

CHAPTER 13

FLOOD DAMAGE REDUCTION

13-1. The Federal Interest. Congress, in the Flood Control Act of 1936, established as a nationwide policy that flood control (i.e., flood damage reduction) on navigable waters or their tributaries is in the interest of the general public welfare and is therefore a proper activity of the Federal Government in cooperation with the states and local entities. The 1936 Act, as amended, and more recently the Water Resources Development Act (WRDA) of 1986, specify the details of Federal participation. They have established the scope of the Federal interest to include consideration of all alternatives in controlling flood waters, reducing the susceptibility of property to flood damage, and relieving human and financial losses.

13-2. Flood Plain Management. Flood plain management (FPM) is a continuing process, involving both Federal and non-Federal action, that seeks a balance between use and environmental quality in the management of the inland and coastal flood plains as components of the larger human communities. The flood damage reduction aspects of flood plain management involve modifying floods and modifying the susceptibility of property to flood damages. The former embraces the physical measures commonly called "flood control;" the latter includes regulatory and other measures intended to reduce damages by means other than modifying flood waters. By guiding flood plain land use and development, flood plain regulations seek to reduce future susceptibility to flood hazards and damages consistent with the risk involved and serve in many cases to preserve and protect natural flood plain values.

a. Flood Plain Management Services. The Corps is authorized by Section 206 of the Flood Control Act of 1960, as amended, to provide information, technical planning assistance, and guidance to aid states, local governments, and Indian Tribes in identifying the magnitude and extent of the flood hazard and in planning wise use of the flood plains. Direct response and assistance of this kind are provided upon request through the Flood Plain Management Services Program. The Corps also provides support for the National Flood Insurance Program to the Federal Emergency Management Agency on a reimbursable basis under interagency agreement. (ER 1105-2-100)

b. Executive Order (EO) 11988. This EO requires the Corps to provide leadership and take action to: (1) avoid development in the base (100-year) flood plain unless it is the only practicable alternative; (2) reduce the hazards and risk associated with floods; (3) minimize the impact of floods on human safety, health and welfare; and (4) restore and preserve the natural and beneficial values of the base flood plain. In this regard, the policy of the Corps is to formulate projects which, to the extent possible, avoid or minimize adverse impacts associated with use of the base flood plain and avoid inducing development in the base flood plain unless there is no practicable alternative for the development. (ER 1165-2-26)

c. Modification of Federal Facilities. In planning or modifying Federal facilities on flood plains and in disposing of Federal lands and property, the Corps will follow the Flood Plain Management Guidelines (43 FR 6030), 10 February 1978, issued by the Water Resources Council pursuant to EO 11988.

13-3. Flood Related Planning Policy. It is the policy of the Corps of Engineers to consider in the planning process all practicable and relevant alternatives applicable to flood damage reduction. No one alternative will be pre-judged superior to any other. Consideration will be given both to measures intended to modify flood behavior (structural measures) and those intended to modify damage susceptibility by altering the ways in which people would otherwise occupy and use flood plain lands and waters (nonstructural measures). The fundamental goal is to develop, define and recommend a robust solution that has public and institutional support (having appropriately determined how well an economical plan can be made to function, how capable are the responsible interests to operate and maintain it, and how safe will be the people who will depend on it). (ER 1105-2-100)

a. Structural Measures. These include dams and reservoirs, levees, walls, diversion channels, bridge modifications, channel alterations, pumping, and land treatment. All such measures reduce the frequency of damaging overflows.

b. Nonstructural Measures. These include flood warning and preparedness; temporary or permanent evacuation and relocation; land use regulations including floodway delineation, flood plain zoning, subdivision regulations and building codes; flood proofing; area renewal policies; and conversion to open space.

13-4. Design Flood Criteria. The Corps policy in design of flood damage reduction projects is to provide an optimum degree of protection consistent with safety of life and property. The Corps seeks an economically efficient degree of protection and land use in agricultural areas, and acceptable reduction of risks and preservation of environmental values in protecting other rural and urban areas. Definitions for certain significant storms and floods, and for terms that relate flood magnitude to project performance, have been adopted as follows:

a. Standard Project Storm (SPS). The SPS is a hypothetical storm having the most severe flood-producing rainfall depth-area-duration relationship and areal distribution pattern that is considered reasonably characteristic of the region in which the drainage area is located. It is developed by studying the major storm events in the region, excluding the most extreme. Development of the SPS may involve transposition and adjustment of a large storm from its observed location to the locality of concern (EM 1110-2-1411). When that is the case, studies are to be coordinated through CECW-EH for review by the Hydrometeorological Section of NWS.

b. Standard Project Flood (SPF). The SPF is the discharge hydrograph resulting from the SPS. SPF for projects east of the 105th meridian may be developed using EM 1110-2-1411. For projects located west of the 105th meridian, use 50 percent of the Probable Maximum Flood (PMF) for SPF.

c. Probable Maximum Precipitation (PMP). Theoretically, the PMP is the greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographical location during a certain time of the year. Development of the PMP considers all storms of record and the observed

precipitation is increased by maximizing the moisture inflows to the storm system. Generalized depth-area-duration and seasonal relationships for the continental U.S. are published by the National Weather Service in a series of hydrometeorological reports .

