

Section 5. Corps Standards for Plan Evaluation, Comparison and Selection

This section reviews the standard Corps planning framework used for the evaluation, comparison and selection of project plans formulated to serve traditional Civil Works purposes, and how it has been adapted to the ecosystem restoration purpose. As used here, the term “plan evaluation” refers to the quantitative measurement of an alternative plan’s negative and positive effects. Plan comparison refers to the analytical procedures used for examining the economic efficiency implications of and tradeoffs among alternative plans, and plan selection standards refer to rules for justifying plans for funding.

5.1 Overview of Policy Standards for Single and Multiple Purpose Projects

Corps planning standards for evaluating plan benefits, and for comparing and selecting among formulated alternatives in the case of traditional “National Economic Development” (NED) projects, “National Ecosystem Restoration” (NER) projects, and multipurpose NED/NER projects are summarized in Table 5.1 and reviewed below.

Table 5.1 Corps Planning Standards for NED & NER Purposes*

	Plan Benefits Measure	Plan Comparison Procedures	Plan Selection Rules
Single Purpose NED Projects	“Contributions to national economic development (NED outputs) are increases in the net value of goods and services, expressed in monetary units.”	Benefit-cost analysis: monetary NED benefits less monetary NED costs	“For all project purposes except ecosystem restoration, the alternative plan that reasonably maximizes net economic benefits consistent with protecting the Nation’s environment, the NED plan, shall be selected.”
Single Purpose NER Projects	“Single purpose ecosystem restoration plans shall be formulated and evaluated in terms of their net contributions to increases in ecosystem value (NER outputs) expressed in non-monetary units.”	Cost effectiveness and incremental cost analyses based on non-monetary NER benefits and costs to implement plans	“For ecosystem restoration projects, a plan that reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective, shall be selected. This selected plan must be shown to be cost-effective and justified to achieve the desired level of output. This plan shall be identified as the NER Plan.”
Multiple Purpose NED/NER Projects	Multipurpose plans are to be evaluated in terms of both (monetary) NED outputs and (non-monetary) NER outputs	“Recommendations for multipurpose projects will be based on a combination of NED benefit-cost analysis, and NER benefits analysis, including cost-effectiveness and incremental cost analysis.”	“Projects which produce both NED benefits and NER benefits will result in a best recommended plan so that no alternative plan or scale has a higher excess of NED benefits plus NER benefits over total project costs. This plan shall attempt to maximize the sum of NED and NER benefits, and to offer the best balance between the two objectives”

Source: Chapter 2 of the *Planning Guidance Notebook* (ER 1105-2-100; April 22, 2000).

5.2 Economic Development Projects

The planning standards used by the Corps for project planning in the case of traditional Civil Works purposes are documented in the so-called *Principles and Guidelines* (P&G) as interpreted by Corps regulations set out in the *Planning Guidance Notebook* (PGN).¹ These define the overall Civil Works objective as the contribution to national economic development (NED), and require the Corps to estimate the NED costs and benefits of alternative project plans. NED benefits are defined as the economic value, expressed in monetary terms, of increases in the national output of goods and services as measured by users' aggregate willingness-to-pay (WTP) for additional units of services produced by a project plan. Aggregate WTP for a change in some service reflects the economic value of that change, as measured in terms of each affected individual's own assessment of his or her utility (i.e., based on individual preferences).

While not universally recognized, the NED concept of service benefit encompasses the economic value of all ecosystem services gained or lost by a project plan, including those services that are most closely aligned with the natural parts and processes of ecosystems (Shabman, 1993). However, because the ways in which these "natural" services contribute to human welfare often can not be readily traced and valued in monetary terms, Corps rules require that project plan effects on significant ecosystem attributes to be measured in physical/biological terms and recorded in the "Environmental Quality" (EQ) account.²

At the same time, however, Corps regulations establish a decision rule for plan selection that gives primary consideration to the NED (monetary) effects of plans. The PGN says that the recommended plan for Federal action in any NED project context is to be the alternative plan with the greatest positive net NED benefits (i.e., excess of money benefits over costs) that is consistent with environmental protection. In other words, the rules impose a "national economic efficiency" standard for plan selection, subject to environmental constraints set by established law and regulation. As discussed in more detail in Section 6, the conclusion that a water resource project that generates positive net NED benefits is in the national interest is based on the "potential compensation principle". This says that if those individuals who gain from a project could fully compensate those individuals who lose and still be better off themselves, then the project would increase overall national welfare.

5.3 Ecosystem Restoration Projects

Corps planning regulations establishes different plan evaluation, comparison and selection standards for project plans formulated to serve the NER purpose. Unlike traditional purposes, Corps rules do not require the monetary valuation of NER outputs produced by plan alternatives, or the use of cost-benefit analysis to identify and rank economically efficient plans.

¹ ER 1105-2-100; April 22, 2000.

² The P&G framework includes four separate accounts for evaluating and displaying the effects of alternative plans: (1) the NED account, (2) the environmental quality (EQ) account, (3) the regional economic development (RED) account, and (4) the other social effects (OSE) account. Only the NED account and EQ account are required for project evaluation, however.

