APPENDIX I

OTHER PLANNING GUIDANCE

Contents

Chapter IV: Process to Prepare a Comprehensive Flood Hazard Management Plan

Introduction

The process to develop a Comprehensive Flood Hazard Management Plan in conformance with Chapter 86.26 RCW and Chapter 173-145 WAC mirrors many of the procedures and steps of general comprehensive planning. Namely:

1. Establish citizen and agency participation process.
2. Set flood hazard management short- and long-term goals and objectives.
3. Inventory and analysis of physical conditions.
4. Determine need for flood hazard management measures.
5. Identify alternative flood hazard management measures.
6. Evaluate alternative measures.
7. Hold public alternative evaluation workshop(s).
8. Develop flood hazard management strategy.
9. Complete draft Comprehensive Flood Hazard Management Plan and SEPA documentation.
10. Submit final Comprehensive Flood Hazard Management Plan to the Department of Ecology (Ecology).
11. Hold public hearing and pass intent to adopt resolution.
12. Notify Ecology that the final plan is adopted.

Based on previous experience, it is envisioned that the tasks to prepare an approvable CFHMP will take approximately 2 years, although this schedule can vary widely. Given this time frame, it may make sense to consider the process as having two phases. Phase I could logically include Steps "1" through "4" described below and result in the background documentation and determination of need. Phase II would then begin with identification of alternative solutions and carry the project through to completion. The diagram on the following page illustrates the various steps in the process and the discussion below outlines the activities that take place in each step. The exact order of each step is not critical. Several of the steps can take place concurrently. However, the general structure of the process outlined on the following page should be used as a guide.

From: Washington State Department of Ecology
"Comprehensive Planning for Flood Hazard Management Guidebook" - August 1991

Process to Prepare a Comprehensive Flood Hazard Management Plan

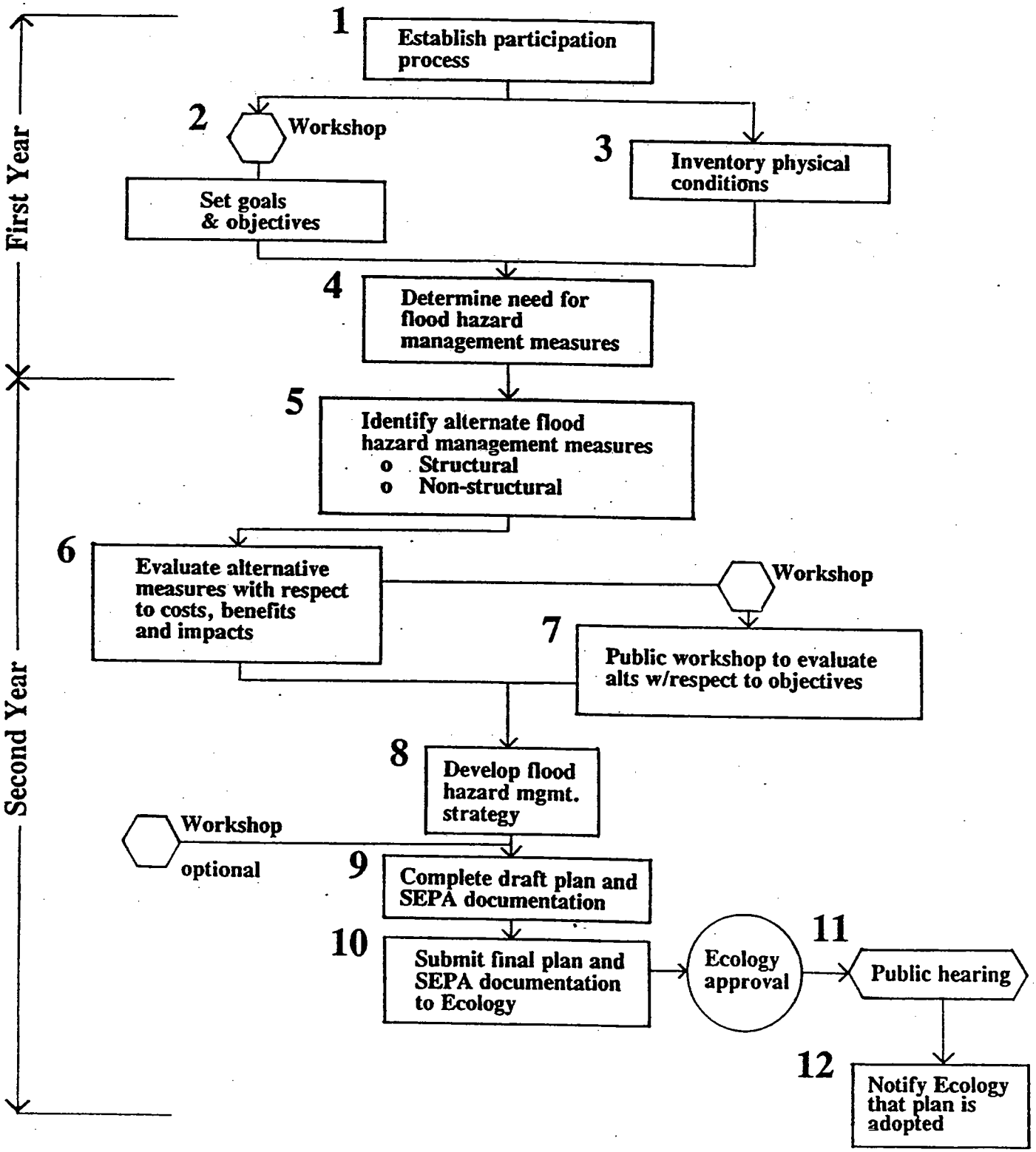


Diagram of Comprehensive Flood Hazard Management Plan (CFHMP) process.

Step 1: Establish Citizens and Agency Participation Process

Participation by the public and affected public agencies is critical to a flood hazard management plan's success for several reasons:

1. Proposed measures will affect many local property owners and their support will be needed to take action.

2. WAC 173-145-070 calls for the review of all Flood Control Assistance Account Program (FCAAP) projects by associated state agencies and affected parties. Therefore, appropriate public agencies such as the State Department's of Fisheries, Wildlife and Natural Resources as well as affected Native American tribes and other public entities should be involved throughout the process for plan formulation and comments.

3. Special interest groups such as the Audubon Society, recreation clubs or associations, real estate development interests, and business organizations may also have an interest in the plan and their objectives should be considered.

4. Since watersheds typically cross jurisdictional lines, representation from neighboring local governments must be incorporated in the process.

5. Since the plan must ultimately be adopted by the local government, it is important to build support among the local constituency.

6. The planning process offers an opportunity for educating the public to the issues, opportunities and public responsibilities of flood hazard management.

Task 1-A: Establish Planning Committee

Purpose and Composition of Advisory Committee

Public and agency participation should be accomplished in at least two ways. First, a planning committee or task force should be formed that includes a representation of public groups and property owners. Since flood hazard management actions may affect other governmental jurisdictions, it is advisable to include staff persons or public officials from neighboring jurisdictions. Other public agencies such as the State Departments of Ecology, Fisheries and Wildlife, as well as key entities such as port or diking districts and Native American tribes should be invited to participate. Since flood hazard management is a broad based planning effort and not solely an engineering exercise, it is important that a wide range of interests and backgrounds be incorporated in the process.

The role of the committee and its tenure must be carefully defined. Such committees or task forces are generally advisory, providing

direction throughout the process and recommending adoption of the final plan to the local government body actually adopting the plan. Under the process recommended in this guidebook, the committee would ideally meet at least once during each major step to review technical work, make decisions regarding alternate proposals and direct the technical planning team regarding the next step.

The size of the committee is an important consideration. Generally speaking, an 8 to 16 person committee has proven large enough to provide comprehensive representation but small enough to allow meaningful discussions and active work sessions. It may be appropriate to structure a two-tiered committee with representatives from within the local jurisdiction as primary members and representatives from state agencies and outside organizations as advisory members. This would provide good communication to the agency representatives but not require that they attend every meeting. In some cases it may make sense that the committee be formally disbanded after adoption of the plan. In other cases, maintaining the committee to review flood control project proposals and to provide advice on flood hazard management planning issues may be advantageous. The situation to avoid is having the committee continue on in a quasi-official capacity after the plan is adopted without a clear set of responsibilities.

The aim of the committee should be to build a consensus that balances competing objectives rather than favors a particular interest group. Therefore, attention should be given to the selection of representatives and committee procedures. It is recommended that in preparing committee recommendations, the committee attempts to define consensus positions rather than resort to divisive voting on individual issues.

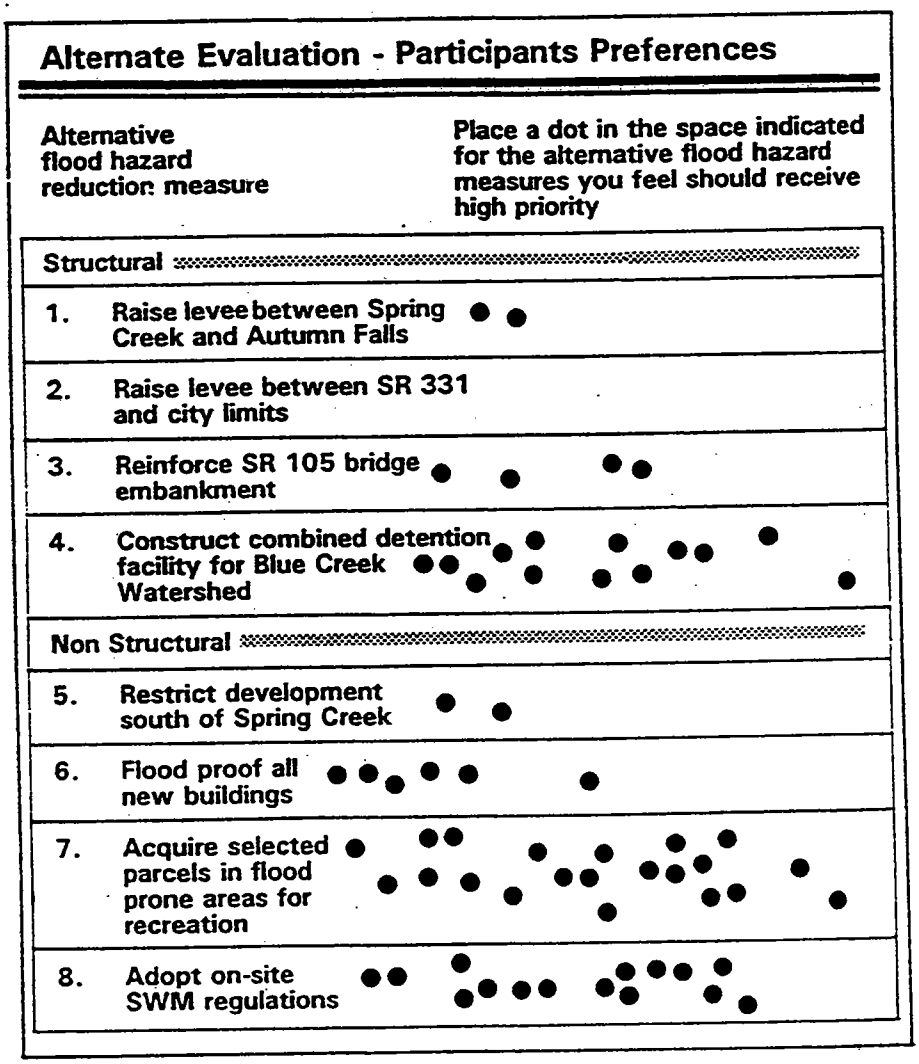
Task 1-B: Define Public Participation Process

The second recommended means to incorporate public input is through a series of public open house/workshops at which citizens can express their views. Experience has shown that public workshops are most effective at the goal formulation, alternative evaluation, and final review steps of the process, although it may be advantageous to add public meetings at other points as well. Asking citizens to describe their goals and objectives is an effective way to begin a public input process. At least one flood hazard management planner has found it very helpful for participants to relate their experiences of flooding using forms or maps on which participants can record historical and anecdotal information.

Citizens also find it relatively easy to compare and evaluate alternative flood hazard management actions when they can respond to a set of proposals. Finally, a presentation to the public just prior to the formal documentation and adoption process is a good way to check public response to the proposed plan.

Public Workshops

Public workshops are especially productive when participants can work in small groups on particular exercises. The small groups can then report back to the larger group and have the results compiled. Usually it is helpful to carefully design and test exercises and to prepare work materials in advance of the workshop. For example, asking people to help set goals and objectives can go much more easily if work groups are asked to comment on specific issues or to respond to a series of questions that require cooperative discussions about key topics. During the alternative evaluation workshop, participants can be given individual and group score sheets with places to grade each alternative with respect to the stated criteria. Another useful technique is "dot" exercises where participants place stick-on dots on a "score sheet" list of alternative flood hazard management measures to determine priorities or alternative preferences.



Prioritizing flood hazard management alternatives.

It is important to get comments from citizens outside the flood plain since their tax dollars help pay for flood hazard management measures. Public workshops must be well advertised in advance with the results carefully documented. Persuading the local media to publicize upcoming workshop dates and the location of previous workshops is also helpful.

Questionnaire Survey

A third way to gauge the public's values is a questionnaire survey which can be useful in providing a sense of community opinions regarding specific issues, and is also a good technique when used in conjunction with public workshops. The difficulty in an opinion survey is obtaining a statistically accurate set of responses. Usually, surveys are published in the paper and mailed to a given zip code. In this case, because there is no control over who mails the questionnaires back, the survey will not necessarily give a true sampling of community opinion. Statistically based telephone or mail-back surveys with follow-up research are often expensive. Even with these difficulties, a survey can be useful in gauging public opinion so long as its limitations are recognized. Opinion surveys are not an effective substitute for public workshops because they do not offer the opportunity for the public to learn more about the issues, to cooperatively tackle problems, and to build a consensus for action. Moreover, opinion surveys tend to elicit responses from the more vocal, flood-damaged property owners as opposed to the less vocal, unaffected public.

Step 2: Set Flood Hazard Management Short- and Long-Term Goals and Objectives

Without carefully thought-out comprehensive goals and objectives, CFHMPs lack an organized framework for flood hazard management. Unless basic project goals are agreed upon, disagreement can easily arise regarding fundamental issues throughout the process, and there will be no set criteria on which to evaluate alternative measures. Therefore, it is critical to carefully define the short- and long-term goals and objectives arising from all interested parties and relate them to the full spectrum of flood hazard management issues.

Difference Between Goals and Objectives

In planning parlance, "goals" are the broadest expression of a jurisdiction's desires. "Objectives" are more specific targets or benchmarks to be achieved in the ongoing implementation of stated goals. Goals tend to have long-term purposes, whereas objective statements often indicate how goals are accomplished. An example of a goal and objectives statement might be:

Goal A: Improve Water Quality

Objective A-1: Reduce point source pollution in industrial areas.

Objective A-2: Reduce non-point specific pollution through biofiltration systems at Bubbling Brook and Silvery Stream.

Objective A-3: Reduce nutrient loading from fertilizer laden runoff in agriculture areas, especially Peter's Prairie and Heavenly Valley.

Objective A-4: Preserve wetlands in accordance with local sensitive areas ordinance.

Performance Standards that Strengthen Goals and Objectives

Both goals and objectives can be strengthened by setting performance standards. For example, the above example goal is more useful if it includes a measurable target to define when the goal is met. For example, the statement "Goal A - Improve water quality to meet Ecology Class AA (extraordinary) water quality standards" sets the expected level of performance and carries implications for the level of effort needed to meet the goal.

Task 2-A: Conduct a Public Goals and Objectives Workshop

Since the goals and objectives should account for interests of all affected parties, the public should be invited to participate in this step. A public open house/workshop is an ideal way to inform the public about the project and to elicit participation from the outset. Therefore, a "goals and objectives" workshop is recommended early in the process. Adequate notification and publicity is essential to achieve a substantial turnout.

Suggested Workshop Formats

There are many formats for such a workshop. One method is to conduct two exercises: first, consider the most broad range goals, interests, and concerns, and second, focus on the more specific objectives, topics or problems as perceived by people. During the first exercise (which can be done with the whole group working together or with several smaller groups working individually), participants would be asked to describe the goals or issues they think are important. The resulting list can then be prioritized by giving each participant a number of sticky-back dots (5 each is a good number), and by asking them to place one or more dots on each issue or goal that they feel is especially important.

To arrive at more specific objectives, it is suggested that during the second exercise the participants be divided into smaller groups, each

with a special focus area dealing with specific issues or geographic areas.

Each of these groups should then consider specific problems related to their subject area and then formulate objectives that address the issues. Often it is helpful for each group to be given a list of questions to consider, just to spark discussion. For example, the "erosion protection" group might be asked:

- What are the primary bank erosion problems in the study area?
- What, if any, are the primary threats to property or the environment?
- How can those threats be reduced?

The responses from each group should be shared with the whole group. Often it is found that the same or related objective will be mentioned in more than one sub-group.

Task 2-B: Prepare Goals and Objectives Statement with Criteria to Evaluate Alternative Flood Hazard Management Measures

The workshop results should be summarized into a working report and presented to the committee who can add their comments and revise the list into a clear goals and objectives statement. This statement is combined with the physical inventory/analysis of conditions which determines the need for flood hazard management measures. An emphasis should be made for both short- and long-term goals in this report. Also, the goals and objectives should be stated in a way that they can be applied as criteria to evaluate the alternate flood hazard management measures (see example on following page).

Step 3: Inventory and Analysis of Physical Conditions

This step can be accomplished concurrently with Step 2, and is aimed at gathering and analyzing background information necessary to determine the need for flood hazard management measures. Whereas Step 2 deals with setting the plan's public policy framework, Step 3 provides the technical information necessary to make informed decisions during subsequent steps.