d. Probable Maximum Flood (PMF). The PMF is the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the drainage basin under study. A PMF is developed from PMP. Assumptions concerning rainfall losses, snowmelt runoff, channel efficiency, etc. are adjusted to produce the largest flood reasonably possible. The PMF is used to design high hazard structures (top of dam, outlet and spillway capacities) where failure cannot be tolerated.

e. Inflow Design Flood (IDF). The IDF for a dam is the flood hydrograph used in the design or evaluation of a dam and its appurtenant works (ER 1110-8-2(FR)). In some older documents, this may be referred to as the spillway design flood. The upper limit of the IDF is the PMF.

f. Project Performance. The analysis will quantify the project reliability and performance by explicitly incorporating the uncertainties associated with key hydrologic, hydraulic, and other engineering variables. This reliability and performance will be reported as the protection for a target percent chance exceedance flood with a specified reliability. For example, the proposed project is expected to contain the one-half percent (0.5 percent) chance exceedance flood, should it occur, with a ninety percent (90%) reliability. This performance may also be described in terms of the percent chance of containing a specific historic flood should it occur. To fully define how a project is expected to function requires describing project impacts at several flood levels and locations. There is no minimum level of performance or reliability required for Corps projects; therefore, any project increments beyond the NED plan represents explicit risk management options. It is, therefore, vital that all participants understand the performance, reliability and costs of the NED plan, as well as, increments and decrements of the plan, in order to fully participate in an informed decision-making process.

13-5. Risk-Based Analysis. The risk-based analysis framework is defined as an approach to evaluation and decision making that explicitly, and to the extent practical, analytically, incorporates considerations of risk and uncertainty. These risks and uncertainties arise from measurement errors, short data records, and from the innate variability of complex physical, social, and economic situations, particularly those dealing with future occurrences. Because it captures and quantifies the extent of the risk and uncertainty in the various planning and design components of an investment project, this approach has been found very useful. Each of the components can be examined and conscious decisions made reflecting an explicit tradeoff between risk and costs. Risk-based analysis can identify which plans are more robust and can be used to compare plans in terms of their likely physical performance and economic success.

13-6. Structural Measures. Different types of structural flood damage reduction measures have different primary and secondary impacts on flooding. Plan formulation and impact assessment should take into

account all impacts, and residual flooding from all sources. (The dominant flooding may be from a different source under without and with project conditions.) In project planning, both the primary beneficial effects and the secondary effects of the alternatives must be borne in mind and appropriately accommodated.

a. Reservoirs. Reservoirs regulate floods downstream from the dam by temporarily storing some part of the flood volume and releasing it later. The impact downstream is to lower flood stages, increase the duration of flooding, and shift the flood to a later time. It is normal for dam and reservoir projects to effect some control on, and lower flood stages for, all magnitudes of floods. This is especially true of dams with ungated spillways. The amount of control and effectiveness will, however, decrease when flood volumes exceed the storage reserved for flood control. For the large flood, dams with gated spillways may exert lesser control on downstream flood stages than comparable ungated dams. Reservoir releases downstream can raise groundwater levels in fields adjacent (and even more distant) to the river and rapid change in stages can exacerbate bank caving. Downstream of dams, uncontrolled tributaries will continue to contribute to flooding, causing stage reductions to become less and less farther downstream. (Tributary flooding may then assume increased significance.) Channel capacities downstream of dams may increase over time; however, farther downstream, especially below a tributary carrying heavy sediment loads, channel capacity may be reduced. (Reservoir regulation tends to shift channel rating curves upward--less flow at a given stage--especially upstream of tributaries.) Upstream of a dam, sediment deposition can be expected to occur mostly in upper pool areas, decreasing the flood control effectiveness over time and raising flood stages and ground water levels around the pool.

b. Channel Enlargements. Channel enlargement will act like a negative reservoir, raising flood stages downstream, shortening flood durations and shifting the flood to an earlier time. Flood stages will be lower in the enlarged channel reach for all floods including those exceeding the channel capacity, if the channel is not excessively long. (Long, oversize channels may have increased flood stages in the lower part of the channel.) With main stem flooding reduced, direct overbank flooding from tributaries may assume increased significance. How flows from upstream and from tributaries are collected, controlled, and transitioned into the enlarged channel can greatly influence the project's beneficial impacts. Some control is generally required to direct overbank flow into the channel. Erosion and considerable attendant damage may occur upstream of the enlarged channel unless there is appropriate hydraulic control; the same applies where tributaries enter. All artificially enlarged channels will tend toward a new equilibrium state where sediment inflow and carrying capacity are in balance; the trend may be to a smaller or larger channel than the one constructed. Whatever the trend, it may be so slow as to be hardly noticeable, may occur at some intermediate rate, or may take place suddenly with one dramatic large flood.

c. Levees and Floodwalls. Levees and floodwalls are constructed to exclude flood waters from the protected area, up to a certain magnitude of flood. Unlike reservoirs and channel enlargements, the flood control effectiveness of a levee or floodwall will cease abruptly if a flood should overtop it. Interior runoff

impeded by the structure may cause interior flooding if there are not proper provisions for interim storage behind it or discharge past the barrier. Potential effects outside a levee, upstream and downstream, are too complex and too site dependent to generalize otherwise, but generally the constriction of flow area caused by the structure will raise flood stages upstream. Within the levee reach, flood stages may be increased or decreased depending on whether the structure forms a hydraulically long or short constriction. A levee may reduce valley storage enough to cause the same impacts downstream as a channel.