Instead, Corps rules say that NER outputs are to be quantified in non-monetary units, and NER project plans evaluated using cost-effectiveness (CE) analysis to ensure that the least cost alternative plan is identified for any possible level of NER output. CE analysis weighs the costs of each project plan against its non-monetary measure of NER output. The CE analysis screens out plans that are not cost effective from further consideration to ensure that the least cost alternative plan is identified for each possible level of NER output. Any particular plan is not cost effective if the same or a larger output level could be produced by another plan at less cost, or if a larger output level could be produced by another plan at the same cost. The plans that remain after this screening process is performed define the “CE frontier”, or the set of cost-effective (or “non-dominated”) plans associated with successively higher possible levels of ecosystem outputs.

Once all cost-effective plans have been identified, then “incremental cost” (IC) analysis can be used to help answer the question “What level of restoration output is worth it? The IC analysis identifies the incremental cost per unit output gained from moving from one plan to the next higher-output plan. This incremental cost and value information helps to identify plans that capture production efficiencies with respect to NER output along different segments of the CE frontier (i.e., output

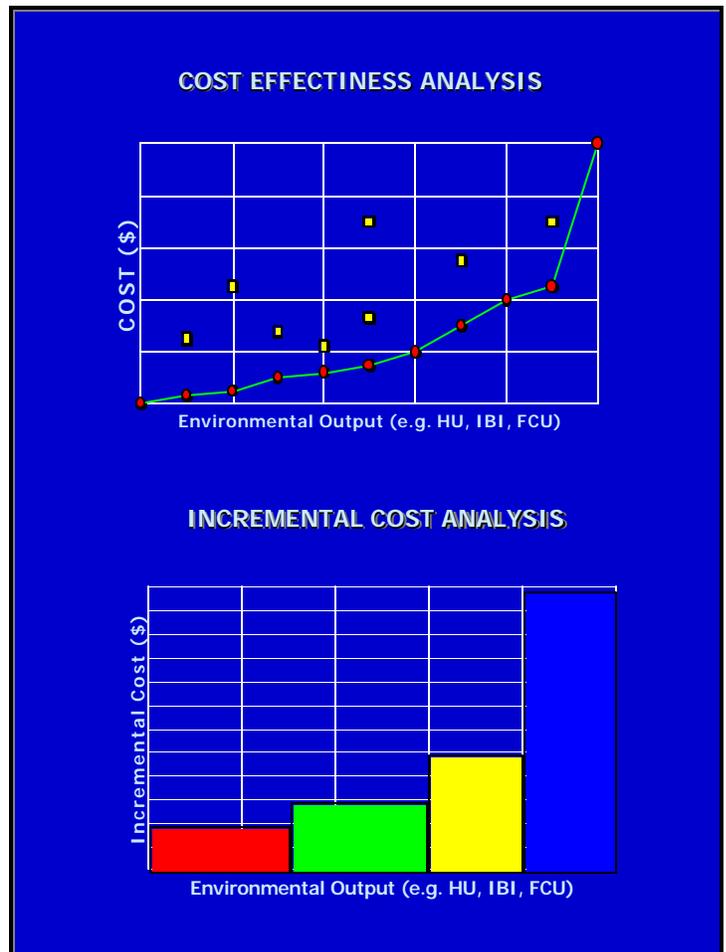


Figure 5.1 Examples of CE/IC Analysis

ranges). Figure 5.1 illustrates the results of a simple example of cost-effectiveness and incremental cost analyses for evaluating alternative restoration plans. Decision support systems have been developed (IWRPLAN, 1999) that make this type of analysis routine within the Corps. Such analyses can be implemented using any single metric of ecological output.

The CE/IC framework is applicable when NER outputs can be adequately characterized in terms of a single non-monetary variable. But in some restoration contexts it might not be reasonable or possible to adequately characterize and measure NER outputs in terms of one single metric. Consider a restoration project concerned with the protection of two endangered species that have substantially different habitat needs. In this case the contribution of any alternative plan to these objectives would likely require separate measures of NER output for each species of concern.

Cost effectiveness analysis is not applicable to the case in which NER outputs are measured in terms of two or more non-commensurate metrics. But that two-dimensional plan comparison framework can be readily extended to one defined over multiple dimensions. That is, a multiple criteria efficiency frontier (or “envelope”) can be estimated over three or more non-commensurate measures of plan effects. As with the basic CE frontier, the multiple criteria frontier defines the set of efficient, or non-dominated, plans. Consider a frontier defined over two NER outputs and plan implementation costs. In this case, the frontier identifies alternative plans for which more of one NER output could not be obtained through choice of an alternative plan without incurring higher implementation costs or obtaining less of the other NER output.

An analysis that traces out an efficiency frontier over multiple objectives can be very useful for informing decisions. However, more alternative plans will generally be identified as non-dominated as the number of plan effects considered increases; thus, fewer plans will be weeded-out as inferior. In addition, incremental cost analysis is not a particularly useful tool for informing the “is it worth it” question when non-dominated plans are defined with respect to multiple, non-commensurate criteria.

Efficiency analysis serves to narrow and illustrate tradeoffs among the set of plans considered for selection. Corps policy says that single-purpose NER project plans can be selected based on a subjective determination that non-monetary benefits are worth monetary costs, provided that the selected plan is shown to be cost-effective and NER outputs are shown to be “significant” based on institutional, public and/or technical recognition of importance. The significance test can be viewed as a way to document general demand for project outputs in the absence of monetary values providing a direct indication of demand. Other applicable project evaluation criteria relate to *effectiveness*, *acceptability*, *efficiency*, and *completeness*.