Task 3-A: Determine Planning Area

Ideally, planning boundaries will be defined prior to project initiation in order to prepare grant requests or to set up the administrative

Table ES.1

Goals and Objectives for Comprehensive Flood Control

Subcategory	Goal	Objectives
Prevent the Loss of Life and Property and Preserve River Character	Prevent the loss of life or property, preserve to the fullest extent possible, the scenic, aesthetic and ecological qualities of the Dungeness River in harmony with those uses which are deemed essential to the life of its citizens, and wherever possible, enhance the instream and riparian uses of the River.	Nonstructural measures should be preferred over structural measures. Land use and related regulations (i.e., SMP's) and zoning should reflect the natural constraints of the Dungeness River flood plain, meander zone, and riparian habitat zone. Together, these plans, programs and codes should present constant goals and objectives. Changes in land use should try to restore the natural character of the river to the predegradation state whenever possible. The need for emergency measures should be reduced or prevented through planning, structural and nonstructural measures.
Maintain the River's Varied Uses	Flood control management on the Dungeness River should occur in the context of the river's varied uses including agricultural and residential, fish and wildlife habitat, water supply, open space, and recreation.	Flood control measures should preserve to the fullest extent possible opportunities for other uses. Structural flood control measures shall not obstruct fish passage. Structural flood control measures should preserve or enhance existing flow characteristics for fisheries, irrigation, and other river uses. Flood control activities should not result in net loss of or damage to fish and wildlife resources, but wherever possible develop or improve diversity of habitat of those resources, particularly with respect to the spring chinook and pink salmon runs.

Goals and objectives for comprehensive flood hazard management.
Source: Dungeness River Comprehensive Flood Control Management Plan.

procedures between jurisdictions. If this has been the case, the planning area should be reviewed at this time to see if the limits are sufficient to allow adequate technical analysis. More often than not, however, it is discovered during the scope of work negotiation that the planning area must be extended to include additional watershed areas outside of the sponsoring government's jurisdiction. In this case coordination and perhaps cost sharing with adjacent government jurisdictions or agencies may be necessary. Lead agency and cooperative interjurisdictional agreements to familiarize the relationship should be adopted. Ecology can provide assistance on this.

WAC 173-145-040(4) states that:

> *Area of coverage for the comprehensive plan shall include, as a minimum, the area of the one-hundred-year frequency flood plain within a reach of the watershed of sufficient length to ensure that a comprehensive evaluation can be made of the flood problems for a specific reach of the watershed. The plan may or may not include an entire watershed. Comprehensive plans shall also include flood hazard areas not subject to riverine flooding such as areas subject to coastal flooding, flash flooding, or flooding from inadequate drainage. Either the meander belt or floodways shall be identified on aerial photographs or maps which will be included with the plan.*

A general criteria for determining whether or not a watershed portion must be included in the plan area is if that section may undergo a change that will affect other sections of the watershed. For example, if logging and residential development is projected in upstream watershed tributaries, then that portion of the watershed should be included because increased runoff could affect downstream portions of the flood plain and the long-term effectiveness of the selected alternatives. On the other hand, if the area is designated as a protected watershed and will not change over time, then it could be left outside of the plan area. In the case of uncertainty over an area's designation, planners may designate both a primary planning area and an outlying secondary planning area for analytical purposes that may be in the urban growth area or cross jurisdictional lines or both.

Special Tip

ESSB 5411 adds language to Chapter 86.12 RCW that defines county and city roles in interjurisdictional planning. Refer to Sections 4 and 5 of ESSB 5411 (see page 12 of this guidebook).

Task 3-B: Gather Background Information

Effective flood hazard management depends on accurate technical analysis that incorporates river hydrology, geology, environmental biology, urban growth projections and civil engineering. Therefore, adequate base line information must be collected which includes the following physical characteristics.

a. **Physiography**, including topography, surface drainage patterns, channel morphology, tidal influences and other conditions that

affect river morphology, flooding impacts and land use development. The United States Geological Survey (USGS) is the primary source of topographical information. Tidal information can be obtained from the National Oceanographic and Atmospheric Administration (NOAA). Local public works/engineering departments, the United States Army Corps of Engineers (COE) (Seattle and Walla Walla Districts) the Washington State Department of Ecology (Ecology) Water Resources Program, the US Environmental Protection Agency (EPA) Water Resources Division and the United States Fish and Wildlife Service (USFWS) (National Wetlands Inventory) may all be sources of information regarding existing surface drainage patterns.

b. **Climatological parameters**, including precipitation patterns, snow cover, temperature, wind, evapotranspiration, and other conditions that effect water runoff and river hydrology. NOAA and the National Weather Service are able to provide background climatological information.

c. **Geology**, including bedrock and soil considerations that affect river channeling, drainage, hydrology, land use, and erosion. Refer to the United States Department of Agricultural, Soil Conservation Service (publications include Soil Survey for Washington State and Hydric Soils of the State of Washington). In addition, local public works/engineering departments and state and local health departments may also be a source of background information.

d. **Surface hydrology**, including water bodies, wetlands, runoff patterns, water usage, and water control structures (dams, dikes, levees, etc.). USGS is the primary source of surface hydrology information. Other sources of information include the COE Hydrology and Hydraulics Branch (Seattle District); the COE Hydrology Branch and Planning (Walla Walla District); EPA's Environmental Services Division & Water Division (Water Planning and Wetlands Section); Ecology's Water Resources Program; USFWS' National Wetlands Survey; and local stream and wetland surveys.

e. **Ground water**, including hydrogeology, groundwater recharge, and stream aquifer relationships. Sources of information include USGS, The Washington Department of Ecology Water Resources Program (Ground Water Section); Washington State Department of Health and local health departments; and EPA's Water Division (Superfund and Drinking Water Sections). Groundwater recharge areas are being identified by local governments as part of the Growth Management Act (GMA) comprehensive planning process.

f. **Water quality**, including degree of conformance to WAC 173-201-045(1) water quality standards and identification of areas or issues of special concern. Refer to Ecology's Water Resources Program and state and local health departments. The United

States Geological survey is a source of ambient water quality information as well.

g. **Fisheries resources,** including identification of migratory species and fish habitat resources. Washington Department of Wildlife (WDW) has a database of priority habitats and species including resident and anadromous fish.

h. **Wildlife habitat,** including significant habitat areas, environmentally sensitive areas, and endangered species locations. Refer to WDW database, USFWS's National Wetlands Inventory and local sensitive areas inventories which are required under the GMA.

i. **Population and land use patterns,** including the type, amounts and density of land uses and identifying historical and projected development patterns. This information is being developed by local governments as part of the GMA comprehensive planning process.

j. **Stormwater runoff and drainage systems in urban areas,** including type of system and level of service. Consult local public works/engineering departments.

k. **Recreation resources,** including parks, trails, wilderness areas. Consult with local, state and national park systems as well as state and national forests.

l. **Visual resources,** including view sheds of special significances, open areas, landmarks, and scenic areas. A "windshield" visual survey recorded on a base map is often the easiest way to obtain this information.

m. **Cultural resources,** including native American sites and historical and cultural landmarks. Refer to the Washington State Department of Community Development, Office of Archeology and Historic Preservation. Also, the county or city preservation office may have a list of historical and cultural resources.

n. **Other significant factors** affecting flood hazard management activities such as large structures, bridges, special activities or resources. A "windshield" survey recorded on a base map is a good way to obtain this information. Consult long-time residents, local community groups and local public works/engineering and planning departments for anecdotal information.

Task 3-C: Identify Regulations and Flood Hazard Management Activities that Affect the Watershed

WAC 173-145-040(1)(g) requires that comprehensive flood hazard management plans describe the regulations that apply within the watershed. These programs include federal (e.g., National Flood Insurance Program (NFIP), Section 10 Rivers and Harbors Act, Section 404 Clean Water Act, etc.), State (e.g., State Environmental Policy Act and Shoreline Management Act), and local (e.g., City and County Comprehensive Plans, flood damage prevention ordinances, zoning ordinances, building codes, etc.) regulations. It is a clear benefit to accomplish this early in the process since it will help involve key players in the process, project future land use and resource utilization trends, and identify potential regulatory tools used in flood hazard management. For the convenience of local flood hazard management planners, a description of federal, state and local regulatory programs that typically apply is included in the appendix of this document. It is intended that this description can be modified and incorporated as appropriate into the flood hazard management plan.

Task 3-D: Document Flood Event History and Identify Specific Problem Areas

WAC 173-145-040 (1)(d) requires that comprehensive flood control management plans include a description of flood damage history. At a minimum, the date, peak discharge (in cubic feet per second (cfs)), maximum elevation and estimated degree of frequency should be noted. Past flood damage assessments should also be compiled.

Local citizen's past experience with flood damage problems can provide a useful perspective regarding problem areas.

The Federal Emergency Management Agency (FEMA) keeps records of all claims made by federal flood insurance policy holders. Although information is tabulated on a "community basis," which may include more than one river system, FEMA's records are often useful to provide a general picture of the amount of damage.

WAC 173-145-040(1)(d) requires that specific problem areas in the watershed be identified. "Problem areas" may include the following types of conditions:

- Areas with the potential for flooding.
- Structures and other man-made features including bridges, utilities, fish hatcheries, water systems, etc. that could potentially be damaged or which require repair due to chronic flooding, siltation, etc.

Bridges and other structures are potential constrictors of water flow and are also subject to erosion and damage.

- Areas with destructive erosion or accretion.
- Areas with common blockage, debris collection, or joining problems.
- Areas with chronic or the potential for channel migration.
- Significant natural and economic resources which could potentially be eroded from chronic flooding (e.g. habitat degradation, fish spawning area loss, agricultural crops, soils and facilities damage, etc.).

- o Areas where chronic flooding causes septic tank drainfield failure.
- o Over-topped roadways.
- o Potential or chronic failure of structures along riverbanks.
- o Threats to water quality.

Anecdotal information gathered from public workshop participants may be useful in assembling a comprehensive picture of flood damage.

The locations of these conditions should be accurately depicted on a detailed map for further analysis.

Special Tip

Many flood hazard management planning efforts are moving in the direction of watershed management plans which emphasize water quality and resource protection. This direction is encouraged by Ecology and is consistent with state flood hazard management statutes. Therefore, it is strongly recommended that resource management issues are included in Task 3-D.

Task 3-E Project Effects, Future Trends or Actions that Affect Flood Hazard Management

Need for Projecting Future Conditions

Flood hazard management could be much simpler if new development and resource extraction were not changing the river's hydrological characteristics. However, most urbanizing flood plains are experiencing increased growth that is reducing rivers' natural characteristics and exacerbating the potential for flood damage. Moreover, intensive development, farming, and logging can increase runoff. Therefore, it is important not only to plan for current conditions, but to take into account the conditions that may occur in the future without additional regulation. To do this, the potential "build-out" of development in the flood plain must be calculated. That is, the amount of development permitted by current zoning, comprehensive plans, and other regulations should be projected on available land area. Keep in mind that future rezones can amend zoning ordinances, and will thus change projected densities. This will yield two conditions for hydrologic analysis; current and projected. The potential impacts to runoff quantities in upland urbanizing areas and areas where additional logging is planned should also be entered into the equation.

Step 4: Determine Need for Flood Hazard Management Measures

Identify Opportunities As Well As Needs

This is the step that documents the need for "flood control work" as required by WAC 173-145-040(1). As was noted in the introduction, effective flood control measures must be considered as part of the broader spectrum of flood hazard management activities. Therefore, the scope of this step should be extended to identify the need for environmental protection, development of resource management regulations, emergency response capabilities, and coordinated planning activities as well as structural flood control measures. Indeed, local planners should look beyond the need for these actions to identifying the opportunities for addressing flood hazard management objectives. This step brings together the public goals and objectives from Step 2, the background information from Task 3-B, flood history and problem area documentation of Task 3-D, and projections of future trends from Task 3-E. It should be emphasized that a 100-year flood has a 1 percent probability; 50-year flood has a 2 percent probability; and a 25-year flood has a 4 percent probability. Too often people incorrectly believe that if a 100-year flood occurred in the current year, then it won't occur for another 99 years. Thorough hydrological analysis of the potential damage for a 50-year, 25-year flood can be estimated for existing land uses and current conditions. What is more difficult is determining the potential damage to future buildings and assessing the impact of new development on river hydrology. It is often necessary to model the river's hydrological response to a given precipitation and snow melt level assuming future development or land utilization projected in Task 3-E. New development can affect flooding problems in several ways, including:

1. Exacerbating the pattern of runoff by reducing the permeability and holding potential of soils (e.g. paved areas).

2. Increasing runoff by vegetation removal.

3. Restricting conveyance capacity of the floodway channel.

4. Reducing the natural storage capacity of flood plains through filling of wetlands, floodway fringe areas, overflow channels or sloughs.

5. Building new developments that are flood prone, thereby necessitating further structural controls.

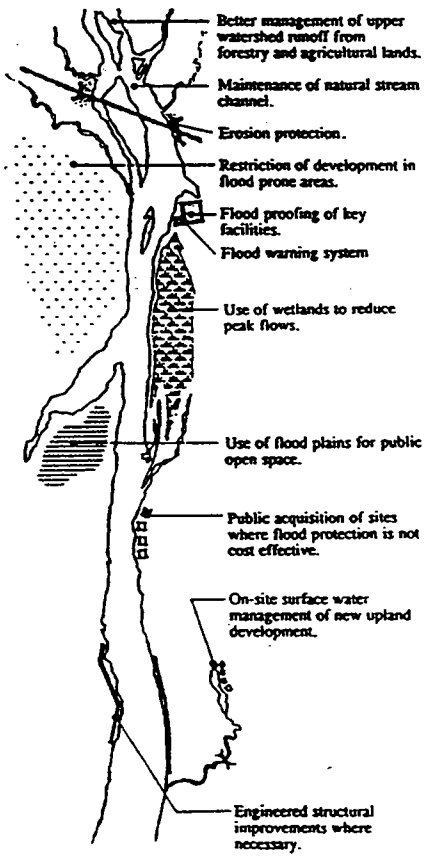
If the hydrological analysis can determine potential impacts of separate land development trends, then potential problems can be predicted and needed flood hazard management actions can be more strategically applied to mitigate the cause of the problems rather than the effect. For example, if it is determined that new development in a portion of a flood plain would cause a rise in the mapped flood elevation and place the development and other downstream areas at greater risk, then it

may be advisable not to develop that portion of the flood plain, rather than construct expensive structures to accommodate higher flood waters. Or, if it is determined that intense logging increases the rapid release of run off, then it may be necessary to take upstream measures to mitigate this impact, rather than rely on down stream structures to handle the increased water.

Step 5: Identify Alternative Flood Hazard Management Measures

In a 1970 report titled *Guidelines for Establishing Economic and Engineering Flood Criteria* several members of a joint University of Washington and Washington State University team noted that flood damage control measures might be classified into either of two categories, structural and non-structural. Structural measures refer to engineering or construction activities on or near the stream channel. Non-structural alternatives include land use regulations and other regulatory measures such as runoff reduction, flood proofing, advance warning and forecasting, flood plain drainage, land acquisition, conservation easements, and removal or relocation of strict uses. Comprehensive flood hazard management emphasizes a multi-objective approach, incorporating a variety of engineering, environmental protection and planning measures as well as local planning innovation. Listed below are some of them.

Comprehensive Flood Hazard Management Measures



The purpose of Step 5 is to determine which of these measures are potentially appropriate within the study area. As stated earlier, it is important early in the process to consider both structural and non-structural actions so that they can be evaluated in Step 5 for their cost effectiveness and environmental impacts. Below are described in general terms several of the alternative measures. Naturally, the application of these measures requires engineering and planning expertise in order to determine the feasibility, degree of effectiveness, costs and impacts of each measure.

Non-structural Alternatives

A. Regulatory Measures

Land development directly affects flood damages in several ways: 1) it encroaches upon the waterway so that channel or floodway capacity during flood stage is gradually reduced to the point where flow rates which once caused no flooding now produce considerable inundation; 2) it places increased capital investment in "flood-prone" zones so tnat flooding causes greater monetary losses; and 3) it reduces the permeability and natural storage capacity of the flood plain and may redirect or reroute watershed and additional water sources affecting flood characteristics.

Local flood damage prevention ordinances are the primary means of controlling development in the flood plain. Regulatory measures including local zoning ordinances, comprehensive plans and shoreline master programs are also effective. Enactment of such regulatory measures should consider the agency or agencies that will hold enforcement power. Enforcement practices may not significantly affect the flood plain areas within the jurisdiction of one agency. It is quite possible, however, that upstream lands, outside the jurisdiction of that same agency, may well be the cause. Therefore, interagency cooperation should be established for such enforcement. Creation of such regulations should be based on comprehensive investigations of physical land conditions, land use, and hydrologic data.

1. Local Zoning and Land Use Regulations

Under the Washington State Constitution and Chapter 35 RCW, cities and counties possess the authority to adopt ordinances and take actions to promote the general public's health, safety and welfare within their boundaries. This authority includes the protection of lives and properties from flood damage by construction of flood control improvements and adopting regulatory controls. Comprehensive planning, as implemented by zoning codes, is the most traditional land use control measure. However, reducing the amount or intensity of land use within the flood plain will often mean "downzoning," an action that is usually strongly opposed by land owners. Because land owners' object to restrictions on what they regard as their property rights, downzoning is often politically impossible even though it is entirely legal and appropriate in many situations. It must be remembered that there are often public safety and property protection consequences for not taking actions.

Growth Management Act Mandates Critical Area Protection

The argument for local land use controls in flood plains has been strengthened by the recent Growth Management Act which directs those cities that are required or choose to plan under the GMA to designate those areas that are susceptible to flooding as "critical areas." Critical areas must be regulated to preclude development or land uses that are inconsistent with frequently flooded areas (see RCW 36.70A0.60 and RCW 36.70A.170). A local "sensitive areas ordinance" conforming to state guidelines will prove an effective method of resource protection and can be useful in flood hazard management as well.

2. Development Standards for On-site Stormwater Management Facilities

The following discussion on stormwater management is based on Ecology's *Stormwater Management Manual for the Puget Sound Basin* (Public Review Draft, June 1991).

Increased stormwater runoff is directly related to an increase in impervious surfaces (roads, parking lots, and rooftops) which prevent water from soaking into the ground. Development, in addition to limiting the potential for surface water infiltration, also alters the land's natural drainage features (streams are culverted, ponds and wetlands are filled and grassy low lying areas are developed). Increased runoff effectively enlarges the area that may experience flooding (the flood plain). Flooding caused by stormwater runoff is a serious problem in urbanized and newly urbanizing areas where the ratio of impervious to non-impervious surfaces is high and the natural landscape has been highly altered.

Traditionally, stormwater management has been achieved through stormwater detention and conveyance systems built during urban development. Culverts, catch basins, detention ponds, concrete lined channels and storm sewers are typical conveyance system components. These systems require considerable capital expenditure and in many cases are undersized, designed only to handle present peak flows without taking into account the cumulative effects of future development.