13-7. Nonstructural Measures. Section 73 of Public Law 93-251 expresses Congressional policy and, in effect, endorses Corps practice that consideration shall be given to nonstructural measures in the planning and formulation of all flood damage reduction plans. Nonstructural measures are defined as those which reduce or avoid flood damages, without significantly altering the nature or extent of flooding, by changing the use made of flood plains or accommodating existing uses to the flood hazard. Examples of nonstructural measures are flood proofing, flood warning/preparedness, temporary or permanent evacuation, and regulation of flood plains. These measures are considered separately, in combination and as incremental elements of plans which may include structural measures also. Economic justification can be based on combined flood damage reduction and other (e.g., recreational) benefits. Nonstructural plans should be formulated without preconception as to what would constitute an acceptable minimum level of protection. The level of protection may vary in order to achieve a more coherent and cohesive plan. The level of protection is a Corps decision; individual owners may decide whether to participate. Plans that would leave occupied buildings inaccessible during a flood are normally not recommended. The separable costs allocated to recreation and fish and wildlife shall not exceed the costs for flood damage reduction.

13-8. Definition of the Flood Control Plan. The Federal flood control project is comprised of two obvious elements: the physical aspects of improvement recommended and the associated requirements of local cooperation. The intended flood control plan (i.e., the outputs from the Federal project) may, however, be dependent upon other elements as well. The assumptions made about how the Federal project improvements will function may depend upon other assumptions about the continued effectiveness of already existing non-Federal developments that shape or control flows (whether specifically intended for flood control, or not). They may reflect the assumed existence of other non-Federal developments planned but not yet in place. It is critical that the non-Federal sponsor, responsible for operation and maintenance (O&M) of the Federal project, understand the importance of all the elements that go together to make the plan function. A complete description of a plan includes all structural, nonstructural, legal, and institutional features, both proposed and existing, that contribute to the intended flood control outputs. The outputs of the plan, and of individual elements if they have separable outputs, should be quantified in understandable physical, economic and environmental terms. The operating requirements should be developed for each element requiring operation (e.g., statement of the trigger that will say it is time to close a gate and the amount of time it will take to close it). Finally, there should be explication of the overall resources required to operate and maintain the plan, i.e., manpower, equipment, cost. The requirement for definition of the plan in these terms begins in the preauthorization feasibility phase and

ends with preparation of the O&M manual furnished to the non-Federal sponsor when the project is turned over (See paragraphs 10-12, 11-2.c).

13-9. Drainage. Section 2 of the Flood Control Act of 1944 redefined flood control to include "channel and major drainage improvements." Section 403 of WRDA 1986 modified this by inserting after "drainage improvements" the following: "and flood prevention improvements for protection from groundwater-induced damages."

a. Major Outlets. Legislative recognition that the provision of major drainage outlets is an essential part of and complement to flood damage reduction improvements, is interpreted to permit major drainage improvements of natural waterways and their tributaries, and of existing artificial waterways. Major outlets are designated as those for the drainage from an organized or contemplated drainage district, groups of drainage districts, or local governmental unit such as county, town, or city. Normally, the Federal project for an outlet drainage channel will consist of works in a natural stream or existing artificial waterway. However, new artificial drainage channels may be constructed under the Federal program wherever that procedure would be technically more effective, environmentally sound, and would be more economical than improvement of existing drainage courses. (The costs of major drainage outlets are included with costs for other project flood control elements and cost shared accordingly.)

b. Agricultural. In agricultural areas, collection of drainage water is considered a local responsibility. This includes such work as ditching, diking, and grading on farms and within local drainage districts or governmental units. Federal outlets works may "tie" into such local works.

c. Urban. Flood damage reduction works in urban areas are the adjustments in land use and the facilities designed to reduce flood damages in urban areas from overflow or backwater due to major storms and snowmelt. They include structural and other engineering modifications to natural streams or to previously modified natural waterways. In urban or urbanizing areas, provision of a basic drainage system to collect and convey the local runoff to a stream is a non-Federal responsibility. Water damage problems may be addressed under the flood control authorities downstream from the point where the flood discharge is greater than 800 cubic feet per second for the 10 percent flood (one chance in ten of being exceeded in any given year) under conditions expected to prevail during the period of analysis. Drainage areas of less than 1.5 square miles shall be assumed to lack adequate discharge to meet the above criterion. Exceptions may be granted in areas of hydrologic disparity producing limited discharges for the 10 percent flood but in excess of 1800 cfs for the one percent flood. (ER 1165-2-21)

d. Groundwater. Section 403 of WRDA 1986 defines flood control to include measures for the prevention of groundwater-induced damages. Study and analysis of this expanded definition of flood control has not produced a satisfactory classification system for defining Corps interest in a groundwater-induced damage prevention program. Accordingly, budget and authorization support is not available at this time for a generic program of groundwater-induced damage prevention. Individual cases involving urban groundwater-induced flooding believed

to have merit within the general context of traditional flood damage reduction should be referred to CECW-P prior to implying any Corps interest to potential sponsors.