Figure 5.2 uses hypothetical project examples to contrast how the overall P&G framework is used for the traditional NED purposes, and how it has been adapted to the NER purpose. The project examples include a single-purpose NED project and a single purpose NER project. The second through fourth boxes moving down the center of the figure indicate what is measured by each of three successive project analysis steps. *Ecosystem outputs* represent the changes in ecosystem structure and functions expected to result from project activities. *Ecosystem service outcomes* represent changes in ecosystem services expected to result from changes in ecosystem structure and functions. Finally, *human uses and benefits* relate to monetary measures of the contribution to human welfare provided by project service outcomes. The numbered arrows that connect the first four boxes represent the various linkages among project activities, ecosystem outputs, service outcomes, and human benefits that must be estimated for comprehensive evaluation of plan alternatives. The final box represents the evaluation component of the P&G framework that involves the comparison of NED costs and benefits, and non-NED effects of project plans.

Single Purpose NED

Single Purpose NER

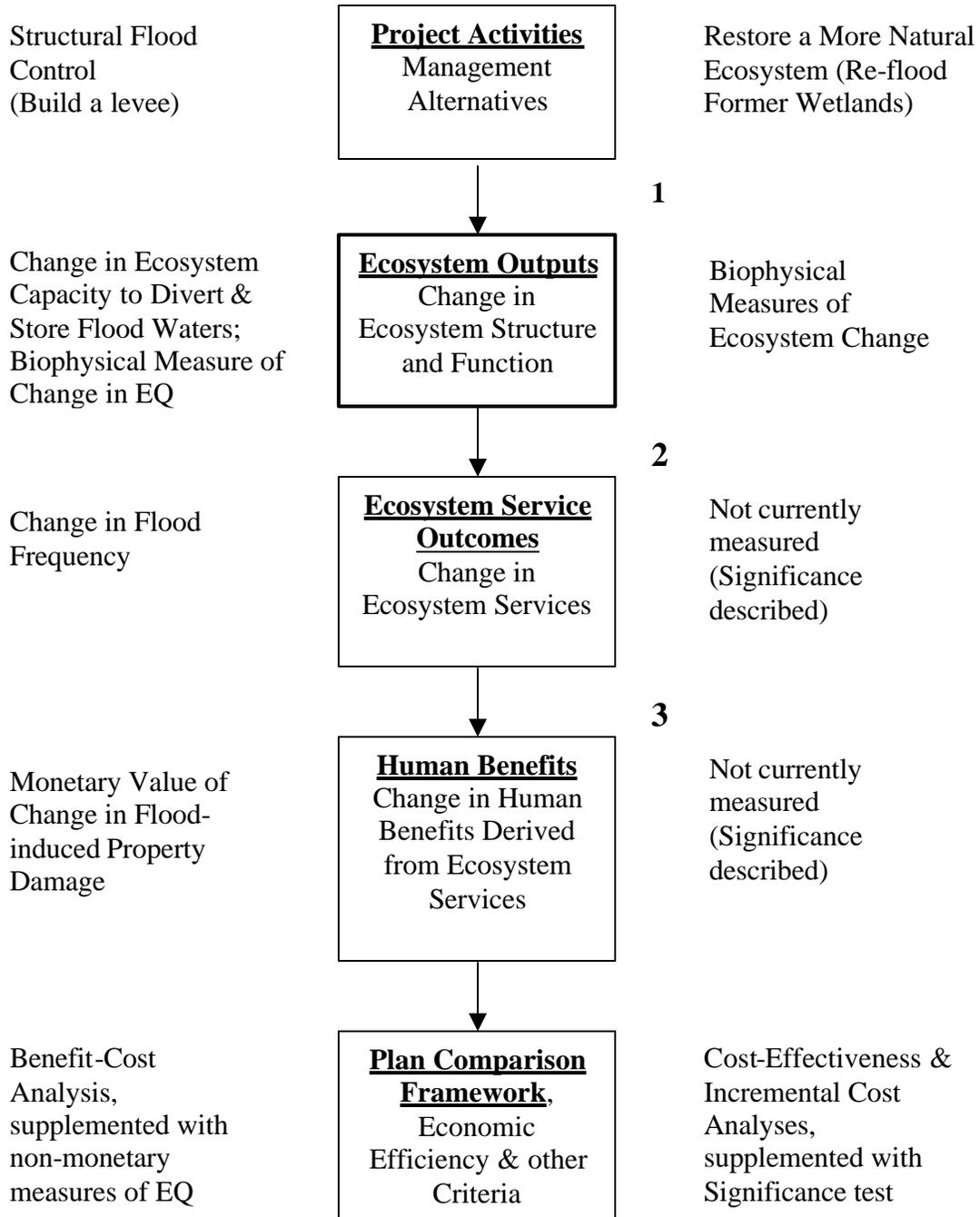


Figure 5.2. Analysis and Evaluation of Single Purpose NED and NER Projects

The NED project example involves structural flood control where the intended service outcome is urban flood hazard reduction. In this case the various linkages among project activities and NED benefits associated with the flood control service are all measurable. The first linkage establishes the increase in floodwater storage and diversion capacity expected to result from the flood control measures of alternative plans. This measure of ecosystem output provides the information needed to estimate the expected change in flood protection, the intended service outcome. The final linkage measures the economic value of this outcome based on the market value of flood damages avoided.