As a non-structural flood hazard management alternative, local governments may adopt comprehensive regulatory and enforcement programs for the design, construction and maintenance of on-site detention and retention facilities.

Detention Facilities

Detention facilities are designed to hold water during runoff events and then slowly release water to downstream channels or storm sewers. In general, these facilities control the rate of runoff but do not reduce runoff volume. Detention facilities can be either wet or dry and either above ground or below ground. The term "wet" indicates the presence of water in the facility at all times. Dry facilities typically hold water only during runoff events. Detention facilities include:

- o constructed wetlands
- o constructed or excavated ponds (wet and dry)
- o underground tanks or vaults (wet and dry)

Detention storage can provide for the settling of sediment and other suspended pollutants to eliminate the direct input of pollutants into receiving waters.

Infiltration Facilities

Infiltration facilities may include natural and biological systems such as wetlands and vegetated swales that naturally retain the water on site for a period of time. Infiltration facilities retain runoff while releasing it via on-site infiltration. In this way, infiltration provides runoff control as well as runoff volume reduction. Infiltration facilities include:

- o basins (ponds)
- o trenches (swales)
- o constructed wetlands
- o porous pavement
- o urban forestry

Additional benefits of infiltration are sedimentation control, stormwater treatment, preservation of base flow in streams, ground water recharge and reduction or elimination of expensive stormwater conveyance systems.

Special Tip: PSWQA/Ecology Stormwater Rules and GMA Requirements

The Puget Sound Water Quality Authority is currently writing a stormwater rule for counties within the Puget Sound basin (defined by the rule) which will require adoption and implementation of local stormwater programs. The rule will provide procedural requirements for stormwater management, such as adoption of local ordinances for new development and operation and maintenance programs. Ecology is producing a companion rule which contains minimum standards (for example, minimum technical requirements) for urban stormwater management. The draft rules are expected to be adopted by early 1992. Ecology has also prepared a Stormwater Management Manual addressing erosion and sedimentation control, and control of pollution from urban land uses for the Puget Sound Basin which is currently undergoing public review. The manual will serve as a technical guide for local governments. Volume III of the draft Manual is devoted to runoff control.

The 1990 Growth Management Act requires counties (and the cities located in those counties) with populations greater than 50,000, or that have experienced a population increase of more than 10 percent in the last ten years, to adopt comprehensive land use plans.

A mandatory element of each county's comprehensive plan is to provide for the protection of the quality and quantity of groundwater supplies, and where applicable, for the local jurisdiction to "review drainage, flooding, and store water runoff in the area...and provide guidance for corrective actions to mitigate those discharges."

Federal, state and local regulations associated with stormwater management as referenced in a 1991 staff memo to the Washington Senate Environment and Natural Resources Committee, include:

- The Federal Water Quality Act of 1987 which reauthorized the Clean Water Act and requires municipalities above 1,000 population to obtain a National Pollution Discharge Elimination System (NPDES) permit from the EPA for stormwater discharge.

- Existing Washington law which allows for the construction and operation of stormwater control facilities in order to lessen property damage resulting from increases in surface water or stormwater accumulation. The law is intended to control stormwater flows beyond that which naturally occurs on or over real property, which results from altering or interrupting natural drainage patterns.

- Local governments which are directed to manage and control stormwater runoff as part of other planning efforts, but the ability to do so is primarily hampered by lack of technical expertise and financial resources.

The following represent current laws which allow local governments to plan for stormwater management and abatement:

- Cities and Municipal Corporations. If a metropolitan municipal corporation (like the Municipality of Metropolitan Seattle (Metro)) is authorized to perform the function of pollution abatement, it shall also prepare a comprehensive water pollution abatement plan that includes provisions for stormwater drainage. The municipal corporation may also develop facilities for the collection of stormwater in portions of its metropolitan area not serviced by another local jurisdiction (RCW 35.58.200).

- Cities are authorized to construct and fix rates for sewer systems, including facilities for storm or surface sewers (Chapter 35.67 RCW).

- Municipal planning commissions acting to adopt or enforce comprehensive plans for the physical development of the municipality must review drainage, flooding, and stormwater runoff pattern in the area, and provide guidance for corrective actions to mitigate or cleanse those discharges that pollute Puget Sound (RCW 35.63.090).

- Washington Department of Fisheries Stormwater Guidelines via Hydraulic Project Approval.

3. Local Shoreline Master Program

Under the State Shoreline Management Act of 1971, all local governments which include shorelines of the state (i.e., all rivers and streams with a mean annual flow over 20 cfs or greater) must prepare a shoreline master program for the purpose of regulating shoreline uses and activities within the shoreline jurisdiction. Shoreline jurisdiction on rivers extends at least 200 feet laterally from ordinary high water mark of floodway, whichever is greater and may extend throughout the entire 100-year flood plain if the local government so chooses (see discussion of Washington State Shoreline Management Act in Appendix A). Local governments prepare, adopt and enforce local shoreline master programs. Ecology has approval authority over all shoreline master programs and several types of shoreline permits and may appeal all shoreline permits for development within shoreline jurisdiction. Ecology's responsibility to safeguard the state's interests and review authority makes the shoreline master program an especially powerful flood hazard management regulatory tool for several reasons.

Advantages of SMP's in Flood Hazard Management Planning

First, because Ecology reviews all master programs, the department can serve a valuable coordinating role by assisting local governments in preparing master program updates and in insuring that changes to one government's master program does not adversely affect a neighboring jurisdiction. Second, the legal authority for the shoreline master program is based not only on the state constitutional powers of enabling legislation, but also on the public trust doctrine that requires the state to safeguard the properties of the state's citizens that are held in public trust, including submerged lands and water resources. Therefore, the state has an interest in preventing development in the flood plain that would affect water quality, fisheries, and other resources.

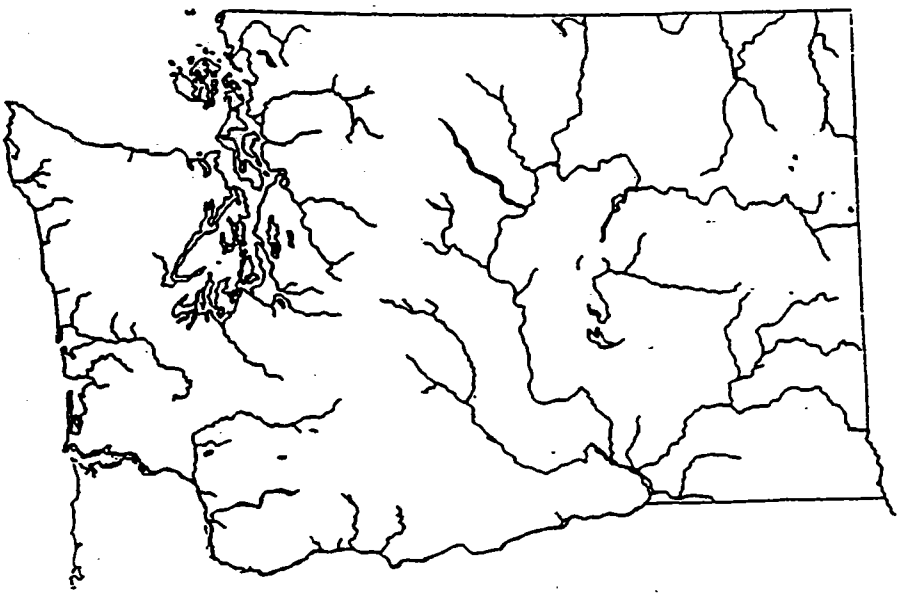
While local governments may be subject to local political pressures against "downzoning" or flood plain planning, the state is more clearly responsible to environmental and resource management objectives. During the review of local shoreline master program updates, Ecology may require additional provisions that restrict undesirable development on the flood plain. This "higher authority" becomes especially useful when Ecology and local planning staff work together in formulating master program provisions and where potential impacts of flood plain development can be documented.

Shorelines of State-wide Significance

There is another provision in the Shoreline Management Act (SMA) that applies to "shorelines of state-wide significance (SSWS)." Rivers that are identified as shorelines of state-wide significance include all rivers west of the Cascade Crest downstream of a point where the mean annual flow is 1000 cubic feet per second or more, and all rivers east of the Cascade Crest down stream of a point where the annual flow is two hundred cubic feet per second or more or from a point downstream from the first 300 square miles of drainage areas, whichever is greater. For such rivers, still stronger state law directives apply.

The SMA sets specific priorities for the management of shorelines of state-wide significance, giving preference to uses which adhere to the seven objectives discussed below. RCW 90.58.020 and WAC 173-16-

040(5) interprets these principles into guidelines for writing master programs. It is important to remember that the SMA lists these objectives in order of preference. Therefore, objective 1, "Protecting state-wide interest over local interest" takes priority over objective 2, "Preserving the natural character of the shoreline." Listed below and on the following pages are the seven criteria with a brief discussion of how the priorities have been applied in specific situations.



Schematic map of shorelines of state-wide significance.

---

1. ***Recognize and protect the state-wide interest over local.***

   This means that where a resource of state-wide interest, such as fisheries, is in jeopardy from some proposed use, state-wide concerns will prevail over local interests. The local jurisdiction should take every opportunity to solicit comments and opinions from citizen groups and individuals representing state-wide interests (e.g., Sierra Club, Audubon Society, Trout Unlimited, etc.). Appropriate state agencies, universities, colleges, and Native American Nations should also be involved along with comments, opinions and advice from experts in ecology, oceanography, geology, liminology, aquaculture and other scientific fields pertinent to shoreline management.

Administratively, the consequence of this guideline is that all state-wide interests prevail, and any proposed use or master program that does not recognize and comply with those state-wide interests will be rejected.

2. ***Preserve the natural character of the shoreline.***

This guideline means that any action that adversely affects the natural character without enhancing the public interest, will probably be denied. Numerous Shorelines Hearings Board (SHB) decisions have been made against private/community boat launches, bulkheads, and the like where the "natural character" of the shoreline would be altered and where there was no benefit for the public at large. The intent is to minimize man-made intrusions on SSWS. There is also a desire in this guideline to upgrade those areas of more intensive development by reducing their adverse impacts on the natural environment. Urban environments that have natural qualities or resources should preserve those low intensity uses compatible with resource protection while accommodating high intensity use in areas already developed. In urban environments this also means that riparian corridors and natural vegetation cover should be preserved (through appropriate structural setbacks and clearing and grading regulations) even in this intensive use environment. This guideline also concerns commercial timber cutting, allowing a maximum of 30 percent of the timber selectively cut from lands designated as SSWS within a ten year period.

3. ***Result in long-term over short-term benefit.***

The purpose here is to ensure for future generations the possibility to use the shorelines either in their natural state or for preferred uses such as those that are water-dependent or water-related. That is to say, if a mixed-use development is slated for an urban waterfront, it should not preclude the possibility of a water-dependent use. The intent here is to evaluate short-term economic gains in relation to long-term and potentially costly impairments to the environment. This provision gives clear priority to long-term flood hazard management solutions.

4. ***Protect the resources and ecology of shorelines.***

The master program should recognize the importance of the unique or fragile natural resources (e.g., wetlands) found along the shorelines and leave those areas undeveloped. This guideline extends beyond the natural shoreline to include the prevention of erosion and sedimentation that would alter the natural function of the water body. Any advances in technology or methodology, as in bioengineering, should be employed to maintain good water quality. In natural areas where it is too difficult to maintain the integrity of the environment under human use, public access should be restricted.

Flood plain planners should be aware that even projects for the greater public good, like in the SHB case of Henderson v. Snohomish County and Barber, the proposed project is subject to scrutiny on the basis of this objective. In this case the SHB ruled that if the proposed camp site is not designed and conditioned to assure preservation or replacement of trees and vegetation, the permit would not be issued.

5. ***Increase public access to publicly owned areas of shorelines.***

The emphasis here is on providing public access to all publicly owned lands, including all federal and state agencies holding shorelands, tidelands and bottom lands, as well as local parks departments and port districts.

Master programs should give priority to developing a path/trail or pocket park system providing water access to and along the shorelines as well as to upland parking and adjacent parks facilities. Master program's general provisions for public access should place special emphasis on providing public access for port district or government sponsored developments on shorelines of state-wide significance. For large industrial sites where direct public access is dangerous or physically undesirable, a port or government agency can provide substantial off-site public access as approved by the local government and Ecology.

6. ***Increase recreational opportunities for the public on the shorelines.***

Any master program update that includes the redesignation of environments on shorelines of state-wide significance should include planning for the encouragement of recreational use of the shorelines. Insure that areas are reserved for lodging and other related facilities on the upland side accompanied by provisions for non-motorized access to the shorelines.

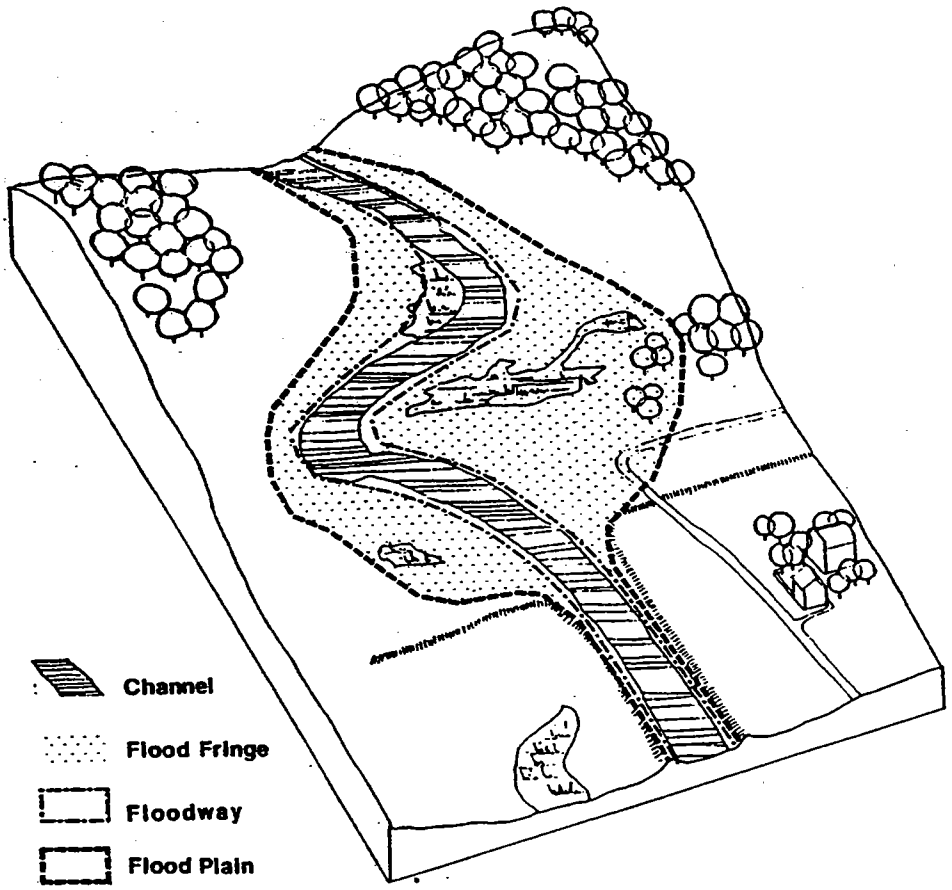
Here, the flood hazard management planner needs to recognize the need to include long-range planning recreational facilities and amenities for their community. The master program should clearly state goals which favor the public and long-range goals.

All of these criteria provide a strong legal basis for protection of flood plain ecology and other resources by restricting development and limiting construction of structures that would degrade natural processes. For all of these reasons it is critical that the shoreline master program be considered as a primary regulatory tool available for local planners to use in flood hazard management planning.

7. ***Provide for any other elements as defined in RCW 90.58.100 deemed appropriate or necessary.***

4. Local Flood Hazard Ordinances to Implement National Flood Insurance Program

The National Flood Insurance Program includes two types of regulatory programs. First, participatory local governments must require that any new construction in the 100-year flood plain be flood proofed (see Item E, Flood Proofing, on page 63). Second, participatory local governments must adopt some measure of land use regulations to insure that the FEMA "floodway" will not be further restricted. In theory, this means that local governments must prohibit new development within the FEMA floodway.



Floodway.

A local means to control development is the use of flood plain management ordinances. Ecology is responsible for coordinating and approving local flood plain management ordinances to make sure that they conform to NFIP standards (Chapter 86.16 RCW) (see Item E, Flood Proofing, on page 63). A flood plain ordinance must, at a minimum, specify the potential flood areas, the type of development permitted (or prohibited) in these areas, development standards, a process for review of development proposals, and an enforcement

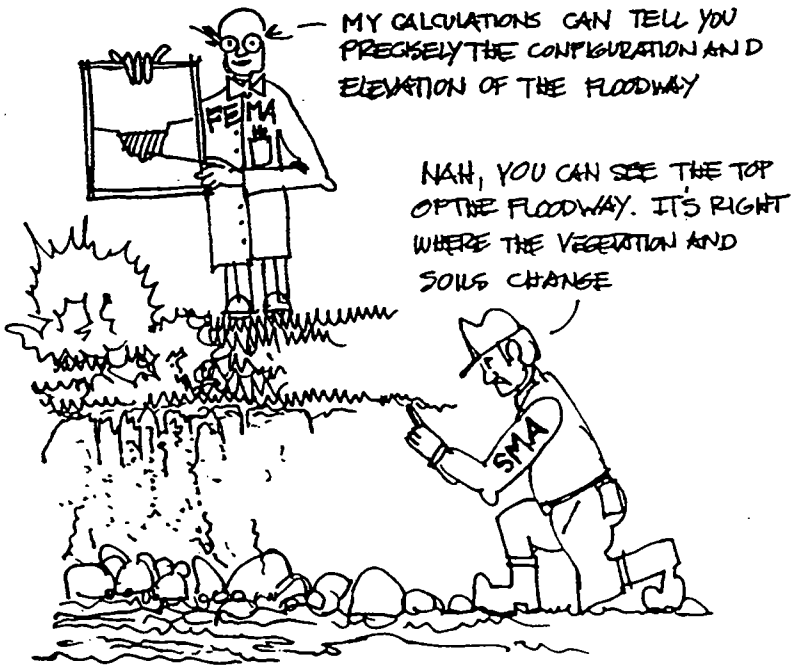
policy. The ordinance need not eliminate all development. For example, one performance criteria for granting a permit in the flood plain could be the requirement that a SEPA environmental assessment find that the development does not contribute to flood hazards either as an individual project or as a contributor to cumulative impacts resulting from a general pattern of development. Analysis done as part of the Comprehensive Flood Hazard Management Plan could provide the background for helping to make that determination.