13-10. Project Cooperation and Cost Sharing. WRDA 1986, superseding previous legislative provisions, and as amended by WRDA 1996, established the basic requirements for non-Federal participation in Federal flood damage reduction projects. Separable costs of recreation features included in structural and nonstructural flood damage reduction projects are cost shared 50-percent Federal/50-percent non-Federal.

a. Structural Measures. For structural projects (or structural components of a project combining both structural and nonstructural elements) non-Federal interests must:

(1) Provide a cash contribution equal to 5 percent of total project costs;

(2) Provide all lands, easements, rights-of-way, relocations (except alterations to railroad bridges and approaches thereto including constructing new railroad bridges over flood control channels constructed in fast lands or new channel alignments which are assigned as construction costs), and dredged material disposal areas (referred to as LERRD);

(3) Provide an additional cash payment when the sum of items (1) and (2) is less than 25 percent of total project costs (35 percent for projects authorized, or reauthorized after formal deauthorization, after 12 October 1996) (if the sum of items (1) and (2) should exceed 50 percent of total project costs, local contributions in excess of 50 percent will be reimbursed by the Federal Government);

(4) Operate, maintain, repair, replace, and rehabilitate the project after completion (referred to as OMR&R);

(5) Hold and save the United States free from damages due to the construction or subsequent maintenance of the project, except any damages due to the fault or negligence of the United States or its contractors;

(6) Prevent future encroachments which might interfere with proper functioning of the project;

(7) For any project for local flood protection, participate in and comply with applicable Federal flood plain management and flood insurance programs (i.e., the National Flood Insurance Program), pursuant to Section 402, Public Law 99-662, as amended, (Note: Item (7) is applicable to projects designed for the primary benefit of specific localities; for projects such as large reservoirs designed to provide widespread benefits of varying significance to disparate jurisdictions throughout an extended area or region, it may be omitted) and, prepare a flood plain management plan designed to reduce the impacts of future flood events in the project area within one year of signing a project cooperation agreement (PCA), and implement such plan not later than one year after completion of construction of the project; and,

(8) Provide guidance and leadership to prevent unwise future

development in the flood plain.

b. Nonstructural Measures. The non-Federal costs for nonstructural measures (as complete projects or as components of a project combining both structural and nonstructural elements) will be limited to 25 percent of total project costs (35 percent for features/projects authorized, or reauthorized after formal deauthorization, after 12 October 1996) for such measures. Non-Federal interests are required to provide all LERRD. If the cost of LERRD should be less than 25 percent of total costs (35 percent for features/projects authorized, or reauthorized after formal deauthorization, after 12 October 1996) for the nonstructural measures, non-Federal interests shall pay the difference in cash. If LERRD costs are in excess of 25 percent (35 percent for features/projects authorized, or reauthorized after formal deauthorization, after 12 October 1996), the difference will be reimbursed by the Federal Government. Non-Federal interests are responsible for all related OMRR&R. They are also required to participate in and comply with applicable Federal flood plain management and flood insurance programs and prepare and implement a flood plain management plan. (The 5 percent cash contribution required for structural components is not required for nonstructural components, nor are non-Federal interests required to contribute any cash for which they may be responsible during the period of project construction, as they might be in connection with structural components.) Nonstructural measures adopted as part of a project, regardless of why so included (e.g., to achieve mitigation of secondary impacts of structural measures), shall, for cost sharing purposes, be treated as a nonstructural components of the project.

c. Special Cases. Special local requirements, cost sharing or otherwise, may be recommended in order to provide equitable and practical Federal/non-Federal cooperation.

(1) Projects providing windfall-type benefits of "unconscionable" magnitude to a few beneficiaries are considered to warrant special and equal cost sharing, usually as a cash contribution, from the responsible local entity, in addition to other requirements of cooperation. Sub-allocation of this added cost is the responsibility of the local entity.

(2) Local interests are assigned the cost of covering flood control channels when provision of the cover is not required for safety or when it decreases net National Economic Development (NED) flood damage reduction benefits. (ER 1165-2-118)

(3) Special items of construction may be assigned to the Corps or to local entities, depending on practical considerations of construction procedures, safety, and efficiency, if provided for in the project authorization.

d. Regulation of the Flood Plain. Responsibility for adoption and enforcement of regulations for flood plain management is entirely local. In the absence of a Federal project the Corps cannot require local interests to implement flood plain regulations (for instance, where feasibility studies result in conclusion that regulation is the most appropriate or only feasible response to the flood problem). However, before construction of any Federal project for local flood protection, or any Federal project for hurricane or



