an implicit land development tax whenever a permit is granted. Of course, they pay a far greater cost if the permit is denied based upon the water dependency determination or the PIRP review, as the applicant loses some share of the development value of the site. And, in the permit review process itself there are costs to both the public and private sector from delay, legal fees, and general administration. These "process costs" can be quite significant. Process costs always are created whenever an area is a jurisdictional wetlands, along with either the implicit development "tax" or the reduction of development value.

The current inflexibility of sequencing not only may have high economic costs, but also can work to the detriment of environmental improvement.

These costs may be justified, but they are most politically acceptable when the public interest gains from wetlands protection are the most clear. Hence the regulatory program maintains its strongest support when riparian areas and certain "isolated" wetlands with "obvious" wetlands functions are the target of regulation. But, as the geographic scope of the program expands, whatever the scientific merit of delineating areas as wetlands, there is an increase in the land area subject to process costs, the implied development tax and development value reduction, weakening the social consensus for the permit program. What was perceived initially as protection of critical, but limited areas of the environment, appears to have become a national land settlement regulation and taxation policy through the back door of wetlands regulation. Therefore, the support for the 404 program depends on how the program is administered and upon the rules for wetlands delineation and program jurisdiction. As jurisdiction expands, perhaps by changes in wetlands delineation, there must be ways to reduce process and "tax" costs at wetland sites having marginal ecological value. This can only be achieved by introducing more flexibility into the regulatory program.

The current inflexibility of sequencing not only may have high economic costs, but also can work to the detriment of environmental improvement. A permit may be denied, but what has been saved? The result of permit denial may be development to the edge of the jurisdictional wetlands, but the permit process does not consider the fragmentation, isolation and functional degradation of the wetlands which are preserved. Commercial and residential development twisting among regulated wetlands is the product of the regulatory rules which stress wetlands avoidance. And if a permit is granted, but in-kind and on-site compensation is expected, the ecological result may also be questioned. Wetlands in the midst of concrete parking lots are the product of on-site compensation requirements.

Rather than filling, the effect of urban development, whether permitted or not, often has been to diminish the ecological functions of wetlands by polluted runoff, by changes in hydrologic regimes and by landscape changes which isolate the wetlands from the surrounding uplands, waters and biological resources. These functional effects, which occur away from the wetlands site, are both uninventoried and escape regulation under almost all Federal and state programs. As a result, in many areas wetlands exist, but their functions in the watershed are so degraded that their contribution to watershed processes is insignificant.

Wetlands Regulatory Reform: Manage Wetlands with a Watershed Perspective

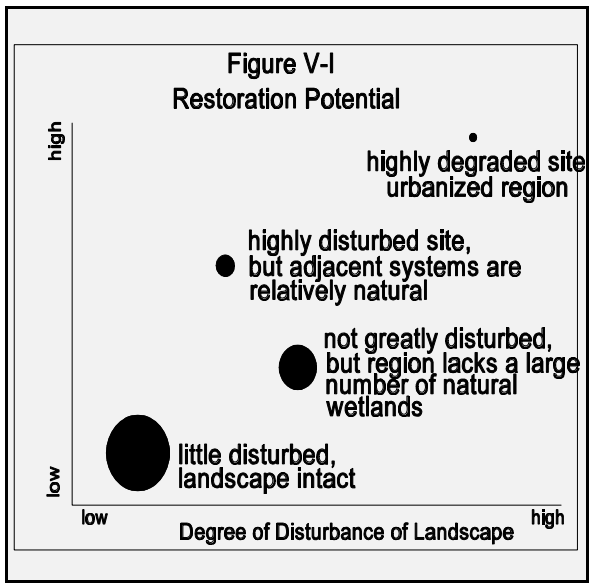
The functional value of an existing wetlands, in a given location, is established by its contribution to a larger aquatic system. Considering this reality, it must be acknowledged that those wetlands locations which remain today are residuals from the development process, as much as they are in ideal configuration for the watershed system. Similarly, the mix of wetlands types which exists in a watershed today may not be the mix that best serves watershed restoration goals. And, of course, those wetlands which remain may be functionally degraded.

Wetlands regulation for the coming decade could begin to incorporate this watershed perspective, and program reforms might be made to serve the end of watershed restoration. The shift would be from protecting the status quo wetlands stock to seeking opportunities to advance environmental improvement at the watershed level through wetlands creation and restoration.

... it must be acknowledged that those wetlands locations which remain today are residuals from the development process, as much as they are in ideal configuration for the watershed system.

Standing in the way of a central focus on restoration and watersheds is a the concern that degraded wetlands can never be restored to their previous condition. And, skepticism about wetlands creation is even more widespread. This concern is based upon past experiences with restoration and creation, which have often not been successful. Unfortunately, the debate over restoration and creation fails to distinguish between failures of the science and failures from poor application of the science. Many failures are attributable to unclear restoration goals, inadequate expertise in doing the restoration, failure to enforce regulatory decisions which require compensation, and an absence of monitoring to make modifications to restoration projects over time. These institutional failures can be addressed with policy and program reform, and should not be confused with the scientific and technical challenges of restoration and creation.

Indeed, the failure to take a watershed perspective may account for restoration and creation failures at particular sites. The likely success of individual restoration and creation projects will, of course, require that particular designs for success be employed -- elevations, soils types and the like. However, the watershed context must also be considered. In Section III, it was argued that the size of the restoration site and the location in relation to undisturbed areas that can provide colonizing species were essential for restoration success. And, obviously, considering the watershed hydrologic regime is an essential aspect of any restoration effort. Figure V-1, adapted from a recent National Research Council



(Adapted from National Research Council)

study, makes this point. The size of the circle indicates potential for successful restoration at a site.

Of course, no matter how well the science is applied, and the science is still developing, it may not be possible to exactly replicate wetlands as they used to be, and it may not be possible to exactly duplicate the functioning of some of the wetlands that now exist. However, the argument about the difficulty of exactly replicating existing wetlands misses the point about the need to focus on watershed restoration. From the environmental restoration perspective, it is not imperative that all restored wetlands be perfect replacements for wetlands that have been lost in the past or which might be lost if a permit is granted.

An important message of a watershed perspective may be that preservation of a particular existing wetlands in time and space may not yield the greatest benefit to a watershed. Instead, it may be desirable to rearrange the landscape, including wetlands, toward the goal of watershed restoration. If this lesson is heeded, it will mean trading some existing wetlands sites in return for the opportunity to restore sites elsewhere.

Of course, some functions are location specific, for example, flood storage which protects a particular land parcel. Specific action to protect location specific functions (such as storm water retention plans) can be required as a permit condition. Care must be taken to assure that in the effort to enhance the ecological contribution of wetlands to watersheds that wetlands functions which are location specific are not ignored. Tradeoffs may be necessary and in making these tradeoffs, as well as when deciding which wetlands should be developed and which restored, the opportunity cost logic from Section IV applies.

Wetlands Regulatory Reform: Increase Regulatory Flexibility Through Watershed Planning

Despite past success in protecting particular wetlands sites, wetlands regulation could achieve broader environmental ends. This would require more regulatory flexibility and certainty for permit applicants, as well as adoption of a quality rating system for wetlands which are within the programs jurisdiction. Together these changes should reduce process costs of the permit program and, by recognizing that not all wetlands are of equal ecological value (the rating system), facilitate the making of the tradeoffs described above. In return for these benefits to permit applicants, the public at large, through the wetlands regulatory program, would have an opportunity to achieve a net gain in wetlands functions in a watershed, going beyond no net loss.

Despite past success in protecting particular wetlands sites, wetlands regulation could achieve broader environmental ends.

To appreciate the relationship between flexibility, costs and the opportunity for net gain, consider an application to fill a wetlands area. For the illustration assume that the foregone development values from permit denial are exceptionally high. Also assume that the environmental benefits of avoidance are questionable, either because the existing wetlands are degraded or because the development which avoids the site will cause a substantial reduction in the function of the wetlands through isolation and fragmentation.

Under current inflexible sequencing rules, neither the high development value foregone, nor environmental losses likely to occur either with or without permit denial, would be considered. In short, the opportunity cost of the decision to deny the permit is not considered. But, if the applicant's development was allowed to proceed as long as a wetlands were reestablished to not only replace, but also to enhance, wetlands functions in the context of a plan to restore the target watershed, the regulatory program will have made a contribution to watershed restoration.