Special Tip: Floodway Definition

The floodway is the portion of the flood plain where the highest flood velocities and greatest flood depths usually occur. The floodway defined by FEMA is not necessarily the same as defined in the Washington State Shoreline Management Act.

FEMA defines floodway as, "the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot."

The SMA defines floodway as, "those portions of the area of a river valley lying streamward from the outer limits of a watercourse upon which flood waters are carried during periods of flooding that occur with reasonable regularity, although not necessarily annually, said floodway being identified, under normal condition, by changes in surface soil conditions or changes in types or quality of vegetative ground cover condition. The floodway shall not include those lands that can reasonably be expected to be protected from flood waters by flood control devices maintained by or maintained under license from the federal government, the state, or a political subdivision of the state. The limit of the floodway is that which has been established in flood regulation ordinance maps or by a reasonable method which meets the objectives of the act."



THE GREAT FLOODWAY DEFINITION DEBATE

Local agencies may adopt a more restrictive definition of floodway. For example, King County's Sensitive Areas Ordinance employs a "zero-rise" floodway standard. The "zero-rise" standard prohibits development in the flood plain which would cause a perceptible rise in the floodway, in effect, enlarging the area defined as the floodway to include almost the entire flood plain.

The following photo, taken in November 1990, illustrates how channel migration (or river meander) can affect the accuracy of FEMA floodway maps. This home, located on the Raging River in King County's Snoqualmie River Valley lies outside the flood hazard area on the existing Flood Insurance Rate Map (FIRM).

Home located on the Raging River in King County. This home is located outside the flood hazard area identified on the existing FIRM.

B. Public Acquisition of Flood Prone Properties

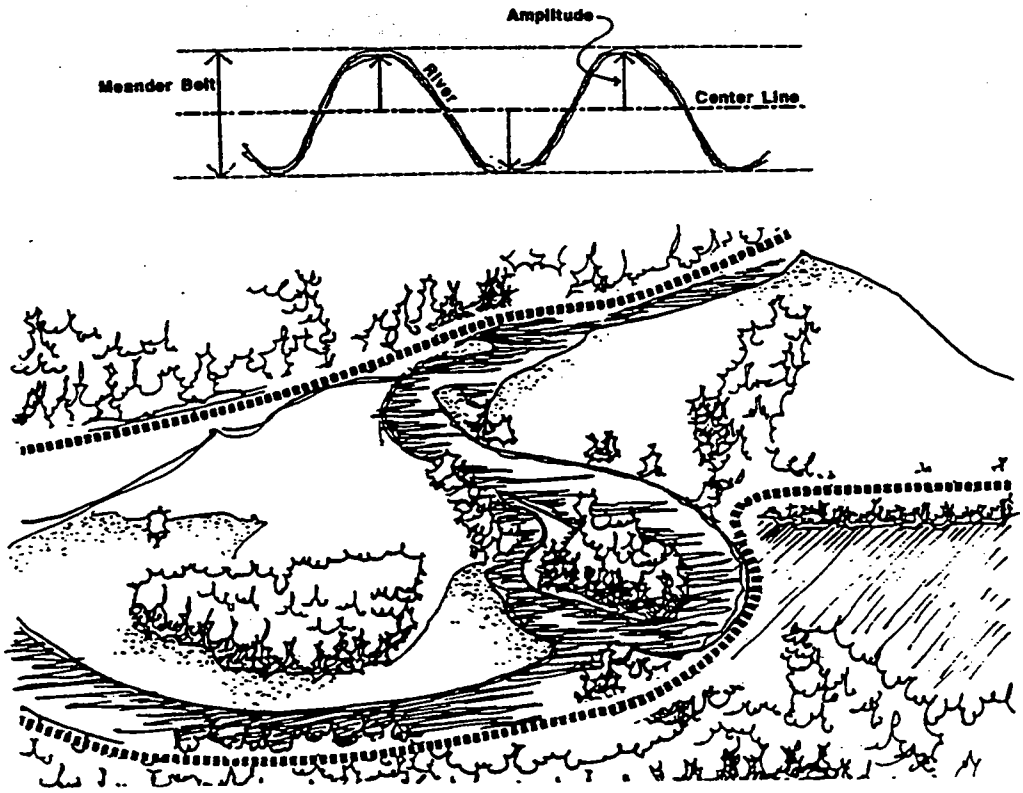
Another way to control growth in flood prone areas is for the public to purchase key properties for flood compatible use such as recreation or passive open space. With increased public interest in preserving greenbelts and open space in urban areas, flood plains and river corridors located within meander belts make excellent choices for acquisitions, riverfront parks, wildlife preserves, and trails. Golf courses can also be appropriate in flood prone areas if they are designed to protect environmentally sensitive areas and prevent herbicides and fertilizers from entering the watershed. Often, such uses can incorporate wetlands and other sites that are only marginally

developable. Communities can also purchase development rights to agricultural lands, insuring that these properties are not developed and property taxes are not raised to reflect "highest and best use."

Of course, the difficulty in this approach is coming up with the funds for purchase. Several options are available. Open space bond levies are one method. Bond issue initiatives are generally most successful when the land purchase is tied to a comprehensive recreation open space plan with recreation features linked by a trail system such as was the case in King County. This provides better public access and "something for everyone," making the bond issue passage more likely.

Special Tip

The meander belt of a river is the amplitude of the meanders of a river about the centerline of the river, or the width of the meander of a river, on both sides of the river in the historical flood plain.



River meander belt.

FCAAP funds may be considered a potential funding source for the purchase of flood prone properties or land to be used for flood storage, after such measures have been identified as possible flood hazard management measures/alternatives as documented in the CFHMP. One other source of acquisition funds is the NFIP section 1362 funds which allow property owners, if insured under NFIP, to sell substantially damaged properties to the federal government rather than apply for insurance payments for damage repairs. Section 1362 funds were used

to purchase homes destroyed by flooding caused by the eruption of Mount Saint Helens, to create Toutle Park and to purchase flood damaged properties in Whatcom County to create a small public park on Lake Whatcom and most recently to purchase thirty seven (37) properties damaged during the November, 1990 floods.

King County has received preliminary approval to acquire this home with NFIP Section 1362 funds.

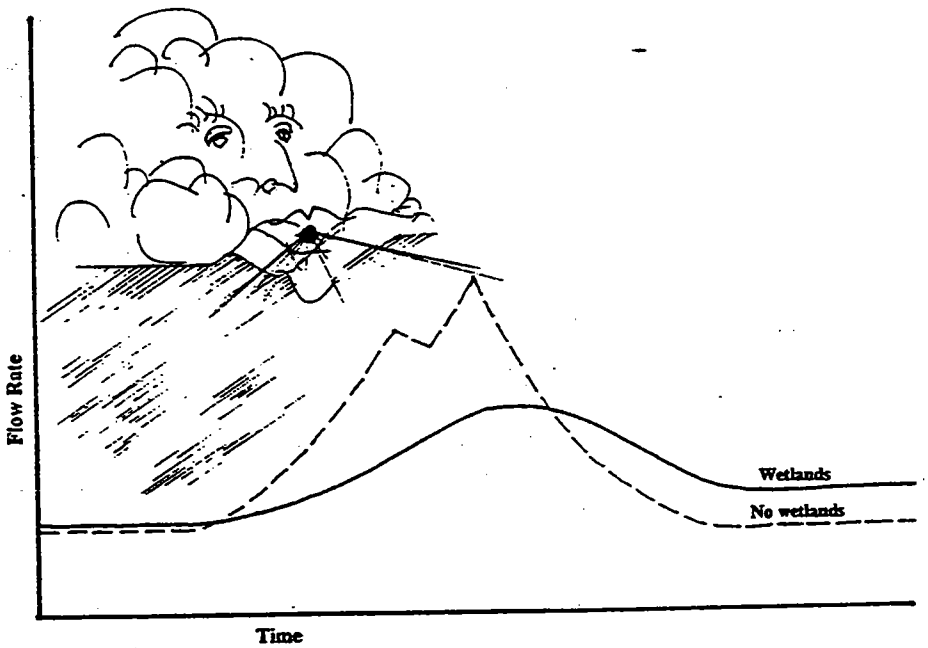
C. Resource Management Regulations

Many renewable resource management and environmental protection practices including forestry, fisheries and water quality relate directly to flood hazard management planning. Concisely, flood hazard management objectives can be furthered through more effective resource management practices. For example, logging on steep slopes can exacerbate runoff.

D. Environmental Protection Measures

Because environmental protection measures, such as wetland conservation, vegetation maintenance and wildlife habitat enhancement are typically dependent upon preserving the natural hydrology of the flood plain, the environmental protection measures generally dovetail with non-structural flood hazard management efforts. For example, wetland protection through local ordinances which restrict development on designated wetland areas as called for in the Growth Management Act, can also serve a useful flood hazard management function by

preserving wetlands that serve as flood water overflow and storage areas. Maintenance of vegetation on side slopes also cuts down on stormwater runoff, and maintaining open space in the flood plain itself increases the average permeability of the area. The following figure illustrates the ability of wetlands to reduce peak flows.



Wetlands provide peak flow reduction.
Source: Washington Coastal Currents Vol. XV, No. 7, January 1991.

E. Flood Proofing

The general description of flood proofing and examples related to different types of development is adapted from *Guidelines for Establishing Engineering and Flood Criteria* by P.W. Barkley et.al. Flood proofing might be defined, generally, as the construction or remodeling of physical structures such that during floods they can either be closed or their occupancy can be modified so that inundation, siltation, or velocity damage can be minimized. While it may be rather expensive and impractical to completely flood proof all developments, this method together with land use regulation, is useful in reducing flood damages.

The feasibility of such activity depends considerably on the use of flood plains. Existing activity may be flood proofed but, in general, this would probably be more difficult and costly than designing flood proofing into new developments. In urban areas where development proceeds at a rather rapid pace, flood proofing practices would find advantageous application. Examples of flood proofing techniques for different types of development are briefly outlined on the next page.

Light Industry:

Typical flood proofing measures might include elevating all processing operations and storage facilities of materials, especially hazardous materials, subject to damage above the flood plain elevation.

Commercial Enterprise:

Firms selling products and/or services for human consumption may find flood proofing relatively more difficult and costly than in the case of industry. Nevertheless, it may be entirely feasible in this instance, to develop customer parking and receiving and delivery areas directly on the flood plain. Suitable access could then be provided to upper level trade areas (perhaps only one-half of normal flood height above existing grade). Inundation would thus occur only to areas which could be evacuated. As an alternative, flood doors and other partitions with sealing mechanisms could be provided so that areas could be closed with advancing flood threat.

Residential Occupation:

Flood proofing here would appear to be the least practical of the three examples cited. Physically, the difficulty would not be insurmountable, but in terms of relative cost requirements, the benefit-cost ratio may be very low for existing structures. However, it may be entirely feasible and possible (if the terrain of the flood plain so allows) to construct new residences on existing "backgrounds" or on built-up areas. Yards, parks, school playfields, and public recreation could then be placed on lower levels of the flood plain. The NFIP standards (see below) require that the first floor of all new residential buildings be at or above the 100-year flood level.

Any development on the flood plain will require that certain utilities (e.g., lights, heat, and water) be available to them. Placement of utilities on the flood plain should be designed to withstand sedimentation, erosion and other forms of damage. This is particularly important if activity is to continue on the flood plain under flood conditions.

National Flood Insurance Program

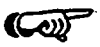
The most useful tool for local cities and counties to require flood proofing of structures in the flood plain is participation in the National Flood Insurance Program. The National Flood Insurance Act of 1968 and Flood Disaster Protection Act of 1973 establish a somewhat comprehensive set of regulations relating to the mitigation of flood damage. A flood insurance program is established to pay for flood damage. A county or city may participate in the flood insurance program, which allows property owners to purchase flood insurance, by both adopting certain zoning restrictions in the 100-year flood plain and requiring construction in the 100-year flood plain to be "flood proofed" or built in such a manner as to limit flood damage.

Technically, it is "voluntary" for a county or city to participate in this program. However, severe consequences arise from not participating in the program, including: (1) limitations on federal disaster assistance that is provided for flood damage; (2) the unavailability of federal loans, as well as mortgages that are sold on the secondary market regulated by the federal government, to finance construction in the flood plain; and (3) inelegibility to participate in the FCAAP.

Need for Inter-Departmental Coordination

Approximately 245 of 270 "flood prone" communities in Washington currently participate in the NFIP. These communities must adopt a "flood hazard ordinance" which sets flood proofing standards for all new development. Generally, city and county building departments enforce the ordinance through the building permit review process. The real key to a successful flood proofing program is to coordinate this activity with land use controls and structural flood hazard management measures so that the most cost effective approach is taken for a given situation. For example, in some undeveloped sections of a watershed, flood proofing may be much more cost effective than dikes or levees. To achieve this coordination, the flood hazard management planning process must bring together those in charge of building permit review, land use regulations and public construction. Usually, this requires the often difficult task of framing a common strategy among the local departments of planning, building and public works.

Special Tip: Increased Flood Proofing Standards



Ecology does not require that local flood plain management ordinances exceed the NFIP standards. However, in many cases it may be advisable for local governments to set higher standards than those imposed by the NFIP. For example, the NFIP requires that the first floor of new residential construction be at or above the 100-year flood level. A local community may wisely elect to set the minimum elevation at 2 feet above the 100-year flood elevation to allow a greater margin of safety for several reasons, including:

- **Projection of higher flooding levels due to changing conditions in the watershed.**
- **Lack of data in hydrological modeling.**
- **Special conditions that could exacerbate flood conditions.**

The photo on the following page, taken in November 1990, is a home under construction along the Cedar River in King County. This type of development is allowed in communities whose flood hazard regulations meet the minimum standards for participation in the NFIP. King County adopted new regulations in September 1990 which greatly exceed federal minimum standards, precluding this type of development which was approved under the federal minimum standards and before King County adopted its new regulations.

Home under construction on the Cedar River in King County. Illustrates the type of development allowed in communities which meet minimum requirements for participation in the NFIP. Note: King County's new regulations, adopted in September, 1990 exceed NFIP standards.

Structural Alternatives

Note: The discussion of impoundments, dikes, levees and channel improvements is adapted from *Guidelines for Establishing Economic and Engineering Flood Criteria* by P.W. Barkley, et.al and from other sources as noted.

A. Impoundments/Regional Detention

An impoundment (or reservoir) is developed on a stream to provide a storage volume that can be used to "hold" flood waters from proceeding uncontrolled downstream. Utilizing this storage, the flood waters can be released in such a manner that the downstream flow rate is controlled to something equal to or less than the capacity of the channel.

Man-made impoundments may remain full, particularly if the impoundment used for other purposes such as water supply, recreation, or power generation in addition to flood damage reduction. In this event, prediction of future flood flows plays an important role. With adequate warning, the reservoir can be emptied in a well-controlled manner thereby creating reservoir volume to store approaching flood waters. Adequate hydrologic analysis can determine the size of impoundment required. Sediment deposition may occur in a reservoir, however, and over a period of years, may fill part of the reservoir volume. Consequently, reservoir design should include allowances for this deposition. Impoundments are known to affect parameters of temperature, dissolved oxygen and nitrogen, and nutrients. The size and shape of the reservoir and its operating criteria should be planned to minimize any adverse affects.

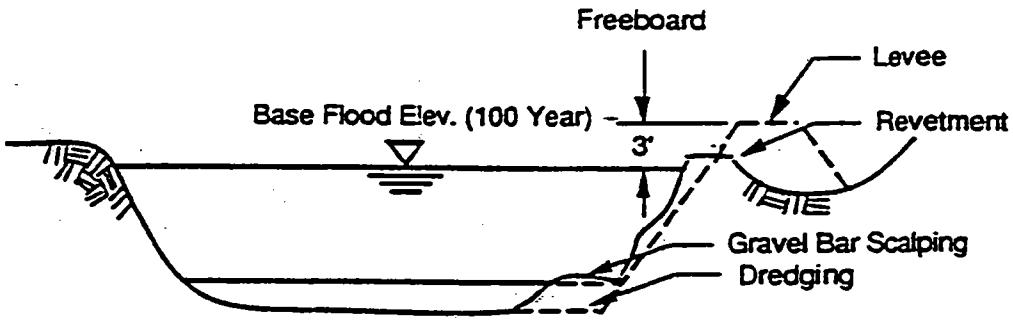
As a practical matter, off-stream impoundments such as dams or detention ponds have the most potential. In-stream impoundments will rarely be allowed within environmental and resource protection regulations.

B. Dikes or Levees

The term "dikes" generally is used to denote linear structures along saltwater shorelines, while a levee is a structural embankment along a river. In many instances, it may be more feasible to confine waters to the stream channel by raising its banks than it would be to control the streamflow rate with impoundments.

While such dikes or levees can reduce flood damage in many instances, they may, in other cases, actually create more flood damage than would occur with the natural channel unaltered. As flood waters rise and the water surface increases in elevation, a certain elevation difference occurs between this water level and the surrounding land areas behind the levees or dikes. If the levee or dike should fail because of overtopping or seepage and subsequent erosion, an initial surge will occur over or through the dike. Inundated land is then

subject not only to submergence, but to impact and erosion from damaging velocities much like what occurred on Fir Island in Skagit County during the November 1990 flooding.



Levee and revetment.
Source: Puyallup River Basin Comprehensive Flood Control Plan

Another situation where increased damages result from construction of dikes and levees is one where such construction occurs to "protect" a relatively low density and low value land use. Economic considerations establish a level of protection for this land use. The levee or dike, when built for this protection level, then leaves the wrong impression that all future floods will be "controlled" and the land use changes to high intensity, high-value occupation. A dike or levee breach subsequently occurs and damages are many times greater than even before the dike was built.

A natural stream channel is capable of passing a maximum rate of flow without overtopping. The dike or levee installation increases this flow capacity. The designer of the levee must consider, however, the hydrology of the stream in question. There is always some probability, however small, that the largest historical flood will be exceeded in the future, either because of natural phenomena or because of unforeseeable changes in upstream drainage basin characteristics. Floods derived on the basis of historical events will also be exceeded.