storm damage reduction, or separable element thereof, including projects developed under Section 103, Section 205, and Section 208 of the Continuing Authorities Program, that involves Federal assistance from the Secretary of the Army (and for which the Secretary and the non-Federal interest enter into a project cooperation agreement (PCA) after 12 October 1996), non-Federal interests are required to agree to participate in and comply with applicable Federal floodplain management and flood insurance programs (e.g., the National Flood Insurance Program which requires the adoption of land use control measures to prevent construction in the floodway or construction of permanent structures in the balance of the flood plain with first floors below the 100-year flood level). Within one year after the date of signing a PCA for construction of a project to which the aforementioned requirement applies, the non-Federal interest is required to prepare a flood plain management plan (FPMP) designed to reduce the impacts of future flood events in the project area, and to implement such FPMP not later than one year after completion of construction of the project. To promote prudent flood plain management at the non-Federal level, it is Corps policy to encourage a non-Federal sponsor to develop its FPMP during the preparation of the feasibility study. A non-Federal sponsor's FPMP should implement measures, public expenditures, and policies to reduce loss of life, injuries, damages to property and facilities, public expenditures, and other adverse impacts associated with flooding, and to preserve and enhance natural flood plain values and should address measures which will help preserve levels of protection provided by the Corps flood damage reduction or hurricane or storm damage reduction project. Also, local interests may be required to adopt and enforce other, special regulations if they are necessary to protect the Federal investment or to achieve expected project benefits (e.g., preservation of channel capacity by adoption of regulations controlling channel encroachments, preservation and reservation of ponding areas, etc.). In general, the local sponsor should adopt flood plain management programs necessary to ensure wise use of flood plains in, as well as adjacent to, the project area. (ER 1105-2-100).

13-11. Single Owner Properties. The Corps will not recommend adoption of a Federal project, or include as a separable element in a recommended structural project plan, flood control improvements which would solely benefit the private property of a single owner. (See Table 12-3 and paragraph 12-7.a) The Corps may recommend Federal cost participation in the construction of a flood control project where the project would serve/benefit property owned publicly by a single state (including the District of Columbia and territories and possessions of the United States), county, municipality, or other duly appointed public entity. (ER 1165-2-123)

13-12. Credit for Compatible Non-Federal Works. The non-Federal sponsor of a Corps flood control project may, pursuant to Section 104 of WRDA 1986 (Public Law 99-662), receive credit toward the sponsor's costs for required local cooperation for compatible flood control works constructed in advance by non-Federal interests. Basically this is limited to such works undertaken by non-Federal sponsors while Federal preauthorization studies for the Federal project are in progress. (ER 1165-2-29)

a. Work accomplished prior to completion of the reconnaissance phase of the preauthorization studies is not eligible.

b. Thereafter, credit may be afforded if, before the work is undertaken, the non-Federal sponsor applies for and receives conditional assurance from the Corps that the work can reasonably be expected to be recommended for credit. (This procedure must be completed prior to project authorization.)

c. The work must subsequently be completed by the non-Federal sponsor; a Federal project must ultimately be authorized by Congress; the completed non-Federal work must still be a relevant element of whatever final plan for the Federal project is adopted; and the Federal project must actually be undertaken.

d. In completion of the feasibility phase of preauthorization studies, the non-Federal works for which credit applications have been favorably acted upon will be included as elements of at least one of the alternative plans under consideration for recommendation as a Federal project; in evaluation of the alternatives, such non-Federal works, whether completed or not, will not be assumed part of the "without" project condition.

e. Proposed crediting will be addressed in feasibility report recommendations.

f. Credit for completed compatible work may be given after the PCA is approved against all requirements of local cooperation for the Federal project, except against the basic 5 percent cash contribution; the creditable work will be valued as the lesser of the actual non-Federal costs or the estimated cost for the work if accomplished as part of Federal project construction; if such value exceeds the final value of the local cooperation requirements against which credit can be given, non-Federal sponsor is not entitled to reimbursement for any such excess.

13-13. Flood Insurance. The National Flood Insurance Program (NFIP) is available to protect the individual in participating communities from extreme financial loss in the event of a disasterous flood. Under the NFIP (Public Law 90-448, as amended) insurance is subsidized, up to an amount specified, on properties in areas designated as hazardous by the Federal Emergency Management Agency (FEMA). The land use control measures required of communities to gain and maintain eligibility for flood insurance are complementary to other flood plain management efforts. Section 202 of Public Law 93-234 states that no Federal officer or agency shall approve any financial assistance for acquisition or construction purposes after July 1, 1975, for use in any area identified by FEMA as an area having special flood hazards unless the community in which such area is situated is then participating in the NFIP. Section 402 of WRDA 1986 expands the prohibition against Federal participation in flood hazard areas by including "Federal participation in construction of local flood control projects"; and Section 14 of WRDA 1988 amended Section 402 to extend prohibition to "hurricane and storm damage reduction projects." Throughout the planning, engineering, and construction process, coordination, investigations and responsibilities of the parties involved must be identified to ensure that the necessary technical data is developed and available for the community to maintain active participation in the NFIP.

13-14. Evaluation of Economic Benefits for Flood Damage Reduction. Flood plain management, including flood control and prevention, can

contribute to the NED objective by improving the net productivity of flood prone land resources. This occurs either by an increase in output of goods and services and/or by reducing the cost of using the land resources (improvement in economic efficiency). The benefit standard is the willingness of users (benefiting activities) to pay for each increment of output from a plan. (P&G, Chapter II)

a. Evaluation Procedure. Each flood plain management plan under consideration is evaluated on a with and without basis. The without condition is that most likely to occur without the specific plan and gives proper recognition of the effect of existing and authorized plans, laws, policies and the flood hazard on the probable course of development. The adoption and enforcement of appropriate land use regulations pursuant to the Flood Disaster Protection Act of 1973 (Public Law 93-234) and compliance with EO 11988 and EO 11990 are assumed, both with and without a Corps plan. For purposes of evaluating structural components of a plan, rational economic use of the flood plain is assumed. Economic rationality assumes that users of the flood plain will attempt to maximize returns, and take actions with full knowledge of the flood hazard unless constrained by laws or policies as mentioned above. Benefits and costs are evaluated under prices existing at the time of submission of the report to HQUSACE.