This restoration can be achieved by making wetlands regulation rules more flexible. Flexibility means a willingness to recognize that avoidance of the wetlands does not always result in protecting wetlands functions. Flexibility means a willingness to trade one wetlands site for another in a different area, while requiring the maintenance of site-specific functions. Flexibility means a willingness to allow out-of-kind replacement when a different type of wetlands than the one being permitted will add ecological value to the watershed.

Introducing flexibility in wetlands regulation to serve the larger purpose of watershed restoration is both a planning and a financing challenge. Planning would identify wetlands and uplands complexes within the watershed that will have the potential for long term survival as functioning ecosystems. These are areas where restoration and creation success will be most likely. Criteria for establishing the potential for restoration success have been noted above. At the same time, planning would designate wetlands areas and wetlands types which would be available for development. The planning premise is that some degraded wetlands areas may be of less importance to the watershed than areas which might be restored or created and that avoidance may not always protect a wetlands' functions.

Introducing flexibility in wetlands regulation to serve the larger purpose of watershed restoration is both a planning and a financing challenge.

This planning may mean mapping, but will always mean rules for categorization of existing areas which have been delineated as wetlands, as well as identifying land parcels which might be returned to wetlands status. The planning could be accomplished in the Special Area Management Process of the Coastal Zone Management Act, in the Advanced Identification Program under Section 404, or as a part of a separate watershed planning authority under state or regional authority. In fact, this planning process will serve more than the regulatory program. Priorities may be set for wetland acquisition programs, for new Corps (and other) environmental restoration projects and for changes in the design or operation of existing water projects.

The categorization of existing wetlands has been the most difficult aspect of wetlands management. The categorization approach proposed here would utilize the planning procedures, tools and decision making protocols described in Section IV. Given that the starting point for watershed planning is the current state of the watershed, the opportunity cost decision framework would be applied. In wetlands categorization, the presumption would be that any wetlands should remain unaltered unless the opportunity cost of protection is too high. The opportunity cost includes both the foregone economic value and the

foregone environmental gain if a restoration or creation opportunity is missed.

In effect, wetlands categorization in a watershed begins with the same philosophy which today emphasizes avoidance. However, the introduction of opportunity cost thinking will serve as an operational rule for defining the conditions when avoidance is not the best economic and environmental decision. Another similarity between the current regulatory program and this categorization process is that sequencing still applies. The difference is that for categorization the sequencing, tests are done in advance and at the whole watershed scale. Finally, the PIRP process is implied by the opportunity cost rules which are embedded in the criteria.

Existing wetlands would be classified based on three criteria.

1. The magnitude of the ecological value to the watershed of the site proposed for development, if development is denied. This magnitude of ecological value will depend on the resulting isolation and fragmentation and the scarcity of the wetlands type.

2. The difficulty and cost of restoring or creating lost functions, in relation to their ecological value, if development of the site is accepted.

3. The magnitude of the development value to the landowner that will be realized if the permit is granted.

In effect, wetlands classification in a watershed begins with the same philosophy which today emphasizes avoidance.... The difference is that for classification the sequencing tests are done in advance and at the whole watershed scale.

The third criterion merits further explanation. The opportunity to achieve a net gain depends upon the financial capacity to pay for restoration. The magnitude of development value at a site is one measure of the ability to pay for restoration, and, therefore, must be considered in designating a wetlands site for development. Currently, when a permit is granted with a no-net-loss regulatory goal, all of the net economic returns from development accrue to the applicant. A "share the gain" approach could secure some of that economic return for watershed restoration programs. Carefully crafting permitting regulations to take advantage of high development values, will offer new opportunities to achieve a net gain in wetlands functions, primarily through permitting development on some degraded wetlands while rehabilitating others.

Some in the development community might be opposed to a share the gain rule. Yet, for the society at large to be willing to move beyond the current sequencing rules there must be some perceived opportunity to be better off with versus without any given permit being issued. This means that there must be a willingness of developers to share the gains (not claim extortion or "a taking"). The zoning proffer developers often must negotiate is the model to consider. Also, as was noted earlier, the current regulatory program already implicitly imposes both an implicit development tax and high process costs. This method of financing restoration simply makes the tax explicit. And, because of the flexible and more certain structure of a reformed permit program, process cost savings will be realized. A share of those savings can be directed toward restoration. The particular application and logic of this argument is explained later in this section.

With the three criteria, three classes of wetlands can be defined. Class I would be those wetlands of exceptionally high ecological value, with functions that are costly or difficult to replicate and for which development values are likely to be low. Avoidance is the best management strategy for these wetlands areas; only the most obvious water dependent and high

value development would be even considered for a permit.

Class II wetlands are those where the wetlands site now has modest functional value to the watershed, or where the current value will be compromised even if a permit for filling is denied. These will tend to be degraded and isolated wetlands, where the functions at stake are not unique to the area and where development values may be high enough to extract payments adequate to achieve the net gain goal. Class III wetlands would be areas where a fixed development fee (discussed below) might be established with only limited permit review being required.

General rules for classification would be established. However, the actual classification of any given site will be subject to review as a part of the permit application process.

General rules for categorization would be established. However, the actual categorization of any given site will be subject to review as a part of the permit application process. Therefore precise mapping of wetlands should not be the end result of categorization. What must be done to make any categorization system work, for both the environment and the economy, is that there be clear and operational decision rules with which categorizations will be made on a case-by-case basis.

... the consideration of mitigation banking is a critical first step towards regulatory flexibility because it admits off-site mitigation into the regulatory program.

Wetlands Regulatory Reform: From Mitigation Banking to Fee Based Permitting

For over a decade wetlands mitigation banking has been considered in concept and cautiously authorized in Federal agency guidance. Increasingly, states now include mitigation banking among their wetlands management techniques. Recently, the Corps has begun studies to explore the potential contribution of mitigation banking to the regulatory program. The mitigation bank is a tool to make compensation for wetlands losses permitted in the regulatory program by a restoration (or creation) elsewhere. Therefore, the consideration of mitigation banking is a critical first step towards regulatory flexibility because it admits off-site mitigation into the regulatory program.

Consider the banking concept. To create a bank a wetlands developer establishes credits by restoring or creating wetlands functions which become deposits in a "checking account". The checking account is administered (monitored) by the regulatory agency. The agency is responsible for certifying the number and "quality" of the credits which are deposited in the bank. That is, the regulator has to establish the criteria for wetlands function restoration or creation success, as well as for the type of functions which are created.

There can be as many created banks as there are certified sites. Therefore the certification role of the wetlands regulatory agency is similar to the role played by regulators of commercial financial institutions. In both cases, the regulator certifies that a bank has the ability to operate successfully over time. The commercial bank regulator has a public interest mission -- to protect depositors from bank failure. The wetlands bank regulator has the responsibility to assure that the compensations made to the public for lost wetlands will persist as wetlands over time, in effect protecting against wetlands bank failure.

Once a wetlands bank is certified, as wetlands development is permitted by the regulatory agency, debits are made to the checking account, reducing its balance. The rate at which wetlands debits are required for development activities is established by the wetlands regulatory agency. This rate of exchange is termed the trading ratio. The trading ratio can be set to achieve no-net-loss of functions where one unit of credit is related to one unit of loss. Or, the regulator can seek to achieve a net gain where more than one unit of credit is expected in return for each unit of loss. Trading ratios greater than 1:1 may also be warranted if the regulator is concerned about a risk that the restored or created wetland will not be successful or if a period of time will elapse between the loss of a wetland function and its replacement.

When a bank has been established, the bank developer may choose to sell some of their banked credits, and not use the credits for their own projects. When this occurs, the analogy to a simple checking account becomes strained. In this case the developer has made an investment in restoration/creation and is now going to recover the costs of that investment by selling wetlands functions to willing buyers at a negotiated price.

Indeed, creation of wetlands bank may be undertaken as an entrepreneurial activity by an economic agent who has no development of their own to compensate for. If a number of entrepreneurial banks emerge to sell credits to many possible buyers, a market for wetlands functions, with its operation regulated by the wetlands regulatory agency, has developed. Competition in this market should assure that functions were provided at least cost and that new applications of science and technology in wetlands restoration and creation were encouraged.