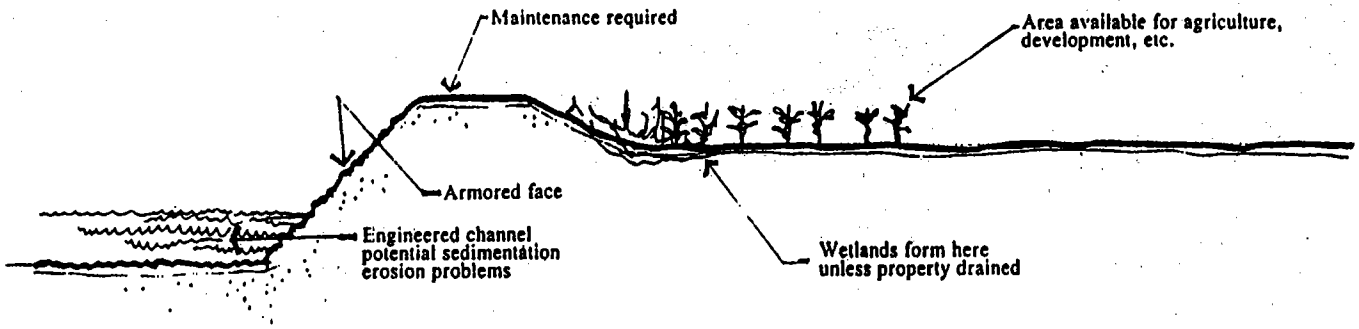
The materials used for the construction of a dike system will dictate the cost of the project and land area requirements for such construction. This material may be rock and earth fill, concrete, or combinations thereof. In many cases, particularly in urban areas, aesthetics play an important role in the design of levees. Water ecology should be considered here also. A rubble mound or earth levee often requires that excavated material be brought to the construction site. This material may have a deleterious effect on water quality, particularly during periods immediately after construction. Such an influence may actually change natural water ecology which in turn would affect resident aquatic life.

Floodwalls

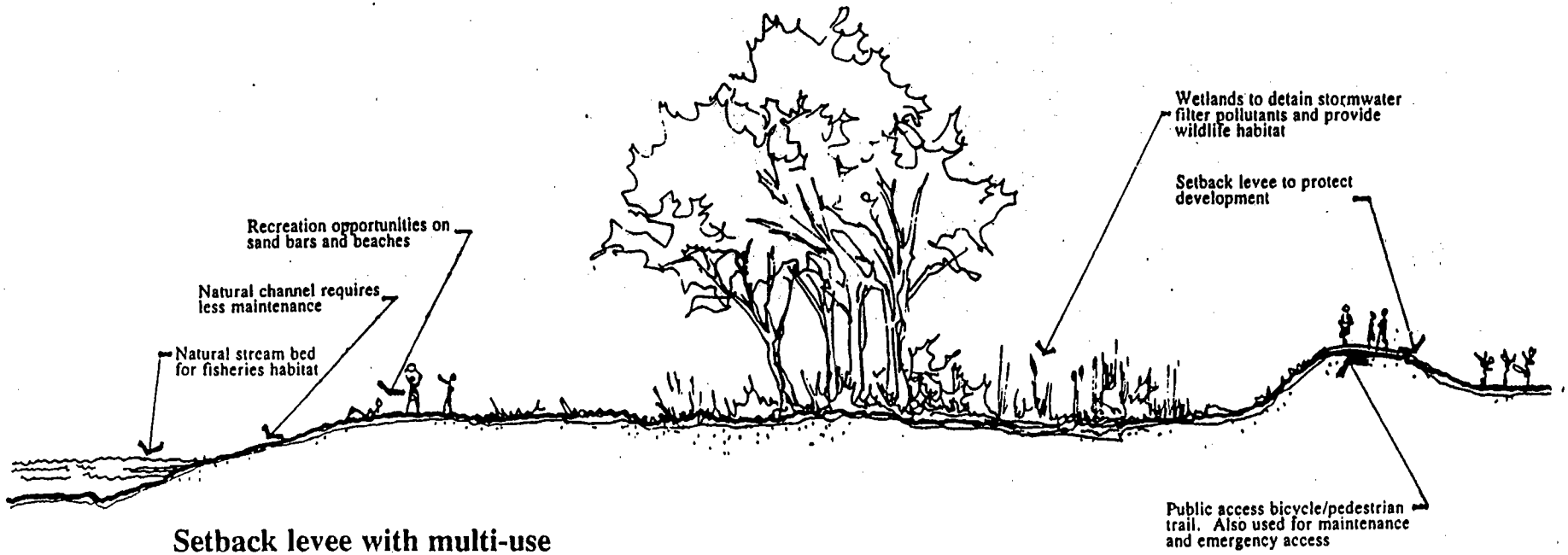
Floodwalls perform much like levees except that they are vertical sided structures which require much less surface area. Because floodwalls are usually constructed of reinforced concrete, the expense of installation is often prohibitive and the structure will degrade adjacent habitat.

Setback Levee- An Attractive Alternative

A variation of the standard levee, which is usually located as close as possible to the river channel is the "set back levee" in which the river-side toe of the levee is "setback" from the river banks at a minimum distance determined by the regulated FEMA floodway. Of course, the setback may be wider. An optimum setback distance should satisfy other criteria: 1) exceed the meander belt of the river, 2) allow for recreation use of the area contained within the levees, either in a natural condition or augmented by play fields, bike paths or picnic areas, 3) would not interfere with existing standards of vegetation, and 4) avoid interference with particular wildlife habitat. Since setback levees allow natural biological and hydrological systems to occur in the setback, the setback levee is a structural solution that merits careful consideration as an alternate to the conventional levee. On the other hand, setback levees require more land area for the project, which may be a disadvantage. The figure on the following page provides an example of a setback levee with multiple use opportunities.

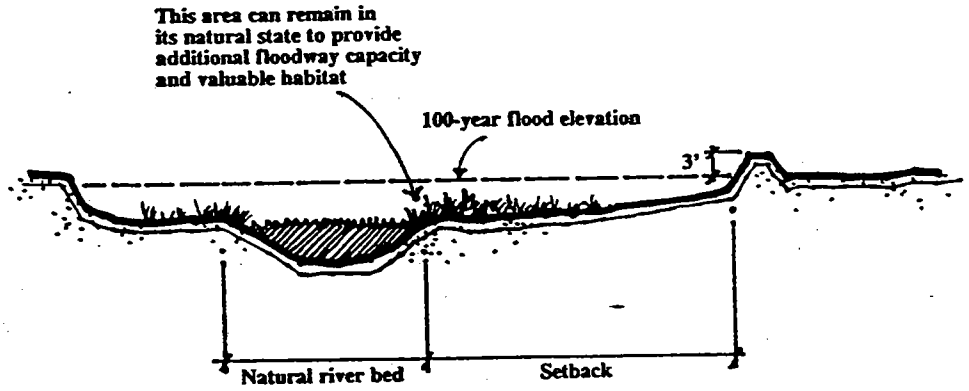


Typical levee



Setback levee with multi-use opportunities

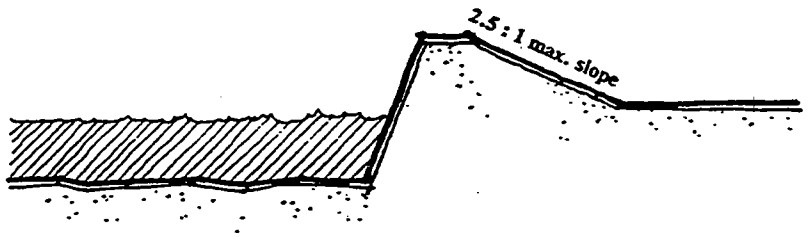
The illustration of the setback levee illustrates the concept of using floodplains for a variety of objectives. Flood hazard management planning should maximiize resource utilization while minimizing the potential for flood damage.



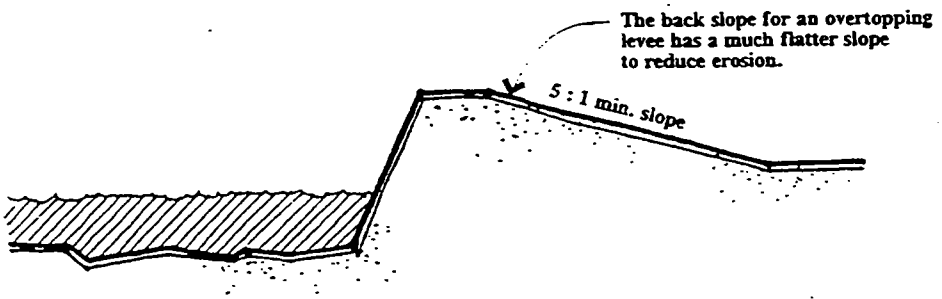
Setback levee.

Overtopping Levees

The level of protection a levee provides is defined as the largest flood which does not overtop the levee. This definition of level of protection does not take into account the ability of that levee to withstand overtopping. "Overtopping levees" are designed to withstand overtopping and thus to minimize levee failure. Levees designed to overtop are initially more expensive than non-overtopping levees, however given the eventuality of overtopping, overtopping levees provide a way to take water safely onto the flood plain. The goal of this flood hazard management measure is to reduce flood damages to the greatest extent possible, not to keep out the largest flood possible.



Regular levee



Overtopping levee.
Source: Snohomish County Comprehensive Flood Control Management Plan.

C. Stream Channel Improvement and Realignment

Stream channel improvement may result in much the same effect as those which would occur from dikes or levees. Here, however, the improvements would involve dredging operations (removal of obstructions and/or straightening the channel course). Channel improvements of this type have a distinct advantage over the levee system in that when flood waters rise, any inundation is relatively slow. The velocity or surge associated with a dike failure mentioned above does not exist.

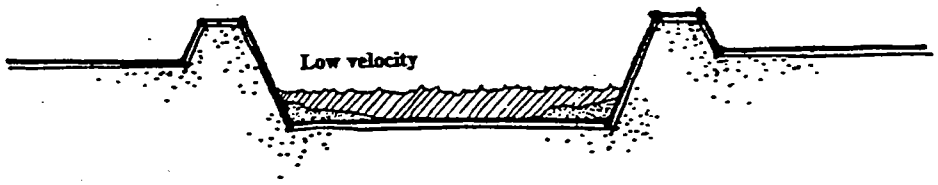
Dredging

Dredging operations will be controlled by the surrounding topography, and attempts to go beyond such limitations will either reap no benefit or will simply move the flood problem to other areas. Attempts to reduce stream roughness must recognize the possibility of vegetative regrowth or sediment deposition, both of which may return the roughness to its original value.

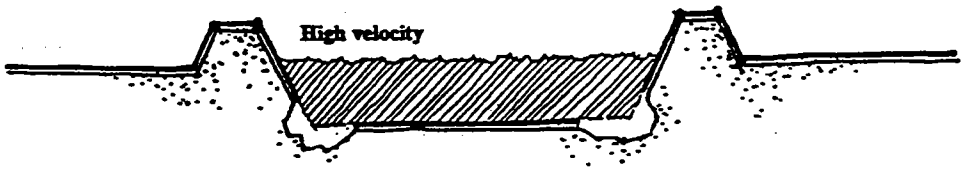
Drawbacks to Engineered Channels

It is reasonable to expect that channel improvements and realignment may require more land area than other alternatives. In many cases, this land area may not be available at acceptable cost. Thus, a concrete-lined or other-lined channel may be necessary. In any event, the aesthetics of the improvements must not be ignored nor must the corresponding loss of fish and wildlife habitat. If dredging and realignment are undertaken, stream water ecology and other environmental impacts (e.g., shallow water habitats) may be affected as discussed earlier. Forces created by flowing water are often underestimated; it is quite difficult to force a meandering channel to assume an "artificial" path in all instances. Unless suitable protection is designed to offset erosive energy of the stream, the meander of the natural channel will reoccur.

Engineered channels and levees are subject to damage or degradation by a river's natural hydrological processes. If the channel's cross section is too wide and allows the river's velocity to decrease, sedimentation is likely to occur. This will eventually obstruct the channel and could lead to flooding during peak flow. If the channel is too narrow, the stream's velocity could lead to erosion at the base of the channel's walls. Since river flow typically varies widely during the years, it is quite likely that there will be periods of erosion and sedimentation. Natural river channels accommodate these dynamic processes by continuously modifying their configurations and/or location. Fixed engineered channels do not allow for these changes and are therefore subject to damage.



During low flow periods the velocity slows and sediment can deposit in the channel, reducing channel capacity.



During high flow periods high velocity currents can erode channel walls.

Stream bed degradation associated with engineered channels.

D. Bank Protection Measures

In their work on the *Dungeness River Comprehensive Flood Control Management Plan* for Clallam County, the firm of Kramer, Chin and Mayo identified several bank protection and in-stream control measures to reduce erosion and damage to nearby properties. The description of these structural alternatives, listed below, are adapted from the plan below.

Bioengineering

Bioengineering is the term given to the practice of using natural materials (vegetation) consisting of bundles of reeds, root systems, and living plant material to stabilize channel side slopes and prevent future erosion. The process includes embedding the more structural organic materials (logs, reeds, etc.) into the slope and planting live materials for surface coverage. Plantings can be selected which enhance fisheries habitat by providing canopy over the normal water surface of the river with a resulting cooling and food source benefit. Other wildlife may also be attracted to this natural environment.

Bank Slope Reduction

Steep banks threatened by erosion can be "flattened" or have the slope reduced and then revegetated using other methods described in this section. The highest portion of the back is cut back away from the channel to reduce sloughing and slide potential during high water conditions. This may not be an appropriate measure if the top of bank

is already heavily vegetated with trees and large shrubbery.

Crib Dams

Crib dams use logs buried length-wise into the slope to achieve bank stability. Vegetation is then planted in the soil between the logs set side by side to provide canopies above the river water surface. However, the use of crib dams has limited application in northwest streams.

Riprap

Along stream reaches where real constraints will not permit bank slope reduction or where there is the potential for a vegetated slope to be undermined, the use of riprap may be acceptable. Riprap is placed in the critical erosion area and is sometimes combined with bioengineering techniques.

Sod/Pavers Along Banks

This method uses a combination of man-made, earth stabilizing materials intermixed with sod or plantings to achieve slope stability. Earth reinforcement could also be based on a geotextile fabric which lays on the surface of the slope and allows seeded plants to grow through the fabric to maturity, leaving the appearance of a vegetated slope.

Gabions

Gabions are cylindrical wire mesh baskets filled with concrete or rocks which can be used in revetment construction and streambank protection. It is possible to combine vegetation with gabions along streambanks or shorelines incorporating bioengineering techniques.

E. In-Stream Controls

Off-channel Gravel Traps and Mining

Mining gravel within the river bed would disrupt the fisheries habitat of the river and require particular construction and mitigative measures. Mining adjacent to the river could have multiple benefits: 1) produce aggregate material, 2) increase river conveyance and 3) enhance fish habitat. Depending on the type of facility, gravel could be mined on a one-time basis or with a frequency based on the river's average bedload transport and resulting replenishing rate. Gravel traps must be properly sited so the river does not cut into the pit.

Anchor Logs in Stream

This alternative, which involves anchoring fallen trees near banks experiencing severe erosion, is used to redirect flow or reduce flow velocity within the stream bed. This may be used as a temporary

remedy or as part of a structural diversion to mitigate the effects on the fisheries habitat. Care must be taken so that the anchor logs do not collect debris and block the channel.

Deflector Structures

Deflector structures are placed across a channel or may jut out from a channel bank to redirect the streamflow away from an eroding side slope or to maintain a minimum flow channel. Their height is generally set below the dry season mean water levels. The structures must be securely anchored and made of a material that can withstand the effects of continuous stream flow. As in the case of other in-stream measures, the structures must be located and designed so that they do not catch debris, obstruct the channel and produce higher velocities.

Spur Dikes

Spur dikes are built from the channel bank into the river bed to direct the main channel flow away from the bank and to create a low velocity zone between the dikes to minimize erosion. The lengths and spacing of the dikes are set based on the hydraulic conditions of the river over the affected reach to achieve particular results. The length of the dikes are limited by the main channel conveyance required by the river and by the effects on the opposite bank and downstream locations. The dikes usually exceed the normal river water surface elevation and are overtopped in moderate and severe flooding conditions.

A recent proposal to use spur dikes along the west bank of the Dungeness River just downstream of Ward Bridge for the protection of Ward Road has received the approval of the reviewing agencies. The project is now in the final design phase to determine the appropriate size and alignment of the dikes to create the desired hydraulic effect which will eliminate the destruction of the river bank.

Chevron Dams

These structures are V-shaped, low water weirs built across a stream to redirect flow. The "V" faces upstream to move water toward the center of the main channel. The weirs are generally submerged and may be notched to allow extreme low flows to pass and prevent stranding fish. Chevron dam application is usually restricted to small streams.

Split Channel/Bypass Channel

This alternative can be described as diverting stream flow during times of high volume to a parallel bed or restoring an abandoned channel for the purpose of increasing river conveyance. However, this concept may require a flow control structure at its confluence with the main channel and/or a section of man-made channel where a natural channel is not available. Moreover, split channels must include appropriate measures to prevent fish stranding.