The flood control project also is shown to be associated with certain environmental effects, and for which the full set of linkages among management measures and NED (monetary) effects are not measured. These environmental effects are instead measured in terms of physical/biological metrics of expected changes and recorded in the EQ account.

The analytical results for all plans formulated in the flood control example provide the information needed to calculate and compare the estimated net NED benefits (monetary value of services yielded less project costs) of alternative plans. The estimated non-monetary EQ effects might also serve some limited role in the plan evaluation and selection. For example, measured EQ effects might be used to determine what mitigation measures are appropriate for each plan, the cost of which would be included in total plan costs. Moreover, a plan showing the highest net NED benefits (with mitigation costs taken into account) could be passed over for an alternative plan associated with less negative EQ effects. However, the recommended plan must be one for which estimated net NED benefits are positive.

In the NER project example, the planning objective relates directly to the types of environmental effects that play only a supplemental role (through the EQ account) in the evaluation and selection of the NED project. And while the flood control project focuses on one intended service outcome, the NER project might be pursued for a variety of related natural service outcomes. However, since it is not readily possible to estimate economic benefits for these services, a non-monetary measure of NER output based on predicted changes in ecosystem outputs is used as a proxy measure for NER benefits. That is, in this case the linkages among project activities, ecosystem outputs, service outcomes, and human benefits are not all estimated. Instead, the economic efficiency implications of and tradeoffs among alternative plans are determined by comparing plans in terms of their costs and non-monetary NER output using CE/IC analyses. Planners can then recommend a plan from among the cost effective set based on a subjective judgment that the level of non-monetary restoration outputs justify the cost to produce them. Corps guidance gives little insight into how that should be done, apart from specifying that restoration outputs must be shown to be “significant” based on institutional, public or technical recognition of importance.

5.4 Multipurpose NED/NER Projects

For multipurpose NED/NER projects, the PGN says that plan selection shall attempt to maximize the difference between the sum of NED and NER benefits and project costs,

and to strike the best balance between the two objectives. As in the single purpose NER context, this justification standard necessarily requires a subjective determination of the “best” plan since NER outputs are measured in non-monetary terms.

The PGN suggests that the evaluation and comparison of NED/NER plans should rely on a combination of benefit-cost analysis and CE/IC analysis. Appendix E of the PGN explains that benefit-cost analysis should be used to relate NED benefits against that portion of plan costs required to produce these benefits, and CE/IC should be used to relate non-monetary NER outputs against that portion of plan costs required to produce those outputs. It also says that any joint costs, defined as plan costs that simultaneously produce both NED benefits and NER outputs, should be allocated among these purposes using the standard method used by the Corps for allocating costs to the various project sponsors for a plan selected for funding. (Cost allocation for purposes of cost sharing the selected plan is needed because Corps policy defines cost sharing rules that vary by project purpose.)

Joint costs should be the norm for multipurpose NED/NER projects since the primary rationale for pursuing a multipurpose project instead of separate single purpose projects is efficiencies realized by exploiting opportunities to jointly produce desired outputs. For example, joint costs would make up the bulk of total costs for a project plan involving the use of floodplain evacuation to simultaneously serve flood control and NER purposes. In this case the costs of securing the required land and relocating structures people would serve both project objectives.

But the allocation of joint costs among project outputs *for the purpose of analyzing the economic efficiency implications of alternative plans* cannot be justified on economic grounds, and at any rate is not necessary nor helpful for that purpose. If a dollar’s worth of plan cost serves both NED and NER outputs, these costs and benefits must be considered together for plan comparison.

This can be readily accomplished since plan costs and NED benefits are both measured in dollars and are recognized by Corps regulations as fungible (i.e., a dollar’s worth of NED benefit for a formulated purpose exactly offsets a dollar’s worth of plan implementation cost). Given this, the CE/IC framework is appropriate for analyzing the efficiency implications of multipurpose NED/NER project plans involving joint costs. In this case, the CE/IC procedures can be implemented using a measure of plan costs calculated by subtracting NED benefits yielded by some plan from the financial costs needed to implement that plan. That is, the two plan effects under consideration that are expressed in dollars would be combined into a “net cost” measure for each alternative plan. Net costs would then be used together with the non-monetary NER output measure to implement CE/IC analyses (see Figure 5.3).

Of course, implementing CE/IC analyses using a net cost measure masks information on the specific levels of implementation costs and NED benefits of plans. But its main purpose is efficiency analysis; that is, it serves to help weed out inefficient (dominated) plans from further consideration. The next step for tradeoff analysis would break out and compare all available information on project effects for the narrowed set of plans, as shown in Table 5.2.