The creation of a bank requires an investment by a wetlands developer or by an economic agent which expects to sell the banked credits at prices which will yield a competitive return on their investment. Therefore, the rules established by the regulators to certify when credits may be sold and to set trading ratios can have a significant influence on the demand for and supply of credits.

Banking has been defended by the logic that many wetlands losses are small by themselves, but may be cumulatively significant. The only practical way to compensate for cumulative effects is to debit a single large scale wetlands restoration -- a checking account. This is true. But, there are other justifications. Wetlands mitigation banking, and an extension to wetlands' credit markets, can also be justified by a recognition that it is not always ecologically desirable to compensate for wetlands losses in-kind and on-site. The siting and design of deposits to the bank, severed from the rigid on-site and in-kind compensation logic, can be part of a proactive program of watershed restoration when trading ratios are set so that a net gain is achieved in watershed functions. Also, in some cases mitigation banking agreements may consider out-of-kind compensation. Another benefit of banks and credit markets is that the success of compensatory mitigation is assured because compensation credits will be in place before a permit is given or some forms of financial assurance (e.g. bonds) can be used to guarantee successful restoration or creation.

Less likely to be the case is that mitigation banking will include more flexibility in the application of the water dependency test. Indeed, among critics of banking are those who fear that the presence of the bank will relax the rigor with which the regulatory program is now administered. More specifically, this is a fear that the requirement for avoidance and the requirement for in-kind replacement will be relaxed. The fact is that skeptics and cynics about banking remain more numerous in wetlands regulatory agencies than supporters. Agencies' wetlands mitigation banking rules reflect this skepticism. In practice, mitigation banking remains a last resort in wetlands regulation, with the emphasis on strict sequencing for each permit on a case by case basis continuing to dominate the regulatory review process. Banking is viewed as permissible only when

all other responses are not warranted or possible.

Because of this remaining rigidity, the analogy between a checking account and the mitigation bank is weakened. First, the mitigation banking rules create uncertainty about the terms under which the mitigation bank regulators will accept deposits (i.e. what is going to be certified as acceptable restoration or creation) and allow debits (i.e. what will be the trading ratio for withdrawals). Second, the continued adherence to strict sequencing makes it clear that the regulators do not want the bank to be heavily used. Under these conditions it is not at all clear that an investment in wetlands restoration and creation to create a bank would result in credits that could be used.

Not surprisingly, as a result of this grudging support, few true mitigation banks have been established. Instead, most arrangements which are called mitigation banks emphasize compensation for damages from the construction of public infrastructure where the use of the credits is foreseeable in advance. There are very few instances of wetlands credit markets, or even of a developer making deposits to a bank, without having a reasonably certain future use for the credits. What has really been negotiated for these banks is a reduction in permit review time for a sequence of highly certain development activities.

The regulators desire to minimize banking is understandable. The regulators first task is wetlands protection, but the current policy is based on a goal of no-net- loss of wetlands function. The mitigation bank as now conceived cannot be a tool to realize any gains in wetlands net worth within the watershed. As a result, when the regulators view their mission, they are no worse off if they do not encourage banks to operate at all. Only by incorporating the idea of net gain into regulatory reform will it become in the interest of wetlands regulators to emphasize banking and credit markets. Fee based permitting and wetlands credit markets can be a step toward reform.

Fee Based Permitting and Wetland Credit Markets: The market systems of fee based permitting and credit market creation are reforms which go beyond simple banking. The mitigation bank ultimately relies on the wetlands developer to undertake restoration or creation as the deposit to the bank. For many permit applicants who are seeking permits for small areas this is financially unworkable (limited cash reserves) or the wetlands compensations required are too small to realize the scale economies that might be achieved by larger scale restoration. Also, this banking approach places the responsibility for successful restoration and creation on wetlands developers who have neither the expertise, experience or long term interest in wetlands and watersheds.

The applicant wants a permit. The regulatory agency wants to protect and restore the ecological functions of watersheds. This later objective is not relevant to the permit applicant. Market systems bridge these objectives by making the decision on securing a permit separate from the decisions about how, where, and when to restore wetlands.

The market systems of fee based permitting and credit market creation are reforms which go beyond simple banking.

In fee based permitting, a recipient of a wetlands development permit would be expected to make a money payment to a permitting agency's trust fund. The permitting agency would then use the funds collected for environmental restoration, within the context of a plan for a watershed space that includes wetlands, uplands and river flows. The agency could collect wetlands conversion fees and, when revenues were sufficient, initiate a restoration project either under its own oversight or by purchase of restoration credits from private suppliers, under a procurement process based on a Request for

Proposal procedure. This public purchase would help stimulate the creation of firms selling wetlands credits. Alternatively, the agency might up-front finance restoration and then collect fees over time to recover costs.

Critical to fee based permitting is setting the fee. The agency fee is based on a trading-ratio, because the fees collected must be adequate to pay for restoration and creation which will achieve a net gain in watershed functions. For Class II wetlands, there would be an expedited permit review process where a negotiation between the applicant and the regulatory agency would form the basis for fee setting. The burden would be placed on the developer to show the costs of avoiding the wetlands. This demonstration through data and analysis would be intended to establish the increased returns possible to the wetlands owner if the permit is granted. The sharing of the development returns would then be negotiated and the permit granted only if the fee paid is adequate to enhance wetlands functions in the target aquatic system.

The negotiation over the fee might be a time consuming process and should be reserved only for circumstances of large scale alterations and/or high value development, typically Class I and II wetlands. For Class III wetlands a published fee schedule, based upon the costs of restoring wetlands with a requirement that there be some positive trading ratio, would be published. The fee schedule would be applied for small acreage and function losses and low value development proposals.

The credit market system would require that payments be made directly to the credit supplier for an amount of credits (the trading ratio) that would be established in the permit process. Once the trading ratio was set the developer could seek credits on the open market. As was noted, a spin-off from banking might be a wetlands credit market. There have been some instances of sale of wetlands function credits from the party making the initial deposit to the bank to others in need of credits. However, such sales are a result of unique circumstances; the sales were not intended when the initial deposits were made to the bank. And, the possibility that entrepreneurs might restore and create wetlands functions, so that credits might be sold is a possibility that recently has become reality. Local and state governments are now developing guidelines on how these private banks might be certified for operation.

Realistically, these entrepreneurs are going to need some expectation of a competitive return on investment if the credit market is going to function. This expectation of a competitive return will depend upon the demand they expect for credits in relation to the costs of supplying them. Regulatory uncertainty that now accompanies the regulatory program raises supply cost, increasing the economic return required to offset the risk that the investment cost will not be recovered. For example, a requirement for "successful advanced compensation" before credits can be certified for sale, with no explicit definitions of the success measures, makes an investment in advanced wetlands restoration or creation extremely risky. On the demand side, the continued adherence to sequencing may limit the demand for banked credits and ambiguity about trading ratios makes demand uncertain, even though higher ratios will increase demand. A full discussion of the demand and supply issues can be found in a report by Shabman, King, and Scodari, "Making Wetlands Mitigation Work: The Credit Market Alternative."

Opportunities for Broader Integration of Programs

The Corps role in contributing to watershed restoration through the regulatory program is to take leadership in the reform of the regulatory program. (Further discussion can be found in Section VII.) However, there are a variety of other possible roles for the Corps which arise from its expertise and from its other environmental programs. One role is to expand use of the Corps technical planning skills in the regulatory program and to then provide technical planning assistance to organizations which are trying to develop

watershed plans. There are efforts to develop whole watershed approaches being promoted at the EPA and in non-Federal agencies. However, alone among Federal agencies, the Corps has the historical expertise and available tools for watershed planning.

A second role for the Corps is to use its engineering expertise to advance the state of the art in wetlands restoration and creation. This is already the case with the research programs at the Waterways Experiment Station. What is needed, as a product from that research, is the development of engineering design guidelines that can increase the likelihood of restoration and creation success. There are many areas where whole watershed restoration may be advanced only if the Corps modifies some of its existing projects, so that the hydrologic regime and riparian areas can be restored. If this is done, then the probable success of wetlands restoration sites that are used for mitigation banks may be increased. The Section 1135 program, as well as other authorities, may be used to this end.