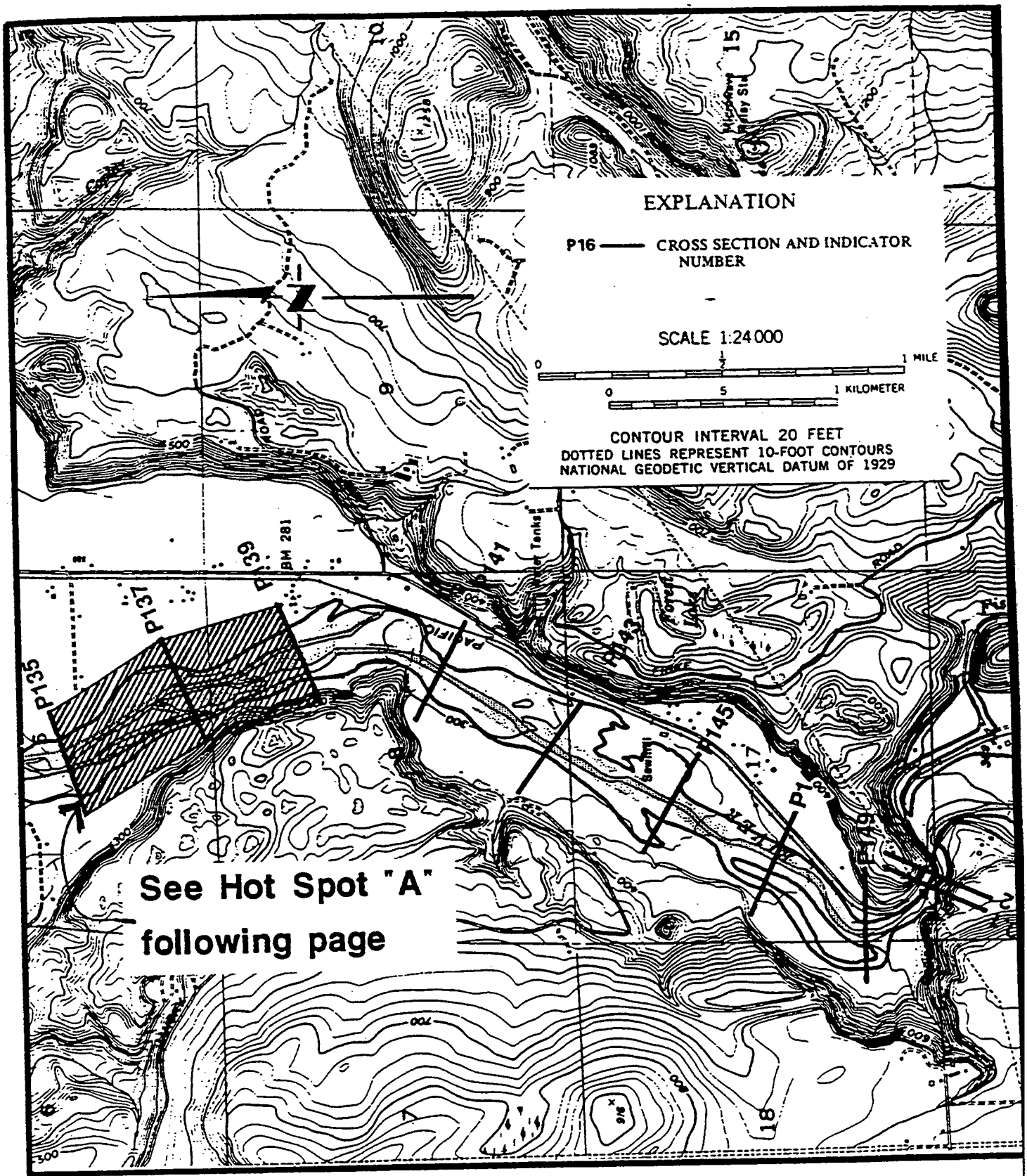
Gravel Bar Scalping

This structural alternative may be considered a maintenance measure because it must be repeated regularly to keep up with the continual bedload deposition along the river in order to be effective. Gravel bar scalping should only be used in areas of confirmed deposition and aggrading river channel. If areas of programmed removal are determined, permanent access easements and structures could be established that would minimize the effects of working within the stream banks.

Summary of Alternative Measures

It is important that the alternative measures be described in specific terms and located on a map. This is also true for non-structural measures. If an alternative calls for protecting wetlands, for example, then the schematic location and size of the wetlands should be shown to illustrate what the measure involves and how it relates to other measures. If a regulatory program is suggested, then the applicability, intent, basic regulations and authority for the program should be described.

It is also useful to indicate which measures solve or contribute to solving which problems. This will help to evaluate the alternatives and to organize preferred measures into a comprehensive strategy in later steps. The following map and matrix, excerpted from the Puyallup Comprehensive Flood Control Management Plan prepared by JMM Consulting Engineers Inc., indicates which of the proposed measures would help to solve problems at various problem areas or "hotspots" along the river. The plan includes a series of detailed maps locating the referenced locations. A sample map is included on the second page following.



PIERCE COUNTY RIVER IMPROVEMENT
PUYALLUP RIVER COMPREHENSIVE FLOOD CONTROL MANAGEMENT PLAN
100 YEAR FLOOD PLAIN BOUNDARIES
PUYALLUP RIVER
CROSS-SECTIONS P135 - P150.2

FIGURE 1-5

Problems or "Hot Spots" and proposed solutions.
Source: Puyallup River Comprehensive Flood Control Management Plan.

Step 6: Evaluate Alternative Measures

Once feasible alternative measures have been identified, they must be studied in enough detail to determine the effectiveness, costs, benefits, and impacts of each one. The purpose of Step 6 is to determine this information so that the alternatives may be compared during Step 7 and the preferred alternatives organized into a flood hazard management plan in Step 8. To be complete, the alternative evaluations should include a description of each measure's characteristics with respect to the following criteria.

A. Environmental impacts.
B. Consistency with applicable policies.
C. Cost, benefits and method of payment.
D. Scheduling and term of benefit.
E. Goals and objectives set in Step 2.

Suggested methods for evaluating measures with respect to each of the criteria is outlined below.

A. Environmental Impacts

The most thorough and, in the long term, expeditious way to assess the measures' potential impacts is to model this task after the procedure for analyzing alternatives in a State Environmental Policy Act (SEPA) programmatic environmental impact statement. That is, the potential impacts with respect to the natural and human system elements as noted in the SEPA guidelines should be identified. Those that are potentially substantial, especially the potential impacts to geohydrological, water quality and biological systems of structural measures should be investigated. At this point it may not be necessary to quantify all the impacts and a summary of impacts may be condensed into a matrix such as the following example from the *Dungeness River Comprehensive Flood Control Management Plan* (see table on following page).

Of course, the key consideration is to provide sufficient analysis so that a SEPA checklist or EIS can be easily developed from the information. Although the planning team may elect to perform more extensive environmental analysis for the alternative measures chosen in Step 8, it is the recommendation of this guidebook that the SEPA impact assessment be integrated into the planning process in a way that can facilitate alternative selection as well as provide SEPA documentation.

Special Tip: Other Impacts to Consider

The impact analysis should pay special attention to other hydrological impacts in other parts of the watershed system. For example, if a proposed channel straightening is proposed that will speed water past a flood prone area down into a neighboring community, the downstream impacts should certainly be addressed.

Table 8.1
Environmental Impacts Associated with Structural Methodologies

Exhibit No.	Structural Methodology	Impact Categories: Fish Resources	Wildlife Resources	Scenic Aesthetic Historic	Water Quality	Hydrology	Existing Recreation	Other
8.1	Approach dikes	---	1	---	---	2	---	---
8.2	Cabling Trees	3,5	---	4	5	---	---	---
8.3	Flow realignment	6,7	---	---	6,7	2	---	---
8.4	Gravel bar scalping	---	---	---	---	2	---	---
8.5	Instream boulders	6,8,9	---	---	9	9	---	---
8.6	Low dikes	---	10	---	---	11	---	---
8.7	Setback levee	---	10	---	---	11	---	---
8.8	Spur dikes	5,6	---	---	5,6	12	---	---
8.9	Reestablish riparian vegetation	5	13	14	5	---	---	---

NOTES:

1. Localized habitat disruption would occur during construction.
2. Flow characteristics would be more efficient resulting in reduced localized backwater, flooding or erosive conditions. Analyses would be needed to ensure flow conditions are not worsened upstream or downstream.
3. Temporary localized disruption to fish habitat could occur during construction. Long term habitat provided for fish by trees.
4. The appearance of cabled trees would be preferred to structural measures using rock or concrete.
5. By protecting an erosion-susceptible bank, sediments discharged to the river would be reduced.
6. Temporary localized disruption to fish habitat and water quality would occur during construction.
7. Long term benefits to fish habitat and water quality by providing reduced erosive flow characteristics and associated generation of sediments.
8. Long term habitat would be provided for fish around the boulder.
9. Reduced erosive-flows would be anticipated associated with the energy dissipation provided by the boulders, thereby reducing sediment contributions to the river.
10. Placement may require removal/loss of habitat.
11. Property would be protected by confinement of flood on river side of dike/levee.
12. Flows would be redirected away from erosion-prone banks.
13. Riparian habitat lost to erosion would be restored.
14. The appearance of vegetation is preferred to concrete or rock erosion-protection.

Environmental impacts summary.
Source: Dungeness River Comprehensive Flood Control Management Plan

B. Consistency with Applicable Policies and Regulations

Each alterative should be examined in light of existing policies, regulations and permit requirements to insure that the proposed measure is feasible from a regulatory standpoint. Potential conflicts should be identified and noted, and where necessary, applicable regulatory agencies should be consulted. The chart below, excerpted from the *Dungeness River Comprehensive Flood Control Management Plan* presents an example of a method to summarize permit requirements for various structural measures.

STRUCTURAL FLOOD CONTROL MEASURE	REQUIRED PERMITS									
	SSDP	SCDP	BP	WQM	WQC	EC	EIS	HPA	NP	IP
APPROACH DIKES	●			●		●	○	●		●
CABLING TREES	✦	●						●		
FLOW REALIGNMENT	✦	✳					○	●		●
GRAVEL BAR SCALPING	✦	●						●		
INSTREAM BOULDERS	✦	●		●		●	○	●		●
LOW DIKES	●					●	○	●		●
SETBACK LEVEES	●					●	○			●
SPUR DIKES	●	●		●		●	○	●		●
REESTABLISH RIPARIAN VEGETATION	✦	●		●		●	○	●		●

● PERMITS REQUIRED

○ EIS REQUIREMENT DEPENDS ON FINDINGS OF PRELIMINARY REVIEW

✦ PERMIT REQUIRED IF FAIR MARKET VALUE OF PROJECT EXEEDS $2,500

✳ USE OF THIS MEASURE WOULD REQUIRE SMP REVISION

Matrix summarizing permit requirements.
Source: Dungeness River Comprehensive Flood Control Management Plan.

C. Cost and Method of Payment

Cost estimates for structural and non-structural solutions should be made in sufficient detail to estimate preliminary planning level project budgets. Estimates for construction budgets should indicate the contingency factors, and land costs, design fees, costs of mitigation measures, taxes and, in some cases, the monitoring or evaluation costs.

Beyond the direct costs of construction and/or land acquisition, the ongoing operations and maintenance costs should also be identified. For example, if a dike requires periodic maintenance every 10 years, then an estimated amount should be entered into the cost analysis. Administrative costs for non-structural alternatives should also be identified. If additional dikes, district actions or building permit

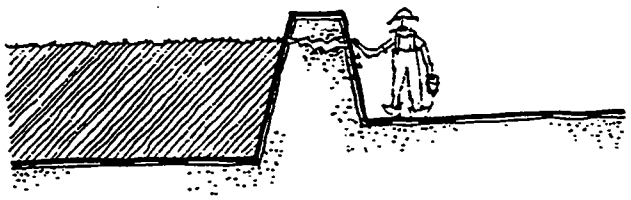
personnel are needed, for example, the cost for these items should be considered. The planning team should also indicate how potential projects are to be funded. For example, if a levee maintenance project is to be accomplished with an FCAAP grant combined with diking district assessments, this combination should be noted so that the public has a clear understanding "who pays how much for what."

Special Tip

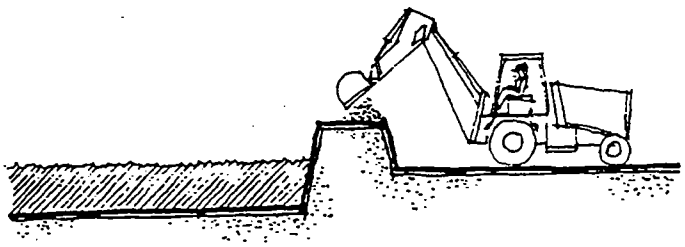
***Guidelines for Establishing Economic and Engineering Flood Criteria* by P.W. Barkley et.al. includes a useful section on the cost/benefit economics of flood damage reduction.**

D. Scheduling and Term of Benefit

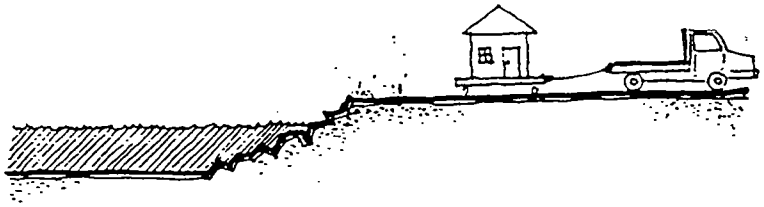
Strategic planning is often a matter of timing. This is especially true in flood hazard management where some solutions are remedial and solve intricate problems for a short-term while other solutions are more far reaching and long-term. The issue of short-term versus long-term benefit must be carefully addressed. In fact, the question of timing is twofold, involving both the scheduling of the proposed measures and the time period for which the measure will provide a benefit. For example, raising a dike may be an immediate solution for protecting a low, flood prone district, but may require further elevation in the future due to projected runoff. On the other hand, land acquisition of that same flood prone area and construction of flood water storage areas may require more time to implement, but also presents a longer term solution that improves conditions in other parts of the watershed.



Short-term solution; high risk



Another solution; less risk; high cost



Permanent solution; good flood plain management

E. Public Goals and Objectives

The alternatives should be measured by the goals and objectives developed in Step 2. The obvious way to accomplish this is to ask the public participants to assist in this evaluation in a public workshop. Step 7 presents some suggestions for a workshop during which participants can indicate which measures most effectively meet the goals and objectives that they helped to develop earlier in the process.

Before the public workshop, the alternative evaluation results should be summarized briefly so that the information can be presented to the Planning Committee and the public. The example alternative measure comparison matrix on the following page summarizes the environmental impacts, related regulatory requirements, cost, and timing benefits of the alternative measure. The alternative comparison matrix summarizes those parameters even more succinctly so that the alternatives can be compared. The format and content of these examples may vary widely, and the examples presented here are only one approach.

Step 7: Hold Public Alternative Evaluation Workshop(s)

A public workshop to present the alternative measures analysis and solicit the public's opinion is an effective way to incorporate public participation for three reasons. First, it provides the planning team the opportunity to present the result of the technical evaluation and to answer questions. Second, it allows the public the opportunity to compare all chosen alternatives among different options. Experience has shown that it is easier for public participants to deliver informed input when they are presented clear choices with the implications of each choice. Finally, it is an opportune time to reaffirm the commitment to public involvement, because it demonstrates that the public goals and objectives developed earlier are incorporated into the decision making process. The workshop should be well publicized to insure that all members of the community are invited to participate.

As in the case of the goals and objectives workshop, there are several different participation exercises that can be used. One format is to take the whole group through each of the alternatives one by one and ask each individual to fill out an evaluation sheet indicating their preferences at the end of the session. Another format is to divide the participants into smaller groups and have each group evaluate the individual alternatives one at a time and then compile the smaller group responses at the end of the workshop. Various scoring systems can be used or the comments can be made qualitatively. One technique is to let individuals vote on their preferred measures using sticky back dots as in the first workshop. Often it is helpful to array the alternatives and the objectives in a matrix format for easy comparison. (see example on page 36).

Alternative Measures Comparison Matrix (Hypothetical Example)

Criteria	Alternative		
	Raise Levees (Sec 1.1)*	Increase Flood Proofing Standards (Sec. 2.1)	Acquire Designated Flood Prone Properties in Valley (Sec 3.1)
Impacts	Reduces habitat significantly (requires mitigation), potential sedimentation downstream (Sec. 1.2).	Slight reduction in development pressure on flood plain (Sec 2.2).	Relocation of 8 homes; loss of 32 acres of pasture land.
Costs	$1,500,000 construction $10,000 maintenance annually (Sec 1.5)	Approx. 10% increase in foundation costs for new development $10,000 annual local administration costs (Sec. 2.5)	$700,000 acquisition costs $1,000 management costs annually (Sec 3.5)
Implementation Strategy	Diking district takes lead coordinating with county; applies for FCAAP matching grant (Sec. 1.6).	County Building Department administers program through permit process coordinated w/NFIP.	County purchase w/ FCAAP and IAC matching grants (Sec. 3.6).
Benefits	Would address local flooding problems of 14 property owners (Sec. 1.8).	Allows additional development space w/out reducing flood plain capacity.	Provide enhanced wildlife and recreation opportunities; reduces flood hazard potential (Sec 3.8).

* Section numbers refer to descriptions in text.

Alternatives evaluation matrix.

Special Tip: EIS Scoping Meeting

If a formal SEPA checklist or EIS process is used in the planning process, it may be advantageous to hold two public workshops during the alternative evaluation. During the first workshop, the planning team would just present the alternative measures and ask the participants what potential impacts or consideration they feel should be considered. This workshop would then serve as a "scoping meeting" within the EIS process. The second workshop, held after evaluation analysis is substantially complete would then allow participants to evaluate the alternatives and indicate their preferences.

Step 8: Develop Flood Hazard Management Strategy

After the public input has been compiled and evaluation analysis completed, the planning team can work with the Project Committee to assemble the preferred alternative measures into a management strategy which serves as the basis for the Comprehensive Flood Hazard Management Plan. The strategy should include a list of actions, the priority, cost and time frame for each, and the coordination activities with adjacent governments, related agencies, and associated programs. There are no strict procedures for this step which involves fitting various alternative measures into a coordinated course of action.

The *City of Edmonds Drainage Basin Studies, Edmonds Way, Perrinville, and Meadowdale* prepared by R.W. Beck and Associates, presents a useful example of one way to present a recommendation for particular alternative measures. That plan identified measures for each individual problem and then discussed the pros and cons of each recommendation.

A recommendation for a single problem area is included below. In discussing the final recommendations, the example describes the costs and benefits of each alternative that is required by Chapter 86.12 RCW as amended by ESSB 5411 Section 3(2a) (see the section on Washington State statutes in the Introduction).

Example of Alternative Selection Recommendation

c. Problem No. 3

Problem No. 3 is the insufficient capacity of both the Perrinville Creek culvert under Talbot Road and the downstream channel to the BNRR tracks.

Alternative A:

Pipe replacement with a 60-inch-diameter culvert incorporating the fish passage design criteria discussed in the fisheries inventory (Appendix E), is recommended for the Talbot Road culvert crossing. Downstream from the channel between Talbot Road and the BNRR tracks, installation of a pipe

parallel to the existing BNRR culvert would prevent water from backing up at the existing culvert which causes the upstream channel to flood (10-year event). It should be noted that the two culvert crossings were sized to carry the 100-year storm, however, the stream channel would not contain the 100-year storm.

Widening the stream channel to carry the 100-year event was not preferred because several property owners had previously improved the channel with landscaped and rockery channel side slopes.