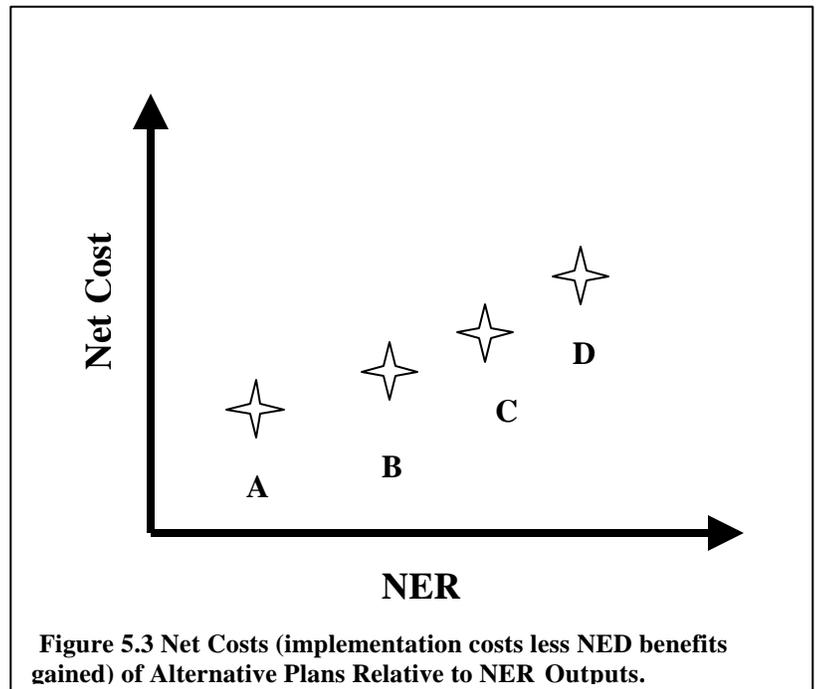


Table 5.2 Display of Flood Damage Reduction (FDR) benefits, Recreation (Rec) benefits, Environmental (Env) benefits, and Implementation Costs for Cost-effective Plans				
Plan Alternative	FDR Benefits	Rec Benefits	Costs	Env. Benefits
Plan A	\$	\$	\$	Non-monetary Output Measure
Plan B	\$	\$	\$	Non-monetary Output Measure
Plan C	\$	\$	\$	Non-monetary Output Measure
Plan D	\$	\$	\$	Non-monetary Output Measure

Current Corps policy guidance does not speak to the use of cost-effectiveness analysis for examining tradeoffs between the net economic development and environmental effects of alternative plans. But it is worth noting that this same basic framework was once used for a short time in the Corps history. Figure 5.4 shows an example of a formal NED-EQ tradeoff analysis developed for a navigation project under consideration in 1977. At that time the Corps planning rules in effect, the *Principles and Standards*, required the formulation of plans that maximized net NED benefits (the NED plan), as well as plans that maximized environmental quality (the EQ plan), however it was defined and measured at that time.

The tradeoff graph shown in Figure 5.4 is equivalent to the cost effectiveness graph discussed above although it differs in perspective. In the NED-NER tradeoff graph, the

vertical axis from the origin upward shows positive net NED (i.e., net dollar benefits), while in the CE graph this portion of the vertical axis shows negative net NED (i.e., net costs). Despite this different perspective, both graphs compare the same thing--NER output with *net* NED effects.

Figure 5.5 presents another example of a tradeoff analysis between net NED benefits and some measure of ecological quality developed for an actual project study. The project in this case examined the implications of restoring natural flow variability of a river system, where environmental effects were measured using an ecological index devised by the Nature Conservancy. Different combinations of reservoir operating rules for the managed system were developed, each addressing a different set of water management objectives (e.g. maximize recreation, navigation or environmental quality). In this project example, the best environmental result achievable was determined to be something far less than the "ideal natural state" because of other man-made alterations to the river system. Further, the tradeoff analysis showed that, in order to achieve this level of ecological quality, nearly all the economic benefits for other multiple purposes (navigation, hydropower, water supply, recreation, etc.) would have to be foregone. Hence, this analysis served to illustrate the opportunity costs in terms of lost economic development opportunities associated with the choice of reservoir operating rules designed to serve environmental quality objectives.

A final point on the use of CE/IC (or NED-NER tradeoff) analysis for multipurpose planning should be recognized. Some within the Corps have expressed concern that the subjective justification standard applicable to NED/NER planning could be abused. The specific concern noted is that NED-focused plans which would otherwise fail the benefit-cost test required for a single purpose NED project, and that do not also produce a significant level of NER output (i.e., that involve little joint production), could be combined with largely separable NER features and show up on the cost-effectiveness frontier in a multipurpose planning case. Planners would then have the opportunity to select these plans following the subjective justification standard applicable to NED/NER planning. This could provide an avenue to push forward NED-focused plans that could not be justified on their own, by simply adding on some NER-focused features.

This is legitimate concern, although one that has long been recognized and addressed by Corps planning rules for traditional (NED only) multipurpose planning. In that context, each purpose represented in a justified plan (i.e., one for which total NED benefits exceed total costs) must be incrementally justified. Incremental justification requires that purpose-specific dollar benefits, as limited by the cost of the least-cost alternative single purpose plan providing equivalent benefits, must equal or exceed separable costs for that purpose, where separable costs are defined as the cost of the multipurpose plan with that purpose included less cost of the plan with that purpose omitted. The incremental justification test ensures that each purpose in a NED-only multipurpose plan adds to rather than subtracts from total net benefits produced by that plan.