Conclusions

The arguments in this section in no way diminish the problems that will arise in designing institutional arrangements for a new regulatory approach. Institutional uncertainties must be addressed. For example, what changes will make it possible to charge for a permit, be consistent with the Section 404 program, and dedicate the funds collected to a non-Federal trust fund? What is needed to encourage private entrepreneurs in selling wetlands credits? Who will be responsible for, and pay for, the watershed planning and application of wetlands categorization rules necessary to achieve the potential of market based permitting? These and other questions should be viewed as challenges and not barriers to desirable regulatory reform.

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VI. OPERATIONS, MAINTENANCE, AND REHABILITATION

The Corps budget for project operations, maintenance and rehabilitation (OMR) now exceeds spending for new project construction. However, the Corps has not developed a structured approach to planning, evaluation, and decision making for environmental activities within the OMR program. This is a sharp contrast with the Corps long tradition of developing evaluation systems for new projects. In this section of the report, several areas of the OMR program are discussed and recommendations to emphasize environmental restoration as a priority output in OMR program are described.

Major Rehabilitation

As projects age, they, like any capital asset, "wear out". As this occurs, the possibility of making significant repairs to the project either to maintain the reliability of the service flow or to "modernize" the project by an enhanced service flow will be considered. Expenditures made for these purposes in the Corps are termed major rehabilitation. While there has long been a program for major rehabilitation of projects, the program's potential to be an increasing claim on budget resources as projects age has brought significant changes in recent years. Among those changes was a recent decision to budget for major rehabilitation within the construction account. This means that major rehabilitation projects must compete for budget funds with new project starts in the construction, general, account rather than in the operations account. It also means that cost sharing responsibilities for some possible outputs of major rehabilitation may follow WRDA 86, and not original project cost sharing. This now is the case for navigation projects and may become the case for other purposes. As a result, an evaluation protocol will need to be followed that is similar to that for new starts. This means that evaluation for major rehabilitation should be as comprehensive as, and consistent with, the P&G. Also, if cost burdens are shifted to non-Federal interests, more attention to the establishment of planning partnerships, as is now the case for new starts, will be in order. These partners may consider planning problems and opportunities to include environmental restoration whenever a major rehabilitation is considered.

> ... the Corps has not developed a structured approach to planning, evaluation, and decision making for environmental activities within the OMR program.

Although issued as interim guidance, economic evaluation procedures for major rehabilitation have been promulgated and are required for all new major rehabilitation projects. The required evaluation generally employs a risk-based decision framework where the evaluation seeks to determine if the costs of a major repair to the project are justified. Benefits of rehabilitation include the following:

1. The future reductions in operations and maintenance costs. This is a rather straightforward accounting process and was the central analytical approach for the economic evaluation of rehabilitation for a number of years.

2. The avoided opportunity costs from a reduction in the expected frequency of service disruption at the project. This evaluation of project reliability considers the probability of the

project being out of service for a given length of time, and the value of project outputs which would be lost with this service disruption. In a purely analytical sense, a rise in the value of those outputs over time might support rehabilitation. Conversely, an expected fall in the value of project outputs might signal a review of the need to maintain the level of the authorized purposes of the project and perhaps to consider advancing other project purposes. However, under the current guidance, the evaluation is expected to limit itself to rehabilitation of the project to serve only authorized purposes. Other purposes may be served only incidental to the rehabilitation, if no incremental costs are incurred to serve those purposes.

3. The opportunity to improve the outputs of the project if state-of-the-art technologies can be incorporated into the rehabilitated project. This can lead to enhanced levels of project output and justification for project rehabilitation might be increased.

At present, environmental considerations are treated in the interim guidance as constraints on the recommended rehabilitation plan. For example, Section 404 program sequencing rules, or other environmental statutes such as the Endangered Species Act, might limit the alternatives that are considered for project rehabilitation. The rehabilitation report is expected to certify that the proposed plan is not in conflict with any environmental statute.

The possibility that environmental restoration might be an ancillary result (that is, no incremental cost) of the rehabilitation is accepted. In this situation, the evaluation might report environmental restoration effects, but cannot proactively plan for such effects. For example, a recent study found that rehabilitation at the Bonneville Dam to increase the power output of the project also would reduce the loss of smolt salmon that pass the dam on the downstream migration. These results were reported and an estimate of the NED value of the restoration of salmon runs was included in the reported NED justification.

... hydrologic modifications to project operation, and, as needed structural modifications, may be an opportunity to serve environmental restoration.

However, more can be done to improve consideration of environmental outputs. The interim major rehabilitation evaluation procedures are not intended to be a complete planning framework. Instead, plan formulation for major rehabilitation is limited to consideration of only authorized project purposes; therefore, environmental restoration opportunities may not be considered. But, hydrologic modifications to project operation, and, as needed structural modifications, may be an opportunity to serve environmental restoration. The way to modernize some projects, if environmental restoration was a focus, might be to alter their structure and operation. And, this may mean going so far as to abandon the project itself over time. Also, as project sponsors are confronted with the costs of rehabilitation, and as the restoration option might be cost shared at 75% Federal expense, the relative prices, costs and benefits of a restoration may make rehabilitation of the project to continue to serve the same purposes as originally authorized unattractive, and make environmental restoration more attractive.

There are two existing barriers to this being considered. First, the authority to include restoration in a major rehabilitation study will need to be clarified. For example, Section 1135 authority might be considered (more discussion of 1135 follows below). However, any major consideration of

environmental activities may also be possible as part of a "Section 216" study. Section 216 refers to P.L. 91-611 (River and Harbor Act of Flood Control Act of 1970). That provision authorizes the Corps to review the operation of completed projects when there have been substantial changes in physical or economic conditions affecting the project. Current policy within the Corps requires the preparation and approval of an initial appraisal at Federal expense, with a favorable finding resulting in a 50/50 cost shared study of the possibility of project modification for any new purposes, presumably including environmental restoration.

Section 216 authority might be appropriate for consideration of environmental restoration in major rehabilitation studies. One possibility is to require that, at the start of any major rehabilitation study, there should also be consideration of beginning a parallel Section 216 study. The field unit might be required to demonstrate that the environmental restoration opportunity is limited. Otherwise, a 216 type study might be mandated. A more practical alternative would be to emphasize the priority of environmental restoration and require that this possibility always be part of a rehabilitation study. If major project change appears warranted, then a 216 study would follow. Plan formulation could proceed accordingly to consider reallocation of project purposes and reconsideration of project justification. In this way, opportunities for environmental restoration from modification of projects can be identified.

Second, even if policy on plan formulation requirements for major rehabilitation was adjusted to promote environmental restoration, the evaluation protocols are still not well defined. The perception that a narrow NED account defines the "Federal objective" persists, and the field analyses which have been completed attempted to force environmental restoration evaluation into the NED framework. The best example of this is the evaluation of the economic justification for the rehabilitation of the Bonneville Dam power units. The turbine efficiencies were expected to be increased by the installation of state-of- the-art equipment. As a result of these efficiencies, survival of endangered smolt salmon would also be enhanced as they passed through the turbines on their migration downstream. The rehabilitation evaluation report was submitted with this increased survival given an NED measure. This was done despite the numerous limitations of applying NED valuation to endangered salmon stocks listed in Section IV of this report. If the recommendations of Section IV for opportunity cost analysis were used, consistent with the P&G, the incremental costs associated with pursuing rehabilitation in order to gain increased fish survival would have been presented with a recommendation to deviate from the NED plan. Evidence to support such a deviation might have included a reference to NED value studies, but would have also included a more complete representation of the Federal interest in monetary and non-monetary gains from an incremental opportunity cost analysis. (It turns out there was no incremental cost to pass fish at Bonneville because the project was justified by increased power and system reliability benefits). The suggestions from the planning and evaluation discussion for new projects in Section IV need to be transferred to major rehabilitation analysis.