b. Flood Damage Reduction Benefits. NED benefits are categorized according to their effect as inundation reduction benefits, intensification benefits, or location benefits. Inundation reduction benefit is the value of reducing or modifying the flood losses to the economic activity using the flood plain without any plan. Inundation reduction benefits are usually measured as the reduction in the amount of flood damages or related costs (those which would be voluntarily undertaken by economically rational individuals to reduce damages). Intensification benefit is the value of more intensive use of the land (e.g., a shift from lower to higher value crops or higher crop yields). Location benefit is the value of making flood plain land available for a new economic use (e.g., where a shift from agricultural to industrial use occurs).

c. Benefits from Evacuation or Relocation. NED benefits resulting from evacuation and relocation plans consist of: benefits from the new use of the flood plain; reduction of externalized flood damages (damages absorbed by non-flood plain occupants); and benefits accruing to off-flood-plain properties adjacent to open space. In addition, non-monetary values such as increases in significant environmental outputs on the evacuated flood-prone lands may be considered in establishing justification for evacuation and relocation plans.

d. Land Development Benefits. Land development, as used here for policy purposes, is defined as the conversion of primarily vacant land (land without significant structural improvements) to more valuable (economically defined) use as a result of a flood damage reduction project. Benefits for land development are usually categorized as "location" benefits and are equivalent to the net change in land value. An example would be the conversion of farmland to residential land as a result of provision of flood protection. Land development does not include cases where land use is the same with or without the flood damage reduction project but would be used more intensively (intensification). It also does not include cases where land use would change without the project and project benefits

are achieved through savings in future flood proofing costs or prevention of damages to future development. The following general policy principles apply to the consideration of land development benefits at structural flood damage reduction projects.

(1) Project or separable increments of projects that achieve only land development (location) benefits do not address the priority purpose of flood damage reduction and, therefore, have a low budget priority. Federal participation in these projects or separable increments will not be recommended.

(2) The NED plan will be formulated to protect existing development and vacant property that is interspersed with existing development. All project benefits, including land development benefits for interspersed vacant property, will be included for project formulation and justification. The NED plan may also provide protection of vacant property that is not interspersed with existing development if it can be demonstrated that the vacant property would be developed without the project and benefits are based on savings in future flood proofing costs or reduction in damages to future development.

(3) If no project or separable project increment can be economically justified to protect existing development, interspersed vacant property and/or property that would be developed without the project, there is ordinarily no budgetary interest in expanding the area of protection to achieve land development (location) benefits even if net benefits are increased and economic justification can be achieved.

(4) A limited exception to policy principles (1) through (3) above can be considered in the case where the cost of protecting existing development can be substantially reduced if some vacant property that is not interspersed with existing development is included in the protected area. This situation typically exists where an existing levee or floodwall is being raised to provide a higher degree of protection. These exceptions will be considered on a case-by-case basis. Compatibility with EO 11988 still must be demonstrated. It also must be clear that the primary objective of the project is not land development but the minimization of the cost of protecting existing development.

e. Benefit Determination Involving Existing Levees. Problems have often arisen in the benefit evaluation of flood damage reduction studies when there are existing levees of uncertain reliability. Specifically, the problem is one of engineering judgment but has implications for benefit evaluation: engineering opinion may differ or be uncertain on the ability of the levees to contain flows with water surface elevations of given heights. This may lead to difficulty in arriving at a clear, reasonable and agreed upon without project condition.

(1) General. Investigations for flood damage prevention involving the evaluation of the physical effectiveness of existing levees and the related effect on the economic analysis shall use a systematic approach to resolving indeterminate, or arguable, degrees of reliability. Reasonable technical investigations shall be pursued to establish the minimum and, to the extent possible, the maximum estimated levels of physical effectiveness. Necessary information and

summary of analyses shall be included in report presentations of plan formulation and shall be documented in appropriate supporting materials.

(2) Sources of Uncertainty. Studies involving existing levees will focus on the sources of uncertainty (likely causes of failure). Other than overtopping, levees principally fail due to one or a combination of four causes: surface erosion, internal erosion (piping), underseepage, and slides within the levee embankment or foundation soils. Reasonable investigations, commensurate with the level of detail suitable to the planning activity underway, shall determine the condition of existing levees with respect to the factors that can lead to failure, if this information does not already exist.

(3) Performance Record. Existing levees either have or have not failed during previous flood events or have shown evidence of distress such as various degrees of piping, underseepage and sloughing. Information regarding their performance is relevant and vitally important in forming judgments regarding future performance. However, it should not be assumed that because a levee has passed a flood of a given frequency it will always do so in the future or vice versa, assuming the levee has been repaired.

(4) Reliability.

(a) Reliability judgments should be based solely on physical phenomena. The question to be answered is: what percent of the time will a given levee withstand water at height "x"? This means that considerations such as degree of protection, induced damages, induced flood heights, potential for increased risk of loss of life due to false sense of security, etc., are not included. These considerations will be dealt with separately during the plan formulation process.