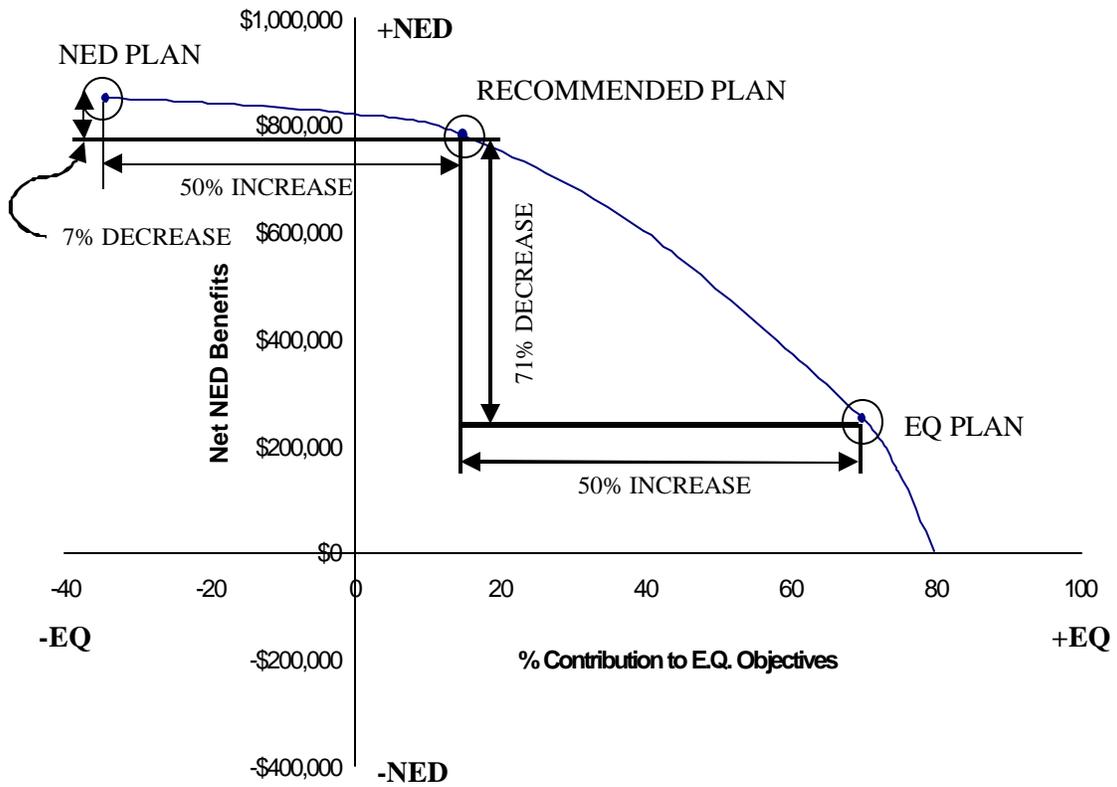
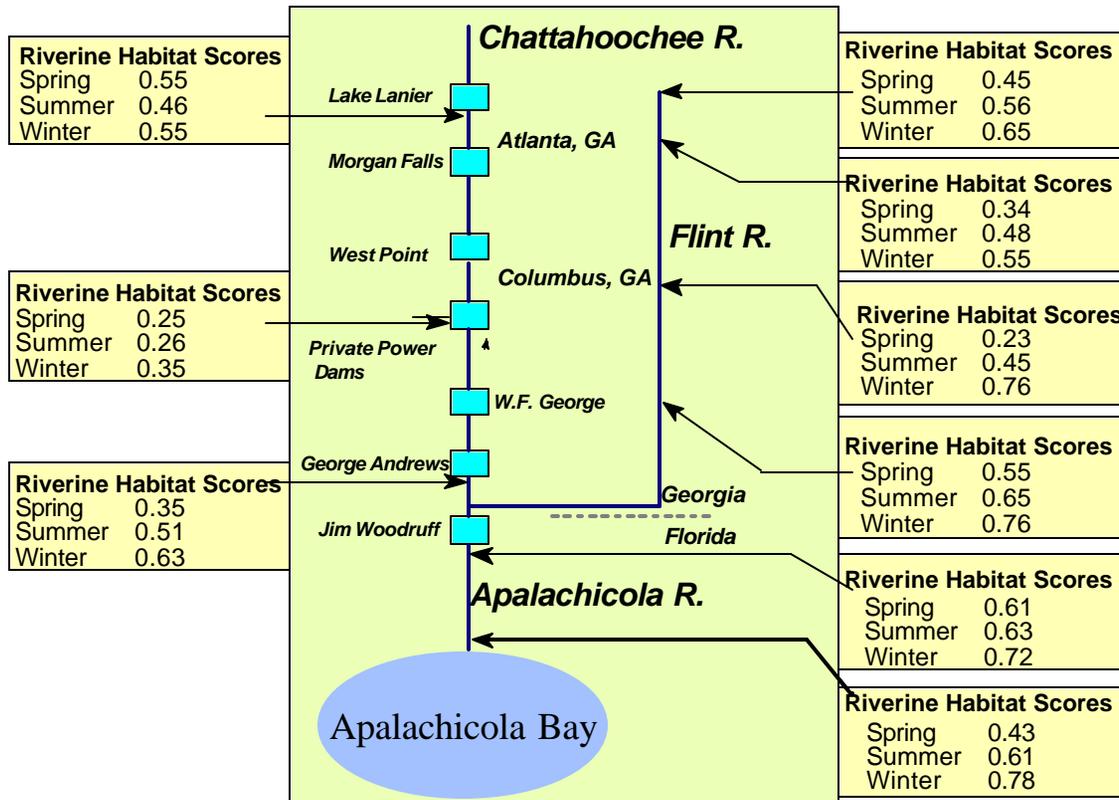
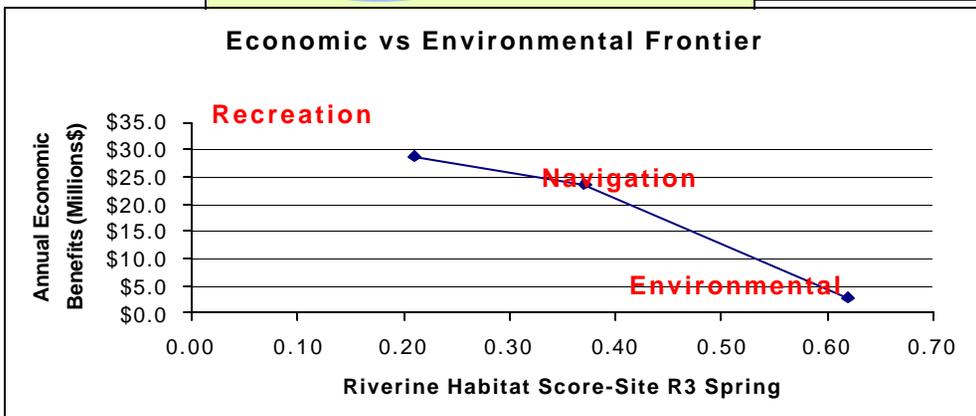