Existing Projects

In Section 1135 of, WRDA 86, the Corps was authorized to review and propose modifications to the structure or operation of its projects to promote "environmental quality." Policy guidance encouraging implementation of this section has only recently been issued, and the guidelines for making evaluations of such changes are still being developed. General approaches from the P&G, and from the incremental cost analysis as applied to mitigation, have been used in plan evaluation. There is little doubt that the traditional Corps planning model which considers tradeoffs among outputs

and objectives is expected to be applied in some form, but detailed planning guidance is not yet available for Section 1135 projects.

The exact provisions of Section 1135 appear to be restrictive, however. Authorized annual spending is limited, with individual projects not to exceed $5 million and cost sharing expected to be 25% non-Federal. Also, no reduction in the authorized levels of project outputs is permitted. Of course, broader consideration of project reauthorization to go beyond the 1135 financial limitations could be made under Section 216 authority. Alternatively, changes to the 1135 authority might be pursued. Finally, special restoration study authority might be developed.

In another program of the Corps, and on a larger scale, the operation of whole systems of existing projects on the Missouri and Columbia Rivers is being studied. In both rivers, the stated purpose of these System Operation Reviews (SORs) is to optimize the benefit stream flowing from the projects already in place. Several agencies of Federal and state government with projects on the river systems are participating in the SOR process, but the Corps has taken the analytical lead. Analytical optimization of system operation has proved to be a practical and useful tool in situations outside the Corps (for example, with the metropolitan Washington, DC, water supply plan). To some extent, the SOR efforts have been motivated by a realization that the historical practices for implementing and designing projects, where locally articulated priorities for project development were advanced in the Congress, often meant that the hydrologic connections among projects were less than optimal for the multiple purposes for which they were built. Indeed, the SORs, in some sense, are an effort to achieve the project coordination once envisioned by the river basing planning efforts initiated in the 1930s.

Within SOR studies and at the individual project level, the evaluation and choice of alternatives needs to follow the opportunity cost decision framework.

In the SOR process, as in the major rehabilitation area, the plan formulation emphasis began as an effort to "squeeze" more of the authorized purposes out of the system of projects and less on aquatic system restoration through modifying hydraulic controls. SOR efforts initially were not expected to formulate alternatives to achieve environmental restoration as a priority output. However, in the Missouri and Columbia Rivers, the pressures of regional interests have directed the SOR efforts toward environmental goals. Such multi-project SOR efforts extend the Corps recent efforts to improve water quality and habitat through the routine operation of individual projects. Much of the individual project operational change was made to assure compliance with select environmental standards. Also, there have been operational changes made which could advance environmental goals, when consistent with authorized project purposes.

Within SOR studies, and at the individual project level, the evaluation and choice of alternatives need to follow the opportunity cost decision framework. The Columbia River SOR illustrates this point. Early in the process, the SOR appeared to be proceeding on an analytical path bound to the NED plan as the Federal objective. In turn, NED valuation of endangered salmon was being attempted and the opportunity cost framework was not being employed. However, more recently there have been changes in the approach used to adopt the opportunity cost decision making model.

Dredged Material Handling

The most obvious linkage between the environment and existing Corps projects involves the problems and opportunities posed by the need to dispose of the 500 million cubic yards of material dredged annually to maintain harbors and waterways. About 5% to 10% of this material is contaminated with toxic materials and requires special handling to comply with water quality regulations. Currently, the degree of contamination and environmental impact of unconfined disposal are determined by a sequence of tests. These tests are used to draw a sharp boundary between those sediments which must be confined and those which may be disposed of in other ways. Once this line is drawn, the economic considerations are limited to finding the least costly manner of disposal for both the contaminated and uncontaminated material. For the contaminated materials, the separate determination of environmental constraints and cost effectiveness can lead to problems which may be addressed by risk cost tradeoff analysis. A study for IWR by J. Stansbury et.al. concludes the following:

> ... if lenient environmental criteria are set, a low cost solution may be found, but at high environmental risk. Conversely, if the environmental criteria are set too high, the costs may be prohibitive and curtail dredging activity. Further, for dredged material that marginally fails unconfined aquatic disposal criteria, inordinately large cost increases may be incurred to dispose of the material at a site that may provide only a marginal improvement in risk reduction. Finally, the disposal criteria themselves may include overly conservative assumptions that implicitly compensate for a high degree of uncertainty that is inherent to such analysis. The economic consequences of such uncertainty should be explicitly considered as a part of any risk-cost evaluation of alternative dredged material disposal management measures. This recommendation for risk cost analysis, which separates risk assessment from risk management, is a direct application of the opportunity cost decision making model, although the particular application is not toward the achievement of restoration, which, for this study, has been defined as the focus of environmental outputs.

Uncontaminated dredged material is clean material which may be used for environmental restoration purposes, primarily for the creation of wetlands. When considering the so-called beneficial uses for the material, there are a variety of analytical and cost sharing requirements which must be considered. Of most significance is the policy constraint to dispose of the materials in a manner consistent with environmental standards, local concerns and sound engineering practice, while seeking, within these constraints, the least costly disposal method. Only if wetlands creation is least cost will this Federal standard be achieved. In effect, then, the dredged material disposal problem is one of minimizing costs, subject to a constraint to do no environmental harm; it is not a proactive effort to use dredged material to restore the environment.

The possibility of environmentally beneficial dredged material disposal has been recognized for a number of years. Nearly 100,000 acres of wetlands have been restored, constructed or intensively managed using material dredged from Corps projects at a total cost exceeding $200 million. Much of this work was conducted under Section 150 of the Water Resources Development Act of 1976, which authorizes incremental costs of $400,000 per dredging project per dredging cycle for wetlands creation. However, the additional funds must be allocated from other projects within the operations and maintenance budget. Therefore, unless the creation of wetlands for environmental restoration receives high priority as an output, these funds may not be made available. Certainly, the current emphasis on environmental restoration might be one way to encourage an increase in the utilization of dredged materials for restoration. And, as environmental constraints become more stringent on other disposal methods, (for example open

water disposal), the wetlands creation option may prove to be the least costly.

This later possibility was considered in a pilot study jointly conducted by the National Marine Fisheries Service (NMFS) and the Corps between 1985 and 1988. The results of several case studies, where wetlands were created that met NMFS concerns for habitat quality, suggested that creation often can be the least costly disposal option, if not for all situations. The report also documented that administrative costs and organizational changes in NMFS and the Corps might be needed, and that interpretations of Clean Water Act regulatory rules might need to be reconsidered for in-water disposal that is also intended to create wetlands. At the time of the report, 1990, there was some feeling that the Corps headquarters needed to give more commitment to the use of these materials for wetlands and watershed restoration. Since 1990, signs that this commitment is there are more clear.

Indeed, soon after a task force on Coastal Wetlands Creation Authorities reported to the Director of Civil Works that the Corps has adequate authority, under Section 150 and other laws, to develop a wetlands creation effort with dredged material, but that there were budget and policy constraints that need to be relaxed if the program were to move forward (22 Feb 91), Congress provided this authority. Section 204 of WRDA 92 provides authority to protect, restore and create wetlands and other habitats in connection with construction of navigation projects or O&M dredging.

In the future, dredged material disposal might be considered a wetlands restoration opportunity that can be incorporated into plans for other activities targeted at watershed restoration. The analytics are simple: if wetlands creation is deemed environmentally and technically acceptable and costs less than other forms of disposal, it should be done. If there are positive incremental costs for wetlands creation they should be considered in relation to the contribution of the created wetlands to overall watershed restoration; this is the opportunity cost test. Perhaps through programs such as Coastal America, where interagency coordination of programs includes dredged material disposal, funds to help offset incremental costs for wetlands creation might be secured from other state and Federal agencies (Further discussion of the Coastal America program is in Section VII).

Conclusion

There are ample opportunities in the operations, maintenance and rehabilitation program to advance environmental restoration. However, several changes will be needed for this to occur. First, and most significantly, a clear policy statement of the possible ways that restoration might be achieved and of the commitment of the operations program to restoration is needed. Then, the plan formulation and evaluation approaches described in detail in Section IV can be transferred to the operations area. This transference should be a simple and straightforward one, with the possible exception of contaminated materials handling.

There are ample opportunities in the operations, maintenance and rehabilitation program to advance environmental restoration.