Estimated Cost: $115,000

Potential Environmental Impacts:

Impacts would include the reduced incidence of flooding, and provide fish passage through the Talbot Road crossing. Temporary disruption of traffic will result during construction. Temporary disruption of the creek would result from installation of the culverts.

Alternative B:

Pipe replacement with a 60-inch-diameter culvert incorporating the fish passage design criteria discussed in the fisheries inventory (Appendix E), is recommended for the Talbot Road culvert crossing. To solve the stream channel flooding problem, peak flows could be diverted through a new 48-inch-diameter drainage pipe to Puget Sound. This pipe would cross under the BNRR tracks. The diversion was sized to pass all flows above the existing capacity of the stream channel.

Estimated Cost: $135,000

Potential Environmental Impacts:

Include the reduced incidence of flooding, and provide fish passage through the Talbot Road crossing. Temporary disruption of traffic will result during construction. Installation of diversion pipe will result in temporary disruption of lawn and landscaped areas. Temporary disruption to the creek would result from installation of the culverts.

Recommended Solution:

Alternative B is recommended because, for a relatively small increase in cost, flooding can be eliminated from the stream channel between Talbot Road and the BNRR for up to a 100-year storm.

Source: City of Edmonds Drainage Basin Studies, Edmonds Way, Perrinville and Meadowdale

---

The individual projects were then assembled into a list of capital improvements and non-structural solutions. Chapter 86.12 RCW as amended by ESSB 5411 Sections 2 and 3(e) calls for identifying sources of revenue sufficient to finance the comprehensive scheme of

the flood protection improvements. Table IX-3 (below) from the *City of Edmonds Drainage Basin Studies, Edmonds Way, Perrinville and Meadowdale* summarizes the cost sharing breakdown for the different jurisdictions involved with the program. The source of funds should also be identified as well.

TABLE IX - 3

CAPITAL IMPROVEMENT PROGRAM

Priority Number	Problem Number	Description	1990 Estimated Cost
1	SB - 5a	6th Avenue W	$58,300
2	SH - 2a	96th Avenue W	$150,000
3	LB - 1	242nd Place (Lake Ballinger)	$120,000
4	SB - 7	5th Avenue	$57,000
5	TP - 2	Fruitdale-on-the-Sound Creek	$267,300
6	EW - 1	Willow Creek Outfall	$105,000
7	P - 3b	Talbot Road	$52,650
8	TP - 4	92nd Avenue W	$180,400
9	FC - 1	Good Hope Pond	$77,000
10	P - 2b	Perrinville Creek Bank Stabilization	$117,450
11	TP - 5b	88th Avenue W	$484,000
12	NS - 5	88th Avenue W	$205,700
13	M - 1	Meadowdale Seepage Collection System	$135,000
14	SB - 5b	Alder	$41,800
15	CL - 7	Chase Lake Elementary	$46,800
16	M - 13	171st Street SW	$85,000
17	SH - 12	Glen Street	$97,200
18	P - 1c1	Perrinville Pond	$144,000
19	SH - 2b	95th Avenue W	$65,000
20	FC - 2	Sierra Drive Collection facilities	$35,200
21	FC - 3	Sierra Drive Collection facilities	$30,800
22	FC - 6	80th Avenue W	$71,500
23	EW - 2c	Edmonds Way Trunk Sewer	$107,600
24	EW - 4	100th Avenue W	$75,000
25	EW - 3	Birch Street	$60,000
26	NS - 3a	Olympic Avenue	$322,300
27	NS - 3b	Olympic Avenue	$28,600
		Total	$3,220,600

Key:

(CL) - Chase Lake
(EW) - Edmonds Way
(FC) - Five Corners
(LB) - Lake Ballinger
(M) - Meadowdale
(NS) - North Stream
(P) - Perrinville
(SB) - Shellabarger
(SH) - Shell Creek
(TB) - Talbot Park

Cost summary and breakdown.
Source: City of Edmonds Drainage Basin Studies, Edmonds Way, Perrinville and Meadowdale.

Special Tip: Non-structural Recommendations

In past years, the plans submitted as comprehensive flood control management plans have given little emphasis to non-structural solutions. Non-structural measures should be described in sufficient detail to clearly define a course of action, identify the regulatory tool to be used and, if possible, outline policies and regulatory language to be pursued. Nebulous statements like, "Revise comprehensive plan to insure better flood hazard management practices," are not acceptable unless supported by more specific direction. One way to provide greater specificity is to provide model ordinances from agencies. For example, the *City of Edmonds Drainage Basin Studies, Edmonds Way, Perrinville and Meadowdale* listed the recommendation to adopt an illegal dumping ordinance and then included examples of illegal dumping ordinances in an appendix.

Step 9: Complete Draft CFHMP and SEPA Documentation

Once the overall management strategy is determined, the plan's recommendations and supporting information must be compiled into a draft plan for review. The most prominent element, of course, should be the recommended actions, along with their time frame, participants, impact mitigation measures, costs and funding sources. The recommendations should also indicate priorities for the various actions. Chapter III outlines the elements that should be in the draft report. Also, completing the draft SEPA assessment (draft EIS or environmental checklist) at this time is also useful, so that the two documents can be distributed and reviewed together.

The draft plan and SEPA documentation should be distributed to agencies and special interest groups who have participated in the planning process and the public for review. Comments received on draft plans should be incorporated into the final plan and SEPA documentation. In addition to advisory committee meeting(s) to review the plan, a third public workshop may be advisable at this point to present the plan and solicit comment. The plan must also include certification from the Washington State Department of Community Development that the local emergency management organization is administering an acceptable comprehensive emergency plan. Once these steps have been taken, 5 copies of the draft plan and the SEPA documentation should be submitted to Ecology.

Ecology staff will disseminate the copies for review by other Ecology sections as well as consult with the State Departments of Fisheries and Wildlife, the State Department of Natural Resources, and affected Native American tribes. Other affected parties may comment on the draft plans as well (WAC 173-145-070(2)). Ecology staff will consolidate review comments and arrange a meeting with the submitting government to discuss the submittal. After receiving the

review comments it is recommended that the grantee write a letter to Ecology indicating how they will respond to the comments. Once Ecology and the local jurisdiction are in agreement on the proposed plan revisions, the local planning staff and/or consultant should revise the draft into the final CFHMP and submit to Ecology.

Step 10: Submit Final CFHMP to Department of Ecology

After comments from the public and regulatory agencies have been incorporated into the final plan and SEPA documentation, the plan is ready for submittal to Ecology.

At least 5 copies of the completed plan must be submitted to Ecology. It is helpful to submit copies of SEPA documentation as well. Ecology FCAAP review staff will review the plan for conformance to WAC-173-145-040 and the grant agreement scope of work.

If all review comments on the draft plan have been adequately addressed and the final CFHMP is in compliance with state statutes and grant agreement, Ecology will approve the plan, in consultation with the Departments of Fisheries and Wildlife.

Special Tip

The checklist on the following page lists some of the major elements the plan should include.

Step 11: Hold Public Hearing and Adopt the CFHMP

After the CFHMP has been approved by Ecology, it should be presented to the adopting governmental body at a public hearing, along with the project committee's recommendation for adoption. Where a plan encompasses more than one participating governmental jurisdiction (e.g. county and a city within the county) both governments should adopt. If there is a dispute, it must be resolved in accordance with ESSB 5411.

Step 12: Notify Ecology that the Final CFHMP is Adopted

Once the plan is adopted a letter should be sent to Ecology formally notifying them that the CFHMP is adopted.

WALLOWA NATIONAL FOREST

WATERSHED MANAGEMENT APPROACHES TO IMPLEMENTING SOLUTIONS

Provided by Greg Knott

WATERSHED MANAGEMENT APPROACHES TO IMPLEMENTING SOLUTIONS

Long-term and short-term management for sustainable resources will restore and maintain a healthy ecosystem for vertebrate species and all other Wallowa County residents. However, to restore this ecosystem, we must understand the parameters of its components and practices that are compatible with it. To develop a successful plan cumulative effects of practices must be considered, as well as long-term goals and short-term requirements.

The resource-based aspects of Wallowa County's economy, ranching, timber harvest, farming, and recreation, all have much to gain by modifying some practices or establishing new parameters so that sustainable timber harvest, grazing, and irrigated crop production can continue in Wallowa County for future generations. Sustainable practices are already utilized by a substantial portion of Wallowa County resource managers.

GENERAL APPROACH

Overall Action

The general public should be educated about overall vertebrae species habitat requirements and reasons for the actions taken and then be allowed to comment. The effectiveness of all actions taken to benefit vertebrae species should be monitored and modified or terminated if not necessary or effective.

Privately Held Lands

Landowners should be educated about beneficial and detrimental effects of land use on vertebrae species. Information about governmental and private funding sources to help correct habitat problems and implement solutions suggested in the recovery plan should be provided to landowners. If funding is limited, funds should be directed first toward correcting high priority problems. Cost share (and possibly other) incentives for landowners should be provided to those who maintain and enhance watershed conditions and overall environmental quality.

Publicly Held Lands

A coordinated and cooperative effort among agencies should be the focus to make sure efforts at implementing solutions are not duplicated or left out. Adequate funding for implementation of solutions necessary for watershed enhancement needs to be assured. Public agencies need to work with adjoining private landowners and other agencies to provide continuity between ownerships in management and monitoring.

Management Tables

The tables in this discussion show general approaches for the management of specific resources or activities. A single management approach can potentially address several interrelated habitat problems. For example, a livestock management approach that encourages buffer strips adjacent to streams would in effect help to

(1) manage livestock to enhance fisheries habitat,
(2) protect vegetative cover,
(3) maintain healthy riparian plant communities,
(4) increase riparian shading to preserve cool water temperatures, etc.

Solutions to specific problems have been categorized and are listed by identifying number in Appendix B. Each table consists of a list of management approaches in the first column and the solutions that would be addressed by that approach in the second column. Numbers in the second column identify the solutions listed in Appendix B.

WATER

The availability of clean, high quality water is a key component of good salmon habitat. Salmon have evolved and adapted to the natural flow conditions of the area which are generally (1) high flows in March through July (depending on elevation) due to melting snowpack and (2) moderate to low flows at other times. The lower natural flows are good for salmon spawning, incubation, and rearing. Higher flows are needed to assist migration and remove fine sediment buildup from streams. On some reaches of streams in the County, irrigation and stock water diversions during low flow times remove enough water to eliminate rearing habitat and make passage impossible for migrating salmon. The goal for water management is to cooperate with water-right holders and governmental water conservation/management agencies (e.g. Natural Resources Conservation Service (NRCS), Soil and Water Conservation Districts (SWCDs), Oregon Water Resources Division (OWRD), and the Bureau of Reclamation (BOR) to find ways to supply water needed for salmon habitat. Some ways of potentially finding water to supplement low flows include irrigation conservation measures, adding.121 irrigation impoundments to replace stream diversions during low flow, and leasing water rights during late season flow (i.e., after the second cutting of hay). Additional water during low flow times may be made available through improved forest management and control of tree densities. Table 3 summarizes the suggested approaches for water management and the solutions that would be addressed.

Table 3.--Water Management Approach
Solutions Addressed

•Inventory all water withdrawals and irrigation return flows.

•Support OWRD monitoring of water withdrawals to ensure that users remain within their legal water appropriations. (This may also benefit junior water-right holders during times their water rights are curtailed due to lack of water.)

•Within existing law, purchase water during low flow times. (Private water right-holders are allowed to sell, lease, or donate water rights to be converted into instream purposes. The Endangered Species Act also allows purchase of water.)

•Water may be obtained through water that is "conserved" by development projects upstream, e.g.; impoundments, sprinkler systems, and pipelines

•Preserve shaded, iced snowpack (no large clearcut or overcutting) to avoid early melt and runoff (control tree densities and study to determine which tree densities provide the largest quantity and longest duration of snowpack)

•Promote the installation of more efficient irrigation systems.

FORESTS

The forest canopy intercepts precipitation. As much as 15 to 40 percent of precipitation remains in the forest canopy for some period of time. Precipitation intercepted by trees is subject to evaporation and transpiration, and this is recycled back into atmospheric water and possible future precipitation, rather than contributing immediately to ground water and streamflow. Small forest openings may be beneficial to stream hydrology and salmonid ecology because they store more snowpack, increase groundwater supply, and release more groundwater to streams. Large clearcuts (greater than 40 acres) have detrimental effects which include early melting and release of water to streams which may result in higher peak or floodflows in the spring and lower flows later in the year. Lower flows can create high temperatures and other stress problems for fish, and less water for irrigation. Flow and environmental problems resulting from large clearcuts persist for 25 to 50 years..

Forest practices that produce roads and compaction may have negative impacts on salmonid ecology. On a healthy forest floor there is almost no overland flow. However, in roads and skid trails that have been devegetated and/or compacted, water does not penetrate the ground as easily. The result is overland flow that may carry significant fine sediment and occasionally coarser sediment into streams. Compaction from roads can also intercept movement of water through soil creating bogs and increasing pore pressure up-slope from the compacted strip. Where slopes are steep, and where fills are present and culverts small or plugged, failure of the road, fill, or slope, and the sudden, major input of

sediments to a stream may occur. Subsoilers and rippers may eliminate the compaction problem but generally create additional sedimentation. The roadway can be seeded to grass with a range drill. This seeds and stabilizes the road, allowing road use for fire management or timber harvest. Table 4 summarizes the forest management approaches related to tree density and fuel loads. Some of the approaches listed in tables of other management categories, e.g., roads, livestock, and campgrounds, also apply to forest management.

Table 4. --Forest Management Approach Solutions Addressed

Tree Density

•Maintain appropriate average density of trees, e.g., 50-110 square feet basal area on south facing slopes and ridges 90-160 square feet basal area on north facing slopes

•Promote early precommercial thinning.

•Emphasize selective logging practices where appropriate.

•Encourage the orientation of created openings according to aspect, slope, alignment, and shape, to maximize shaded snow pack.

•Encourage 40-50 percent shading (winter sun) at noon on 50 percent of the forested watershed outside riparian areas.

•Encourage species diversity.

•Encourage development of management plans for private landowners, e.g., Assistance from Oregon State Forestry Department, Assistance from forestry consultants. Assistance from Oregon State Extension/Master Woodland Managers. Can address many solutions in plan

•Shelter wood seed cut, shelter wood removal cut, irregular shelterwood, single tree selection, group selection, and clearcut.
•Mechanical under thinning.

Fuel Loads

•Encourage land managers to maintain riparian fuel loads at not more than 35 tons/acre average. Some acres may have higher loads, and some may have lower loads depending on the intensity of fuel management.

•Encourage land managers to maintain upland fuel loads at an average of 25 tons/acre or less. Some acres may have higher or lower loads, depending on the intensity of fuel management.

•Encourage land managers to harvest salvage as rapidly as possible while meeting environmental concerns such as adequate woody material recruitment for stream and riparian needs.

•Encourage land managers to analyze fuels and fire potential ladder. Fuels and dense crowns contribute to crown fires.

•Encourage land managers to develop fire control corridors if time and resources are not available to treat the entire area.

•Encourage land managers to select and place appropriate woody material in upland areas, riparian area, and streams to benefit stream structure, replenish soil inventories, reduce soil movement, and reduce fire risks.

RIPARIAN AREAS

Riparian areas, about 5 percent of Wallowa County's forested areas, are the most fragile and yet the most productive parts of a watershed. About 70 percent of the wildlife in a watershed either lives in or frequents the riparian zone. The intent of timber harvest in riparian zones should be to enhance watershed conditions. A healthy stream is a stream with little bank exposed. Even during high water, the effect of riparian vegetation is to protect streambanks from erosion by floods and ice and to slow floodwaters and allow fine sediments to settle out, building soil fertility and thickness. The fine soils of the floodplain store water. Establishment and preservation of woody vegetation along floodplains and in riparian zones is essential to a healthy stream system. Woody debris in the stream provides hiding cover for small fish and nutrients for invertebrates that fish eat. Past practices removed woody debris from the streams. Approaches for riparian management are summarized in table 5.

Table 5.--Riparian Management Approach

•Encourage the design of riparian management to be site specific

•Encourage relocation design of roads, trails, and campgrounds whenever possible. Revegetate roads and trails with native grass species and/or non-native desirables.

•Encourage hardened fords and bridges for crossing and watering points for livestock.

•Encourage fencing, electronic tagging, and creation of natural barriers to large animal use of critical spawning and rearing reaches. e.g., Develop and encourage alternatives to instream watering.

•Provide shade for riparian areas to maintain optimum water temperature for salmon on a site specific basis:

Good=60 percent and above
Fair=40 percent to 60 percent
Poor=40 percent and below

•Encourage retention of snags and trees for future large woody debris.

•Encourage revegetation and protection of existing vegetation on non-forested riparian areas with woody material. e.g., Educate land owners on value of streamside woody plants.

•Establish carrying capacities for campgrounds and trails.

•Education by signing and brochures to fishermen and campers about use of riparian zone.

•Encourage design, implementation, and evaluation of grazing management systems. e.g., Manage late summer/fall use in riparian pastures.

•Limit future development in riparian zones,e.g., Avoid building on floodplains.

•Utilize Oregon Forest Practices Act for minimum protection standards. (The current FPA is in the process of being updated.)

•Encourage minimal impact methods for noxious weed control in riparian zone. e.g., Spot-spraying, pull by hand, biological control. Revegetate with thrifty competitive native species

•Use filter strips as appropriate.

LIVESTOCK

Properly managed, livestock grazing may be of benefit in riparian management. However, livestock near streams can cause a variety of habitat problems. Major problems are loss of riparian vegetation and water quality degradation. Riparian vegetation provides shade for streams and protects banks. It is to the long term benefit of the landowner to maintain healthy riparian vegetation because the root systems of the shrubs and forbs in meadow areas and trees in other areas are a protection against bank erosion during high water. In some cases, several acres of ground have been lost to erosion during high water. Livestock use can reduce

water quality by increasing temperature through loss of shade, adding sediment, and adding fecal coliform bacteria. Improving water quality in some stream reaches is important for several reasons in addition to improving salmon habitat. Maintaining water quality is important in avoiding potential health problems for children and adults who use the water downstream for recreation. The season, timing, frequency, duration and intensity of grazing use should be based on the physical and biological characteristics of the site. This should offer adequate cover (live plants, plant litter, and residue), vigorous plants, and proper root growth to promote infiltration, conserve soil moisture and maintain soil stability. Approaches to livestock management are listed in table 6. Many of these approaches, while requiring a change in management practices, should benefit landowners over the long term by providing for the continued health and productivity of the land.