Figure 5.4 NED-EQ Tradeoff for Wilmington Navigation Project

Figure 5.5 Consideration of EQ-NED Trade-Offs



The Schematic diagram of ACF reservoirs and river reaches (left) shows measuring points for three types of environmental impacts, Riverine Habitat, Riparian Wetlands and Reservoir Fisheries. A consensus of study biologists agreed that the best single metric for ranking the environmental desirability of flow regimes was the Riverine habitat measure at site R3.



The graph (lower left) shows a tradeoff between economic benefits (y-axis) and environmental desirability (x-axis) for three alternative reservoir-operating plans. The **Recreation** alternative minimizes releases to keep reservoirs high for boating. The **Environmental** alternative eliminates reservoir regulation. The **Navigation** alternative draws reservoirs down during drought to maintain downstream flows and navigation depths. The graph shows that the Navigation alternative splits the difference in the environmental score at a cost of about \$5 million per year. Choosing "Environmental" over "Navigation" provides the same incremental environmental gain at a cost of \$23 million.

In the NED/NER case, the incremental justification test would show that NED/NER plans formed by combining NER-specific plan features with NED features that could not otherwise be justified as single purpose NED plans and that do not also provide significant NER output, are not justifiable as multipurpose plans even if they show up on the CE frontier (i.e., represent a non-dominated plan). In this context the incremental justification test ensures that multipurpose plans are providing efficiencies over two or more single-purpose plans serving each purpose (output) individually. The key to achieving such efficiencies is the degree to which NED/NER plans involve joint production, as indicated by the extent to which plan costs jointly produce both NED and NER output. The greater joint costs are in relation to total plan costs, the easier it would be for each purpose in a NED/NER plan to be incrementally justified.

In sum, the incremental justification test, if correctly applied, should prevent abuse of the subjective justification standard applicable to multipurpose planning by exposing plans that do not involve more than a trivial level of joint production. At the same time, the subjective justification standard applicable to NED/NER planning offers the opportunity to justify multipurpose plans that involve significant joint production. Thus, for example, a floodplain evacuation plan that otherwise could not be justified as a single purpose flood control project, could be justified as a multipurpose NED/NER plan to the extent that it jointly produces a significant level of NER output.

5.5 Foregone and Incidental Benefits

Civil Works plans sometimes involve foregone and/or incidental benefits that are unrelated to project objectives, and that can be valued in monetary terms. Foregone benefits are the opportunity costs associated with a reduction of current levels of NED services expected to result from project plans. Incidental benefits are the value of expected NED outputs that are different from the specific outputs for which plans are formulated, and for which no additional project expenditure is required. In the case of a single-purpose flood control project, for example, any existing recreation benefits lost due to project plans would be viewed as foregone benefits, while any added recreational benefits yielded would be viewed as incidental benefits. Although they represent two sides of the same coin, Corps rules treat foregone benefits differently from incidental benefits for project evaluation, comparison and justification (see Table 5.2).

Corps regulations say that the estimation of plan costs should include any foregone NED benefits of plans. These opportunity costs thus would be appropriately included in the cost measure used for CE/IC analysis. For example, if a single-purpose NER project plan resulted in a reduction in an existing flood control service, then these lost NED benefits would be estimated and added to plan implementation costs to calculate total plan costs. Foregone benefits thus would be considered directly within the CE/IC framework used to evaluate the economic efficiency implications of alternative restoration plans.