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VII. CORPS LEADERSHIP FOR ENVIRONMENTAL RESTORATION: SOME CHALLENGES

Section II of this report described the historical context of the Corps water resources mission, including the vacuum of leadership in the Nation, and especially at the Federal level, for setting new directions in whole watershed management. In other sections of this report, it was argued that the new emphasis in watershed management will be on watershed restoration, with the restoration decision being made in a participatory decision process which is sensitive to the opportunity cost of each restoration proposal. Recommendations for the Corps in the areas of planning, regulatory reform, and project operations and maintenance, as the agency addresses watershed restoration, were made.

However, as was noted several times, technical knowledge about restoration, and social perceptions about the meaning of restoration, are still forming. This was the reason given for making the opportunity for adaptive management a project planning objective. At the same time, shifting social priorities for the services of watersheds, shifting inter-governmental responsibilities for water management, shifting public attitudes toward professional expertise, increased demand for participation in decision making and limited budgets at all levels of government may spin off new institutional forms to address watershed and water resources management in the future. Some general responses the Corps might consider in this new plan formulation and evaluation context are suggested in this concluding section.

Making Adaptive Management Work

One definition of traditional planning offered by Wildavsky is "... the ability to control the future by current acts." With this benchmark, a test of good planning is an ex-post assessment of whether, and to what degree, control over future events has been achieved. Anticipating this test, a traditional planning effort for an environmental restoration project would begin with this question: What choices will assure that the "public interest" is served by a restoration effort?

> As we learn more about watershed restoration, it is likely that we will need to adjust past decisions to accommodate improved technical knowledge and changing social preferences.

However, focusing on this question requires an unrealistic expectation of the ability to understand and control the watershed system. The question also incorrectly presumes that project planners can anticipate current and future social priorities accorded to restoration at a project site. As Gilbert White noted over a decade ago, "The sobering prospect is that most of the major public decisions about resource use and environmental management will be made in the face of large uncertainty deriving from ignorance of physical and biological systems and from evolving techniques and social values" (White, 1980).

As we learn more about watershed restoration, it is likely that we will need to adjust past decisions to accommodate improved technical knowledge and changing social preferences. In Section IV, this accommodation was termed adaptive management. Adaptive management assumes that no knowledge base is adequate for defining and implementing the socially correct and technically feasible long-term plan of action. Instead, decision making must proceed as sequential adjustments in response to new insights about social and economic priorities, and in response to new

understandings of the watershed system. This is Lindbloom's conception of incremental decision making which not only describes what is possible, but also describes what is desirable.

Replacing the definition of planning as future control by current actions, with planning as incremental decision making, challenges the current Corps approach to planning and decision making. One particular implication of this challenge is that all restoration projects should include a long-term operation and maintenance responsibility which includes the authority and resources to make changes to the original restoration plan. In exercising that authority, a project manager must be permitted to take a researcher's perspective. A researcher's perspective means that funds for operation of the project are used, in part, to create information about how the restoration project is functioning. This monitoring of the project should be conducted according to a carefully designed research protocol. Particular experimental designs should be developed to address specific unknowns about restoration both at the project site and at similar sites. Then, data should be collected and analyzed so that new knowledge for this and other sites is generated.

For the agency, each restoration project should be considered to be an experiment, as well as a restoration project. To achieve this result, the Corps should consider a closer link between its research and development mission at its labs (HEC, IWR and WES) and the execution of individual projects.

For the agency, each restoration project should be considered an experiment, as well as a restoration project. To achieve this result, the Corps should consider a closer link between its research and development mission at its labs (HEC, IWR and WES) and the execution of individual projects. In project planning, and in project operations, a recognition of the need for adaptive management will call for early and continuing involvement of the Corps research community. Through such involvement, the knowledge base for restoration will be expanded based on practical experience, and that knowledge may be more easily transferred to other restoration projects both within the Corps and elsewhere.

A move toward incorporating adaptive management into the program will be a significant departure from past practice. Budget authorities and the public have come to expect plans to be for definitive final actions. The expectation is that an agency will make a decision, act and move on to the next problem to be solved. Without making restoration projects appear to conform to this image of planning, there may be little budget or political support for a recommended restoration project. However, a desire for funding a definitive and inflexible plan is not compatible with the adaptive management challenge. The authorities of our governmental organizations, and existing budget flexibility, may need to be modified to reflect the reality of the longer term adaptive management focus. If certainty and the promise of expert knowledge remain conditions for project support, despite the overwhelming evidence that we can't achieve that certainty of expertise, then the charade of expert planning will be perpetuated, but progress in restoration will be impeded.

Restoration Decision Making: Responding to a New Era

At one level, the Corps adherence to the P&G and in the regulatory program to the PIRP, is a legacy of a progressive era planning model. In this planning model, the "public interest" was found through an analysis expected to capture in a computational formula "the benefits and costs to whomsoever they may accrue." As

long as Federal tax receipts paid for project costs, and there was a perception of superiority of Federal agency expertise in establishing technical and social feasibility, a Federal agency (the Corps) was expected to bear responsibility for making the choice among project alternatives.

However, even then the Federal agency's choice was not expected to be independent of group negotiation as that agency was assumed to consider, and tradeoff among, interests preferences. Decision-by-computation was a facade around a bargaining system that was used to build support for projects conceived and designed within the agency. Bargains were made to secure local and other agency support for a project. Usually, support was gained by providing add-on purposes to projects, such as recreation and fish and wildlife measures, in addition to traditional outputs.

Many remain convinced of the progressive era argument that sound public decisions only will be made by experts housed in agencies administered by a single, well-informed and technically sophisticated decision maker. Slowly, however, the long standing suspicion of any decision made by interest group bargaining has given way to its grudging acceptance as a component of water resource decision making. Why?

During the 1960s and 1970s, opinion leaders wrote persuasively about a degraded natural world, questioning many of the premises and approaches of United States water management. One part of this critique was a challenge to the expert-based planning model that had defined the progressive vision. The demand was for a more "participatory" decision making process. The evidence had long been accumulating that interest group politics was as significant in regulatory and investment decisions as the application of expertise. Agencies were said to be "captured" by those they were to regulate. Spending decisions were said to be made in response to an "iron-triangle" of agency personnel, interest groups, and congressional subcommittee members. Accelerating the decline of political support for the agency expert was the recognition that pure expertise was a myth, especially for environmental management where the questions needing answers often appeared scientific, but in fact were confounded with social values about such matters as the proper response to environmental risk or the appropriate tradeoffs between natural and manipulated watershed systems.

Slowly, however, the long standing suspicion of any decision made by interest group bargaining has given way to its grudging acceptance as a component of water resource decision making.

In response, the numerous pieces of environmental legislation of the early 1970s intentionally placed limits on agency discretion and included quite specific and rigid performance rules for agency decision making. For example, water quality goals, that is, the ambient standards for rivers which dictated the means by which waste dischargers would be expected to reduce their waste emissions, were all expected to be specified in regulations. The regulations, in turn, were subject to legislative oversight of agency rule making and enforcement. Also, legislative provision for citizen suits was often included to give access to agency decision making to a variety of interests. Legislatures, the courts and a variety of new "publics" had been given the authority and ability to substitute their judgment for that of the agency.

The intent of this change was to insure that no undue influence was exerted by selected interest groups on the agency's choice, and that matters of competing values were not treated as matters of "science." One result was to simply increase the number of interests with the ability to influence agency decisions and to change the power relationships among the many interests. Now, two decades have passed since the early 1970s and given us

- many new interests influencing decisions

- intensive oversight on the decisions made by water resource agencies

- the realization that values and science are often bound together in water resources issues

- an instability in power relationships among numerous interests and the agencies.

These results have been created by the past environmental legislation, but these results have often led to stalemates and delays in making water resources decisions in an increasingly litigious setting, partly attributable to the laws of the 1970s.

As a result, a new legitimacy is being accorded to group bargaining as a means to find ways to once again energize water resources decision making and project implementation. Indeed, negotiation processes have even been used to write environmental regulations in a limited number of experiments. Three arguments are made in defense of encouraging bargaining as a decision process. It is said that a bargained outcome will be just and equitable, because compensation for losses borne by all affected interests is often required for agreement to be reached. It is said that if an agreement is reached, that is evidence that the resulting decision is economically efficient, much as we presume voluntary exchange relationships in markets yield efficiency. And, bargaining is the way to gain political acceptance in situations that have too frequently been characterized by stalemate.