(b) The purpose of reliability determination is to be able to estimate the without-project damages. Its purpose is not to make statements about the degree of protection afforded by the existing levees. Major subordinate commands (MSC) and district commands (DC) making reliability determinations should gather information to enable them to identify two points on the existing levees. The first point is the highest vertical elevation on the levee such that it is highly likely that the levee would not fail if the water surface elevation were to reach this level. This point shall be referred to as the Probable Non-failure Point (PNP). The second point is the lowest vertical elevation on the levee such that it is highly likely that the levee would fail. This point shall be referred to as the Probable Failure Point (PFP). As used here, "highly likely" means 85+ percent confidence. As defined, the PNP will be at a lower elevation than the the PFP. When there are unresolved uncertainties or differences of opinion, consideration should be given to having the range of uncertainty extend from the lower of arguable PNPs to the higher of the PFPs. Because of lack of information or other reasons, if the PFP cannot be determined then the PFP shall be the low point in the levee where the levee is first overtopped. When determining the low point in the levee, MSC and DC shall assume that closure actions have taken place.

(5) Benefit Evaluation Procedure. Even if no degree of protection is claimed for an existing levee, it does, most likely, provide some benefits. Assessment of these benefits must be in some

degree arbitrary in the absence of illuminating engineering or statistical analyses. The function of identifying the probable failure and non-failure points is to create a range of water surface elevations on the levee over which it may be presumed that the probability of levee failure increases as water height increases. The requirement that as the water surface height increases the probability of failure increases, incorporates the reasonable assumption that as the levee becomes more and more stressed it is more and more likely to fail. If the form of the probability distribution is not known, a linear relationship is an acceptable approach for calculating the benefits associated with the existing levees. For benefit evaluation, assume all flood damages will be prevented below the PNP; and no damages will be prevented above the PFP.

f. Restoration of Market Values. Valid estimates of restored market value are difficult and costly to make in typical flood control project evaluations. Therefore, no resources should be used in efforts to quantify restoration of market values for flood control projects.

13-15. Flood Emergency Operations and Disaster Assistance.

a. Corps of Engineers Authority. Emergency activities pursuant to Section 5 of Public Law 77-288, as amended by Public Law 99, 84th Congress, Section 206 of the Flood Control Act of 1962 and Section 302 of WRDA 1990, and others, includes the following work whenever and wherever required: preparation for emergency response to any natural disaster; flood fighting and rescue operations; post flood response; emergency repair and restoration of flood damaged or destroyed flood control works such as levees; emergency protection of Federally authorized hurricane and shore protection works being threatened; and the repair or restoration of Federal hurricane or shore protection structures damaged or destroyed by wind, wave, or water action of other than an ordinary nature. The authority under Section 5, as amended, was expanded by Section 82 of Public Law 93-251, which authorized providing emergency supplies of clean water to any locality confronted with a source of contaminated water causing or likely to cause a substantial threat to the public health and welfare of the inhabitants of the locality. Public Law 95-51 further amended Section 5 to provide the Secretary of the Army authority to provide emergency water supplies in areas determined to be drought distressed. Authorized emergency activities are financed from an Emergency Fund authorized by Section 5, to be replenished on an annual basis. (ER 11-1-320, ER 500-1-1)

(1) The provision of advance flood damage reduction measures by the Corps is supplemental to state and local community efforts, rather than replacements for them. Corps protective and preventive measures will generally be of a temporary nature designed to meet an imminent flood threat. Permanent rehabilitation work to protect against the threat of future disasters will be considered separately from advance measures. A declaration of a state of emergency or written request by the governor of a state is a prerequisite to furnishing advance measures. Local interests are required to remove temporary works provided as advanced measures.

(2) It is Corps policy that local assurances and appropriate requests for assistance will be obtained. Local cooperation for accomplishment of advance measures and rehabilitation works require

local assurances to (a) provide without cost to the United States all lands, easements and rights-of-way necessary for the authorized emergency work; (b) hold and save the United States free from damage due to the authorized emergency work; and (c) maintain and operate all the rehabilitation work after its completion. Additional features of local participation should also be considered, as appropriate, and included in the assurance agreement; e.g., the removal of emergency flood damage reduction measures, after their purpose has been served, is a local responsibility.

(3) Requests for providing emergency supplies of clean water due to contamination or drought are considered separately from the flood and coastal storm emergency activities. Requests for assistance due to a contaminated source must be made in writing by the governor of the state affected. Assistance for contaminated source situations is limited to 30 days. Applications from drought distressed areas may be presented by individuals or political subdivisions who must agree to the terms deemed necessary by the Secretary of the Army. Assistance is limited to Federally owned equipment and Federal manpower for implementation.

(4) Under Section 5, as amended, emergency funds may be expended directly by the Corps for authorized purposes. However, there is no authority under Section 5 whereby local interests may be reimbursed for any of their costs for emergency operations accomplished on their own behalf. Also, Section 5 authority and funds are not used in lieu of other appropriate Corps continuing authorities.