Table 5.2 Corps Planning Guidance on Foregone & Incidental Benefits *

Project Costs	Project measures, whether structural or nonstructural, require the use of various resources. NED costs are used for the economic analysis of alternative projects and reflect the opportunity costs of direct or indirect resources consumed by project implementation. From an economic perspective, the real measure of cost is opportunity cost, i.e., the value of that which is foregone when a choice of a particular plan is made. In order to capture the opportunity costs of proposed plans, NED costs include three types of costs: implementation costs, other direct costs and associated costs.” ... “Other direct costs are the costs of resources directly required for a project or a plan but for which no implementation outlays are made. Examples of these costs are interest during construction, value of donated land, <i>uncompensated NED losses and other negative externalities.</i> ” [Italics added] Source: PGN Section 2-2k
Project Benefits	“Ecosystem restoration outputs must be clearly identified and quantified in appropriate units. Although it is possible to evaluate various physical, chemical and/or biological parameters that can be modified by management measures which would result in an increase in ecosystem quantity and quality in the project area, the use of units that measure an increase in “ecosystem” value and productivity are preferred”... “ <i>Monetary gains (e.g., incidental recreation or flood damage reduction) and losses (e.g., flood damage reduction or hydropower) associated with the project shall also be identified.</i> ” [Italics added] Source: PGN Section 3-5c(1)
Evaluation Focus	“While the planning process for single purpose ecosystem restoration projects is the same as for any other purpose, the evaluation process is somewhat different in that it focuses on quantitative and qualitative restoration outputs and <i>monetary benefits are usually incidental.</i> ” [Italics added] Source: PGN Section 3-5c

* Source: *Planning Guidance Notebook* (ER 1105-2-100; April 22, 2000).

At the same time, Corps rules suggest that the incidental NED benefits of restoration project plans should *not* be combined with plan implementation costs for plan evaluation within the CE/IC framework. That is, Corps policy seems to disallow plan comparison and justification based on CE/IC evaluations that use a net measure of plan costs calculated by subtracting the incidental benefits of plans from plan implementation costs. The reasoning is that such a net cost measure could obscure information needed to ensure that the Federal interest in priority outputs are served by recommended plans. For example, a local sponsor intent on gaining approval for a NER project pursued by the locality primarily for recreation services might want to define and use a measure of project costs net of estimated monetary recreation benefits yielded to help show the project is justified. To avoid this possibility, Corps policy suggests that recommended plans must be shown to be cost-effective based solely on the comparison of plan costs (including foregone NED benefits) and the non-monetary measure of NER output. Any estimated incidental NED benefits could serve a supplemental role in the determination of project worth, but not a direct role in the CE/IC analyses used for plan comparison and justification.

This procedure is consistent with the way that incidental benefits are treated in the evaluation of NED projects, at least in the case of some authorized Civil Works purposes.

For example, a recommended structural flood control project plan must be shown to produce flood hazard reduction benefits in excess of project costs; any estimated incidental recreation benefits associated with the project could not be used to meet this positive net benefits standard for project justification.

In the restoration context, data on monetary benefits can usefully inform plan selection without being included within CE/IC analyses. Specifically, this data can serve as supplemental information when using incremental costs analysis to help decide the “is it worth it” question for cost-effective plans that provide successively higher levels of NER output (Shabman, 1993).

5.6 Discounting and Plan Evaluation

The costs and benefits of Civil Works projects are typically paid and received at different times throughout the project time horizon. For example, construction costs are incurred in the initial years of a project, while operation and maintenance costs are paid and project benefits are realized as annual flows throughout the project useful life. In order to inform present-day public investment decisions, project evaluation requires that project costs and benefits be translated into comparable present-day values.

“Discounting” is the method by which project costs and benefits that occur in different time periods are adjusted to reflect that a given amount of consumption in some future time period is worth less than the same amount of consumption today. Essentially, discounting is an added valuation process that measures the “time value” of project costs and benefits.

Discounting project costs and benefits that are expressed in dollar terms is relatively straightforward and uncontroversial with respect to the evaluation of public investments that affect only present-day generations (although choice of the appropriate interest rate for discounting project effects over time remains highly contentious). The same is not true with respect to project effects that are estimated in non-monetary terms, however, such as will be the case for ecosystem restoration outputs. There is generally no consensus on whether it is appropriate to discount non-monetary effects of public investment decisions for project evaluation.

One view holds that project effects that are measured in non-monetary terms and that do not have a close connection to service outcomes and monetary benefits should not be discounted for project evaluation. For example, the measurement of ecosystem restoration outputs generally must rely on some measure of ecosystem function as a gross proxy for “natural” ecosystem service outcomes. But since this functional measure does not directly say anything about the magnitude or timing of natural service flows or associated benefits, it should not be discounted for project evaluation.

The PGN seems to adopt this view by specifying that non-monetary ecosystem restoration outputs should not be discounted for project evaluation. Instead, it says that these output measures should be computed as average annual measures, taking into

consideration that the outputs of alternative plans are likely to vary over time. For example, consider two restoration plans that each produces 50 functional units annually when restoration outputs are fully realized. If the first plan achieves the full 50 functional units in year 1 after project construction, while the other will take 10 years of gradually increasing output to reach the 50 functional units, then this information should inform the calculation of average annual output for the two plans. In this example the first plan would produce an average annual output of 50 functional units over the project life, while the second would produce something less. This highlights that information on the timing of non-monetary outputs is always relevant for project evaluation and thus should be considered in some way.