> If a participatory model is to be the conceptual touchstone of the future environmental decision making in the agency, the Corps will find itself engaged in observing, reacting to various types of conflict.

Some take exception to this public interest interpretation of the bargained outcome, expressing concern that negotiated solutions may not achieve equity and economic efficiency if the interests who are party to the bargain are not the only ones affected by a decision. For them, if beneficiaries do not bear the costs of an action, the potential for cost shifting to others will make the outcomes of the negotiation optimal for the parties to the negotiation, but will come at a cost to the society at large.

Some also worry about whether the outcomes of the negotiation process will be "fair" or "just," referring again to the concern about who is represented at the negotiation, but also to the relative power of those who are represented. And, finally there are some who are concerned that the negotiated solution will not result in the correct outcomes. For these people, the nature of the outcomes themselves must be a criterion for judging the bargaining process. Some are concerned that environmental values may be under represented. Others are concerned that the technical knowledge of those who can influence a decision may be limited, so that the chosen actions will be infeasible or even counter productive.

These are valid concerns about the association of the negotiated outcomes with the public interest. However, there is a perceived legacy of past government failure, and there is a promise for increased efficiency, equity and political acceptability from a negotiation based water resources decision making system, following the opportunity cost decision making model advocated in Section IV. This means fostering an increased interest within the Corps in directing group bargaining, as it is informed by opportunity cost analysis.

Structuring the Corps Role in Bargaining: Lord describes three sources of conflict over watersheds -- value conflict, interest conflict, and cognitive conflict. If a participatory model is to be the conceptual touchstone of the future environmental decision making in the agency,

the Corps will find itself engaged in observing, reacting to various types of conflict.

Value conflict stems from different assessments of the desirable goals of public action. It is, therefore, ideological in nature. For example, water resources management decisions may result in conflict over the desirability of the use of water to support greater economic productivity versus the use of the water to support environmental purposes. Thus, two conflicting groups may agree upon the physical and biological impact on a river system of a water transfer to an urban area but disagree about the acceptability of the impact. While resolution of value conflicts may be facilitated by inter group communication, Lord argues that "value conflicts are [often] resolved by a unilateral (authoritarian) or collective (democratic) choice, in which one view prevails over the other ...."

In the face of value conflict, the Corps does not so much resolve value conflict as it operates within the legislative and social context that establishes the bounds on the acceptable decisions the agency might make. Most often, there is ambiguity in the legislative and administrative policy -- a collection of published guidelines, policy statements, executive orders and legislation. Being capable of understanding and recognizing value conflict is essential if the Corps planners are to avoid being frustrated by participatory decision making. In the face of value conflict, the Corps planner must have reduced expectations for reaching agreement through the agencies own decision making forums and must be willing to accept long delays in making the decisions.

The current experiences of the Corps in finding a role for itself on the Columbia and Snake Rivers salmon restoration effort is an example of a situation where value conflict over the most desirable social outcomes for the allocation of the river to different uses has caused a certain frustration in the agency. Under the Endangered Species Act, leadership for restoring the Columbia River Salmon Runs has fallen to agencies other than the Corps, even though the dams constructed by the Corps are a central focus of the restoration program. Even before the listing of certain species of salmon as endangered, the lead agency was, arguably, the Northwest Power Planning Council. And it was the Council that saw its role as leading a regional negotiation and consensus building process over such matters as spilling water for fish passage, in lieu of generating power from operation of the reservoirs. In this setting, the Corps now has limited its role to "factual" analysis of the opportunity costs and the effectiveness of alternatives for fish passage. These analyses are offered as information for the regional and national decision makers who must be responsible for the value conflict resolution.

As in the past, much Corps planning activity will be addressed to cognitive conflict; that is, disagreement over the facts of a situation.... Cognitive conflict resolution is an area where planning and evaluation protocols will make their greatest contribution.

As in the past, much Corps planning activity will be addressed to cognitive conflict; that is, disagreement over the facts of a situation. For example, groups may have different perceptions of the effect of increased water withdrawals upon lake levels or on the legality of water withdrawals. In general, cognitive conflicts may be resolved by sound technical analysis based upon an adequate data base. Analysts may differ in their conclusions, however, it is more likely that agreement among groups can be reached upon cognitive conflicts than upon value conflicts.

Cognitive conflict resolution is an area where planning and evaluation protocols will make their greatest contribution. For the Corps, data analysis and interpretation, along with conceptualization of logical

arguments, can be a basic contribution to the planning process -- sound information is the first step toward settlement of disputes.

Nonetheless, simply producing information which is in strict conformance with some agency rules for analysis cannot be the goal of agency planning guidance or of the field analyst. The choice of which information to produce must be made in response to the decision making needs of the participants in the particular decision. Analysis structured to support those who are seeking to resolve value conflict can also serve as the basis for addressing interest conflict -- the third basis for disagreement.

Interest conflict occurs when a decision will have different effects on different groups, and those groups can effectively support or oppose the proposed decision. At times, some groups will be negatively affected so that others may realize benefits. One resolution of interest conflict occurs through bargaining with offers of compensation from those benefiting to those harmed. Such compensation may be in ranking small changes in a decision. For example, in the past, adding a fish ladder to a dam might compensate fish and wildlife interests who would otherwise oppose the dam's construction. At other times, compensation actions may require significant changes in a broad range of decisions, as when fish and wildlife interests might not object to construction of a dam if a program is implemented to designate another area as a scenic river. But, not all interest conflicts are mitigated by compensation. The exercise of power by one group to impose its preferences on another may be the way interest conflict is addressed.

To better understand and manage conflict, the Corps should actively investigate alternative methods of conflict management and then train project managers in the approaches to addressing, in an integrated way, the sources of conflict which can serve as barriers to reaching decisions.

In the past, the Corps took on the role of "Federal lead agency," and in that role internalized the resolution of all forms of conflict. The Federal lead agency was responsible for organizing the planning activity and usually had the authority to implement and pay for whatever plan was selected. Its planning efforts were directed toward developing a menu of alternative plans for consideration by "decision makers" who expressed their particular preferences among the alternative plans. The lead agency would then make its own internal choice for a recommended plan, so that the choice would reflect preferences for the tradeoffs, and reflect power relationships among interests which existed both outside and within the Corps.

Today, however, the Corps will be expected to bring an array of interests in the planning <u>and</u> decision making process -- the current term in the Corps is "partnerships." At a minimum, incorporating diverse groups into a planning process (for example, through formation of advisory committees) can facilitate conflict resolution as the interests recognize, respect and then make offers and counter offers based upon their own and others preferences. Allee argues that just getting all affected interests into the "same room" to debate water-use issues has been one of the most significant products of water resources planning.

However, leadership also will require more than simply inviting effected interests to agree on problems and their solutions -- this is a facilitator role. There are more formal roles to consider. The Corps could serve as a mediator among conflicting interests. In some instances, the Corps may have the authority to move, in subtle ways, toward an arbitrator role, forcing interests to reach agreement lest the Corps act within its authorities and without the consent of all interests.

The movement toward negotiation based decision making, informed by opportunity cost analysis, does bring challenges and questions. These are well recognized, but need to be made clear to project managers and advice and guidance developed. Among the questions needing to be addressed are who should define the stakeholders in a negotiation process, by what criteria should they be defined, what is the area over which affected interests are to be defined, and what will be the decision rules used for reaching agreements. To better understand and manage conflict, the Corps should actively investigate alternative methods of conflict management and then train project managers in the approaches to addressing, in an integrated way, the sources of conflict which can serve as barriers to reaching decisions.

Cost Discipline: In what sense can group bargaining in the face of opportunity costs direct "optimal" restoration? In negotiation, those who bear the costs of a restoration often must be compensated in order to eliminate interest conflict. With the assurance of compensation for losses from a change, any change might be deemed equitable and, if agreement with compensation is reached, the change may be presumed to be economically efficient. As was noted, some take exception to this "public interest" interpretation of the bargained outcome if the interests who are party to the bargain are not the only ones affected by a decision.