(5) After a flood event, the Corps may perform emergency work on public and private lands and waters for a period of 10 days following a governor's request for assistance. This work must be essential for the preservation of life and property, including, but not limited to, channel clearance, emergency shore protection, clearance and removal of debris and wreckage endangering health and safety, and temporary restoration of essential public facilities and services.

b. Other Disaster Assistance. Disaster assistance beyond Corps statutory authority will conform to the provisions of AR 500-60 which pertains primarily to military assistance. In the event of Presidential declaration of a major disaster, or emergency declared by the Director, Federal Emergency Management Agency (FEMA), assistance to state and local governments is provided in essential response and recovery operations when and as directed by the President through FEMA under the provisions of The Robert T. Stafford Disaster Relief Act (42 U.S.C. 5121 et seq). The Corps fully responds to all requests from the FEMA Director or Regional Director. (ER 11-1-320, ER 500-1-1)

13-16. Use of Storage Allocated for Flood Damage Reduction and Navigation at Non-Corps Projects. Section 7 of the Flood Control Act of 1944 requires the Secretary to prescribe regulations for the use of storage allocated for flood control or navigation at all reservoirs constructed wholly or in part with Federal funds. During the planning and design phases, project owners consult with the Corps regarding the quantity and value of space to reserve in the reservoir for flood damage reduction and/or navigation. (ER 1110-2-241, EM 1110-2-3600)

13-17. Provision of Flood Protection at Urban Renewal Projects. The inclusion of flood protection at urban renewal projects must be in accordance with the WRC Principles and Guidelines (P&G).

13-18. Construction of Flood Control Projects by Non-Federal Interests. Section 211 of WRDA 1996 provides authority for non-Federal sponsors to undertake the design and construction of federally authorized flood control projects without Federal funding, and to be eligible to be reimbursed an amount equal to the estimate of the Federal share, without interest (or inflation), of the design and construction cost of the project or separable element thereof. The Energy and Water Development Appropriations Act of 1998 provides additional guidance on Section 211 of WRDA 1996 regarding notification of the Committees on Appropriations of the House and Senate on scheduling of reimbursements.

a. General. Reimbursement for the construction of any authorized flood control project undertaken by a non-Federal sponsor pursuant to Section 211 of WRDA 1996 is contingent upon approval by the Secretary of the Army of the plans for construction and the Secretary's determination, after a review of studies and design documents, that the project or separable element thereof, is economically justified and environmentally acceptable. This approval must be obtained prior to the initiation of construction of the work for which the reimbursement request will be made. Further, prior to initiating negotiations for a reimbursement agreement for the construction of any project pursuant to Section 211 of WRDA 1996, the Secretary of the Army must notify the Committees on Appropriations of the House and the Senate. This notification must include the total commitment and the reimbursement requirements that the Administration intends to support in future budget submissions. Budgetary and programmatic priorities will be taken into account when reviewing plans submitted by non-Federal sponsors. Only projects or separable elements of projects which have been specifically authorized by Congress will be considered eligible for reimbursement under this provision. Reimbursement of non-Federal sponsor work under Section 211(e) of WRDA 1996 will not be considered for the Continuing Authorities Program projects.

b. Non-Federal Requirements. All projects pursued under the authority of Section 211 must be planned, designed and constructed in accordance with appropriate Federal criteria, standards and policies, including the appropriate National Environmental Policy Act (NEPA) documentation, and construction must comply with all applicable Federal and state laws and regulations. The non-Federal sponsor will normally be required to develop the design, engineering plans and specifications for the construction it proposes to undertake. In addition, the non-Federal sponsor must conduct NEPA investigations, prepare appropriate NEPA documents, conduct all public and agency coordination, and obtain all necessary Federal and state permits. The Corps may undertake these efforts if funds are provided by the non-Federal sponsor and if such work does not delay the completion of other Corps assignments. Further, funds for activities undertaken by the Corps district offices which are necessary for the successful completion of a Section 211 project or separable element thereof, and construction of the sponsor proposed work including, but not limited to, design, review of project economics, environmental assessments, determination of LERRDs requirements, auditing, permit evaluations, and inspections, must also be provided by the non-Federal sponsor.



The non-Federal sponsor must provide all LERRDs and shall perform or ensure performance of all relocations that the Corps determines are required for the construction, operation and maintenance of the project. The value of LERRDs provided by the non-Federal sponsor that are required for the project will be determined in accordance with standard valuation procedures as contained in the model PCA for structural flood control projects. In addition, the non-Federal sponsor will be responsible for the operation, maintenance, repair, replacement and rehabilitation of the project in accordance with regulations or directions prescribed by the Corps and shall perform all other items of sponsor cooperation required by the project authorization.

c. Section 211 Agreement. In the development of a Section 211 agreement, the normal procedures for processing and reviewing a PCA will be used. The decision document approved by the Secretary must be included as support for the Section 211 agreement. Negotiations for proceeding with a project under Section 211 are to be accomplished at the district level once approval to initiate the negotiations has been received.

d. Reimbursement. Reimbursements pursuant to Section 211(e)(1) of WRDA 1996 cannot occur until the flood control project, or separable element thereof, has been constructed. Reimbursements are subject to appropriations Acts. Any eligible reimbursable Federal share of costs associated with studies or design efforts conducted by non-Federal sponsors after authorization and prior to construction will be included in the final auditing of the total project costs upon completion of the construction of a project or separable element thereof. Any reimbursement desired by a non-Federal sponsor for studies or design it accomplished prior to authorization must be specifically identified and requested in the authorizing document.