To discourage this new pork barrel, project beneficiaries should bear a share of the costs of an action. But there may be some problems with cost-bearing requirements. For example, the ability of environmental interests to secure funds to make the compensation payments needed for voluntary market water rights reallocations to restore aquatic systems is limited. One suggested response is illustrated by the purchase of water rights for the restoration of the wetland in the Truckee-Carson River, Nevada, watershed, where funds were provided by the Federal government to purchase water rights for the wetlands. The promise of this type of Federal spending might be viewed as an effort to make bargaining work better. An alternative perspective is that tapping the Federal treasury for buying rights raises the risk of a new pork barrel politics like that which developed around funding of storage projects in the past.

From the Corps perspective, it is desirable to pay renewed attention to intergovernmental cost sharing, finance and repayment for restoration, even though cost sharing reform was only recently made in the Water Resources Development Act of 1986. With the WRDA 86, intergovernmental cost sharing and financing for water development have undergone major revisions in part to alter the incentives in the bargaining arena in order to promote efficiency and equity. One result is smaller and fewer traditional water projects and, hence, less disruption to watershed systems. But, restoration was not a focus of attention at the time WRDA 86 was being debated.

At present, the rules on restoration cost sharing are for the Federal government to pay 75% of the cost of construction. The 25% non-Federal share of construction costs may have some disciplining effect on demands made on the Corps budget, but more study of this formula may be warranted because habitat will not be the only output of a restoration project. For example, when storm water management or tertiary waste water treatment is an output, cost sharing rules for the Corps should be similar to the cost sharing implied by the limited Federal funds available through the USEPA waste water management programs.

Finally, many restorations will require operational changes, not new construction.

What should be the cost burden for these effects of operational charges? To illustrate with one example, if there is a need to draw down pools on the Columbia and Snake reservoirs for enhancing salmon survival and if irrigators are damaged: i) should they be compensated? and, ii) what should be the source of funds for the compensation? How these questions are answered will directly affect the perceptions of the participants in the negotiation process on salmon restoration plans.

The Corps as Federal Leader

The term "lead Federal agency" may be obsolete. In many cases, the states will assert lead responsibility in planning and executing watershed restoration. In the final analysis, watershed restoration is a land and water use management problem and the constitutional authorities for land and water use management rest at the state level. Today, the states are developing the necessary planning expertise and research capacity to execute that water management promise. Even the Kissimmee River restoration project, which requires substantial Federal expenditures, has been designed largely by South Florida Water Management District and the state of Florida is ready to pay substantial sums toward its implementation. More typical of the future are plans which are developed by non-Federal interests, but which may be encouraged with Federal planning grants, supported with Federal expertise or motivated by Federal regulation under 404. Among the best known of these plans is the West Eugene Oregon Wetlands Management Program.

In this setting, where within the Federal government might leadership on environmental restoration be located? The reality is that a new national emphasis on environmental restoration will require many agencies other than the Corps to be involved. It might seem that the USEPA is the agency to lead the Federal effort to respond to a new environmental restoration theme. However, there is no watershed planning tradition or expertise within the USEPA, and that will make it difficult for that agency to provide the technical leadership required. USEPA will have a problem taking long-term leadership for watershed restoration because of their dearth of field level technical capacity to deliver programs. And, the central theme of USEPA programs is to find better ways to achieve the statutory or administratively established environmental goals of the USEPA. The programs are not about planning for multiple use resource problems and opportunities. The USEPA programs are fundamentally oriented toward resource protection and not resource management as that distinction has been made in this report. As a result, the USEPA programs are reactive and not proactive in approaches to environmental management. This has been a criticism made of the agency by its own Science Advisory Board.

Still, there is a recent effort at USEPA to establish a leadership position on environmental restoration. The Multi-objective River Corridor Management program and Watershed Protection Program are expected to encourage a coordination of programs that have long been isolated within that agency. For example, the integration of point and nonpoint source water quality programs might be achieved by these programs. The Chesapeake Bay Program and the National Estuary Program are offered as models for these programs. In these cases, and in smaller watersheds, the USEPA has provided planning funds to non-Federal interests and in so doing has started watershed management programs that have been able to persist over time. This seed money role is an important one which might be expanded in a reauthorized Clean Water Act.

Another alternative is to locate a Federal watershed restoration leadership function within an agency whose authorities are limited to interagency coordination. A recent NRC report recommends that such an effort begin and suggests that the focus of the effort be on the development of a Unified National Restoration Program, modeled after the interagency program on floodplain management. The development of the Unified Program might be the

responsibility of a reconstituted Water Resources Council. The Council program would be to assure that disparate Federal programs, such as those in the Corps, USDA, Interior, EPA and NOAA, which touch on restoration, are managed in such a way that opportunities for joint gains from cooperation are realized. However, the factors which limited the capacity of the WRC in the past are still present and reconstituting it as a functioning body may not be warranted.

Another possibility might be to reinvigorate and restructure the United States Council on Environmental Quality (CEQ), giving it the coordination responsibility. CEQ initially and successfully directed the implementation of the National Environmental Policy Act and the EIS process within the Federal government. Also, it was responsible for the Carter Executive Order on Floodplains and Wetlands that was an important force for changing Federal programs in the 1970s. CEQ also served in the late 1970s as the chair of a Federal task force made up of the Corps, USEPA and the Department of the Interior that, together with the state of Louisiana, put together a non-channelization water management plan for the Atchafalaya Basin. However, in the last decade that leadership waned and CEQ has now been subsumed into the White House Office on Environmental Policy.

One important legacy from CEQ is the Coastal America Program. This program has been successful in facilitating Federal agency collaboration on environmental restoration. Unlike the WRC and CEQ leadership models of the past, the Coastal America program does not have a mission to establish rules and procedures for the conduct of the business of the individual agencies. Instead, the Coastal America program accepts the decision making protocols and authorities of individual Federal agencies. The program instead encourages piecing together Federal agency program and projects which are developed elsewhere. The program provides a way for separate agencies to consider how their individual projects fit together to meet established priorities for coastal zone projects. The administrators of the program have secured a commitment from the participating agencies that projects which are coordinated through, and which meet the priorities of, Coastal America will receive budget priority in the agency. In this way, there is an incentive for the field units to behave cooperatively. Another incentive currently in the program is reduced difficulty in obtaining interagency reviews of plans and project proposals. Efforts to expand the financial support to the program and to extend its geographic reach nationwide are under consideration.

The Corps has exercised leadership within the Coastal America Program. Also, without a clear policy or purpose, the Corps already has moved into environmental restoration as a new mission to parallel navigation and flood control. This has occurred through Congressional action and executive branch directive, mostly in response to specific problems. These opportunities should be seized in order to reinvigorate the public support for the Corps, a support base which has withered in the past two decades. Every agency needs to develop and cultivate political support which aligns with the social priorities of the time. The challenges and opportunities are many. For example, regulatory reform may need to be based on a wetlands/ watershed restoration plan. What uses of the Corps budget and planning capacity are warranted for development of local watershed plans in both the planning and regulatory programs? The USEPA has given several grants under its watershed management programs for advanced identification planning. What can be or should be the Corps role?

However, new political support for the Corps is not needed just to keep the agency viable. It is also warranted because the central need for successful watershed restoration is management of river hydrology -- the expertise of the Corps. And, perhaps of still more significance, the Corps, alone among the Federal agencies, continues to conduct its business with attention to structured decision making built around sound analysis. The Corps strength as a vibrant and technically strong agency with a tradition of technical analysis to support social decisions is a necessary

skill for socially acceptable restoration programs. Having made this assertion, it should be immediately noted that the mix of skills in the Corps and the organizational forms which have evolved may not be well-suited to environmental restoration plan formulation and evaluation. This possibility should be reviewed and reforms considered. Indeed, the intent of the recent Corps reorganization was to strengthen that technical capacity by creating centers of specific expertises in certain districts. The Corps should assure that some of these centers stress restoration plan formulation and evaluation for all areas of the Corps mission.

Conclusion

The Corps has an opportunity to lead new efforts at watershed restoration in the Federal government, because of its engineering and management skills and its tradition of careful analysis and evaluation. This opportunity can be realized through the already extensive, explicit authorities in the Corps planning and regulatory programs. By acting on the implications and suggestions of this report, the Corps could assert itself as the key Federal agency for watershed restoration.

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