Table 6.--Livestock Management Approach SolutionsAddressed

General

•Provide alternate water sources in both upland and riparian areas.

•Use upland salting.

•Study and monitor the use of seasonal grazing to enhance riparian conditions.

•Use well planned riparian fencing in spawning areas, e.g.,-Let down type fencing.-Temporary electric.-Permanent fencing.

•Use approved educational processes through whatever means available, e.**g.,** NRC**S,** OSU Department of Forestry and Extension Service.

•Keep abreast of and use new technology such as electronic ear tags as it becomes available.

•Where beneficial, look at reorganization of pasture rotation as well as resource allocation between livestock and wildlife.

•Document early spring use by wildlife that occurs prior to turnout.

•Use temporary fencing along rivers to prevent riparian damage during winter feeding periods.

•Use BLM, USFS, SCS, ASCS, OSU Extension, and ODFW to provide coordinated monitoring.

•Encourage rangeland revegetation.

•Monitor and control noxious weeds.

•Develop CRMP with USFS, BLM, NRCS, FSA, SWCD and ODFW.

•Use filter strips as appropriate.

•Use appropriate timing frequency, duration and intensity of livestock grazing.

ROADS

Roads are an integral part of resource management and have many roles. They are particularly important in forest management where they play a key role as fire breaks and as means of quickly bringing firefighters and equipment to the fire. Poorly designed, located, and maintained roads are a major source of sedimentation to streams. Other impacts can include loss of riparian shade and channelization due to drawbottom roads, increased surface runoff, decreased groundwater recharge, and potential chemical contamination. Wallowa County roads need to be evaluated, designed, and maintained to handle the heaviest expected rainfall and runoff without excessive sedimentation. The approaches outlined in table 8 are to be implemented to mitigate the adverse effects of roads on salmon habitat

.

Table 8.--Road Management Approach
Solutions Addressed

•Develop a comprehensive County transportation plan.
- Identify and map all existing roads in the County.
- Identify non-essential roads and make decision to leave open, close with very limited use or obliterate.
- Develop condition index for all existing roads, and bring substandard roads up to "use" standards or close.

•Evaluate draw bottom roads.
-Identify draw bottom roads on County transportation map.
-Determine total mileage and percent of total riparian area occupied by draw bottom roads.
- Close draw bottom road wherever appropriate.

•Temporary road/skid trail construction and maintenance.
-Build to suit use; do not over build.
-In small stream crossings it might cause less damage to the stream if hard ended fords were used instead of installing, then removing culverts.
-Cover with slash if the road/trail will be used within 2 years.
-Reseed with grass if the road/trail will be used within 2-20 years.

- Plant trees or other suitable plant species if the road/trail will be closed for more than 20 years.
-Ripping should be avoided unless no other option is available.

•Criteria for maintenance of closed road.
-Develop a County-wide definition of a "closed road."
-Pull all culverts if a road is closed and not maintained.
-Pull all culverts on obliterated roads.
-Maintain all seasonally closed roads.
-Use structures sufficient to effectively close road.

•Road surface criteria
- Permanent main-haul roads should be paved whenever practical.
-Dust should be minimized through application of lignosulfonate, water, etc.
-Surface material needed (i.e., pavement, gravel, or soil) would depend on the expected use, length of use, and, if temporary, the length of closure. Pavement would be preferred for high traffic permanent roads. Gravel would be preferred for medium traffic, permanent roads and for temporary roads that would have shorter closure times and would, therefore, not be replanted. Soil would be acceptable for minimum traffic roads that would have longer closure times, and would, therefore, be replanted. Local conditions will necessarily play an important role in choosing a suitable surfacing material.

•Criteria for road placement.
-Wet areas should be avoided.
-Minimize erosion during construction.
-Do not construct roads during the rainy season where overland flow (perennial or intermittent) is present.
-Construct the road to the standard needed for the projected use.

•Criteria for road maintenance.
-A maintenance plan and schedule should be developed for all roads.
-Use of gravel and dirt roads would be minimized during the spring thaw, and the use of dirt roads would be minimized during the rainy season.
-Draw bottom roads should not be graded toward the stream.
-Culverts, water bars, and dips would be regularly inspected and immediately repaired as needed.

•Criteria for determining appropriate road grades.
-Assess associated environmental effects to determine whether a steeper, shorter road might be more appropriate than a longer, lower gradient one.
-Take into account slope, aspect, substrate, length, and type of use.

•Road drainage requirements.

-Use an adequate number of relief culverts, water bars, or dips to prevent active erosional features from appearing on the road, and direct the outlet onto a suitable substrate (and/or filter strip) to minimize erosion down slope of the road.
-Relief structures are generally needed for every five feet of elevation gain.
-Out-sloping of the road may minimize the need for relief structures.

•Use filter strips where appropriate

FILTER STRIPS

Filter strips are managed areas of firmly rooted vegetation designed to slow sheet movement of water and intercept the sediment contained in the water. They can improve water quality by reducing movement of excess nutrients and other pollutants as well as sediment into streams. Filter strips can also help recharge the groundwater by intercepting water from roads, allowing the water to percolate into the ground. Filter strips are effective in stopping or reducing sedimentation from a variety of sources including feedlots, agricultural fields, and roads. They are effective as field borders in reducing sheet erosion from bare, plowed fields. Located below relief culverts and dips on the downhill side of roads, they can be especially effective in reducing sediment movement. Filter strips, as outlined in table 9, are a management tool that can be applied in resource management..

Table 9.—Filter Strip Management Approach Solutions Addressed

•Suggested minimum filter strip widths (NRCS). Considerations for designing a filter strip include type and quantity of pollutant, slope,soil type, drainage, vegetative species, etc. The chart below shows the width of filter strip in feet, based on slope (vertical drop in feet per 100 feet) and the length of the slope in feet.

Slope	Length of Slope (feet)									
100	110	120	130	140	150	160	180	200	300
10	14	14	14	14	14	14	14	14	17
12	14	14.5	17	17	17	18	18	19	20	22
14	14	20	20	21	21	22	22	23	24	27
16	14	23	24	25	25	26	26	27	28	32
18	14	27	28	29	30	30	31	32	33	37
20	14	32	32	33	34	35	36	37	38	43
23	14	42	43	44	46	47	48	49	51	57
30	14	54	55	57	58	59	60	62	64	73
40	14	78	80	82	84	86	88	91	94	106
50	14	105	108	110	113	115	117	122	125	142
60	14	133	136	140	143	146	149	154	160	180

•Discourage intensive activities in areas which might need a filter strip that have over 5 percent slope.

•Design and install settling basins between waste source and filter strip when more than 100-1,000 pound animal units are confined. Clean basin as needed.

•Grass area filter strips shall be generally on contour and sufficiently wide to pass peak flow at a depth of 0.5 inches or less and provide a minimum of 15 minutes flow-through time.

•Grass channel filter strips shall be designed to carry the peak flow at a depth of 0.5 feet or less and provide at least 30 minutes of flow-through time.

•Filter strips on forest land should be at least 25 feet on slopes of less than 1 percent and proportionately up to 65 feet for 30 percent slopes and at least 150 feet for 70 percent slopes. Longer flow lengths should be used as contributing drainage areas increase.

•Monitor performance and condition of filter strips. Rills and small channels should be minimized to maintain sheet flow through filter area.

•Grazing in filter strip should be controlled to maintain vegetation in a vigorous condition.

•Installation of filter strips in riparian areas should avoid ground disturbance and removal of trees, stumps, brush, rocks, etc., and consequently may need to be larger than the minimum dimensions.

.

National Forest Planning : the proper perspective

The guest commentary "Selling out our forests" (08/28/03) by Edward O. Wilson shows a misunderstanding of the issues. Here is the proper perspective:

Prior to European settlement, much of the forest of the Western U.S. was burned periodically by light fires set by Native Americans or started by lightning. These fires created a shifting mosaic of all types of tree cover, including patches of seedlings, groups of young trees and open stands of mature trees.

Because of the suppression of wildfires in the last 100 years or so, our National Forests in California and the West are highly vulnerable to destruction by fire, insects and disease due to very dense tree cover and a heavy accumulation of fuel on the ground. A 1997 report to Congress by the Forest Health Science Panel, chaired by Professor Chad Oliver of University of Washington, provided a detailed analysis of the forest health problem.

The pre-European-settlement forest ecosystem was robust against catastrophic wildfire and provided a diversity of habitats for wildlife species that have been, or might be, listed, under the Endangered Species Act. The U.S. Fish and Wildlife Service and the National Marine Fisheries Service are now beginning to realize that, because of the high probability of extremely destructive wildfire and the dynamic nature of forest ecosystems, a "no-touch" forest management policy is not beneficial to species of concern.

A proper management goal for our National Forests is to restore existing forest stands to the pre-European-settlement condition as quickly as feasible. As the disastrous Los Alamos fire emonstrated, use of only prescribed burning is environmentally, technically and financially infeasible. A 1998 report to the U.S. Congress by Professors Oliver, Tom Bonnicksen of Texas A & M University, Gene Wood of Clemson University and myself said: "The difficulties of using prescribed fire) should not be downplayed. For example air quality restrictions and budgetary constraints are major barriers to its large-scale implementation. In addition, there are very limited periods and opportunities when all of the factors such as fuel loadings, fuel moisture, existence of defensible perimeters, and weather conditions, especially wind velocity, are at levels appropriate to burn. Furthermore, it must be realized that the dangers of fire escapement require fire crews to be on stand-by and have good access by road to the area being subject to prescribed burning"

The only economically feasible way to restore forest ecosystems is to use a timber-harvesting program to reduce fuel loadings before using prescribed burning. Silvicultural techniques, such as group selection, which make small openings in the forest, will recreate the mosaic of all age classes of trees without significant aesthetic or environmental effects.

Protection and restoration of forest ecosystems cannot be accomplished without a well-maintained road system. Furthermore, recent proposals to ban road construction on the National Forests ignore the welfare of the great majority of the population. For example, an adequate road system is necessary for recreation on the National Forests (99 percent of it is road-based).

Revision of current procedures as proposed by President Bush is much needed. The old planning rule is infeasible. It is ridiculous that it usually takes about seven years to prepare plans that only last for fifteen years and that planning absorbs thirty percent of the U.S. Forest Service budget. A former Chief of the Forest Service, a Clinton appointee, has said that there is not enough gold in Fort Knox to implement the old rule.

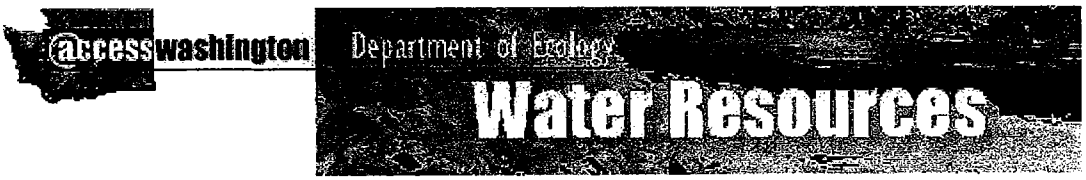
The proposed planning rule does not nullify the National Environmental Policy Act or the Endangered Species Act. In fact, it will enhance environmental and wildlife protection by making it possible to improve forest health and resistance to wildfire. It is designed to speed up only those projects whose purpose is to restore or protect the forest.

The National Forests are an important source of wood products for home-construction and other every-day needs. In 1990, they produced about 24 percent of the nation's softwood lumber consumption. Wilson, in trying to diminish the importance of National Forest timber, refers to a draft U.S Forest Service report [1995 Draft RPA Program document] that was withdrawn after Dr.Con Schallau, Professor Wilbur Maki and I revealed its gross defects in a 1998 refereed paper in the Forest Products Journal.

We already have almost 250 million acres of forest in the U.S. which are in parks or wilderness areas or not suitable for growing timber. Our National Forests have 85 million acres of forest that are capable of producing timber, but timber harvesting is prohibited on much of that. For example, National Forests in the California Sierra Nevada have a total forest area of 7.6 million acres. Timber harvesting is permissible on less than half of that, and may be conducted only if it uses silvicultural methods, such as group selection, that are environmentally and aesthetically preferable.

Timber growth and mortality on our National Forests far exceed timber removals. A timber harvesting program should be initiated to remove an annual volume that is, at least, equal to mortality. Such a program will move us towards the pre-European-settlement ecosystem that was resistant to catastrophic fire and also provided the mix of habitats necessary for endangered species. At no cost to the taxpayer, it will provide jobs and revenue to local governments and ensure an adequate supply of wood products to meet the needs of consumers. It is a win-win proposition.

William McKillop is Professor Emeritus of Forest Economics at the University of California, Berkeley



Drought Home
Overview

Air Quality
Laws and Regs
Drought Science
Water Conservation
Water Management

Links
News Releases
Photos

Search Feedback Water Resources Home Ecology Home

Drought Laws and Regulations

Ch. 43.83B RCW - Water Supply Facilities | Ch. 173-166 WAC - Emergency Drought Relief

Chapter 43.83B RCW - Water Supply Facilities

Law which gives the Department of Ecology authority to respond to a drought emergency

- 43.83B.400 defines a "drought condition" as one in which "the water supply for a geographical area or for a significant portion of a geographical area is below seventy-five percent of normal and the water shortage is likely to create undue hardships for various water uses and users."
- 43.83B.405 gives Ecology the authority, after obtaining the views of certain state and federal agencies and receiving written approval from the governor, to issue orders to address a drought.
- 43.83B.410 (1) gives Ecology specific authority, if certain conditions are met, to issue orders to "authorize emergency withdrawal of public surface and ground waters, including dead storage within reservoirs, on a temporary basis and to authorize associated physical works which may be either temporary or permanent."
- 43.83B.410 (2) gives Ecology authority to approve a "temporary change in purpose, place of use, or point of diversion, consistent with state policy allowing transfer or lease of waters between willing parties..."
- 43.83B.430 created a drought preparedness account in the state treasury. The funds in the account can only be used for activities directly related to drought preparedness.

Chapter 173-166 WAC - Emergency Drought Relief

Regulation adopted by the Department of Ecology to implement Chapter 43.83B RCW

Declaration of Drought Conditions

- Ch. 173-166 WAC--Section 050 Forecast of drought conditions
- Ch. 173-166 WAC--Section 060 Orders declaring drought conditions

Emergency Drought Permits / Temporary Transfers

- Ch. 173-166 WAC--Section 040 General eligibility rule
- Ch. 173-166 WAC--Section 070 Emergency drought permits
- Ch. 173-166 WAC--Section 080 Temporary transfers of water rights

---

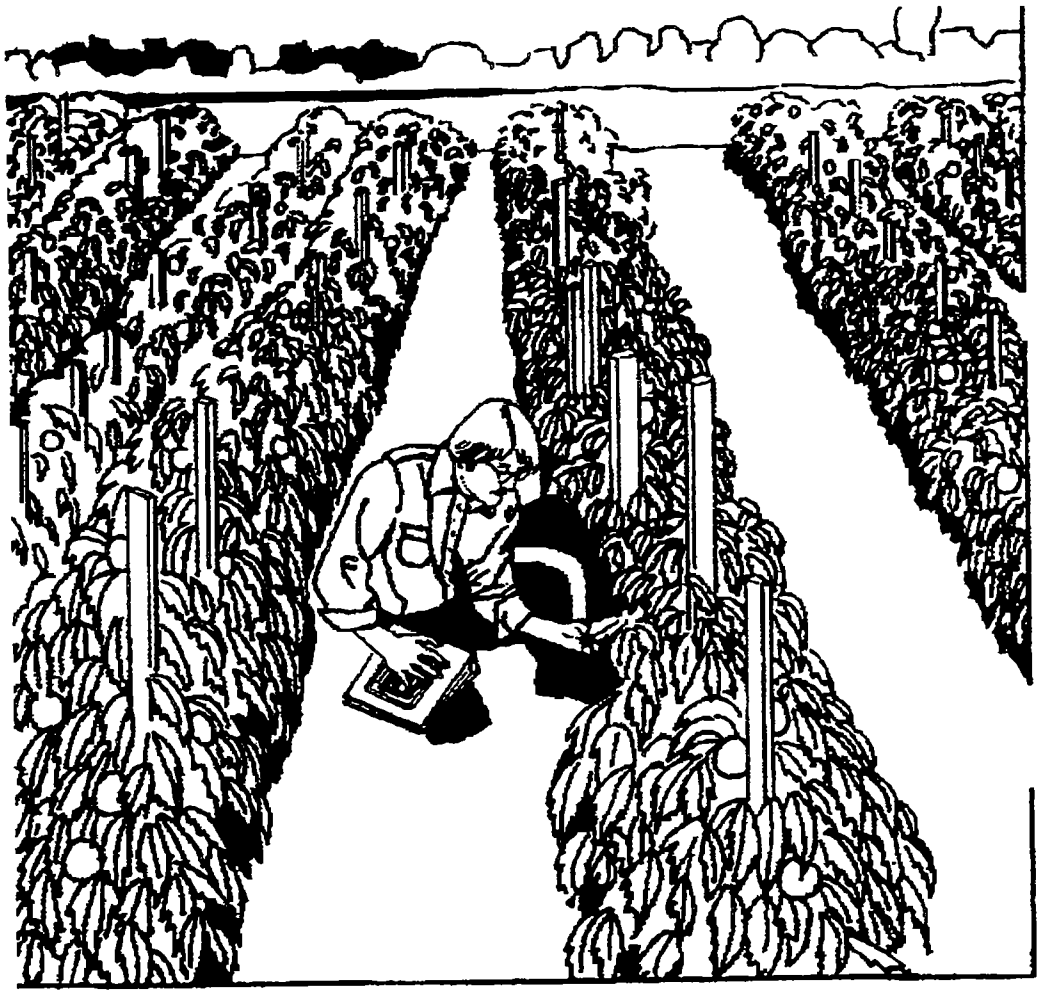
Ecology Home > Water Resources Home > Drought Home > Laws and Regulations

Last Update: April 21, 2003
Comments or questions regarding this page? Contact Us!

SECTION FOUR – ASSEMBLING A WATER MANAGEMENT PLAN

This section of the Guidebook will help you prepare a document describing your water management action plan. It will:

- ☞ Describe the reasons for preparing a plan document
- ☞ Suggest how the document should be organized
- ☞ Present a sample water management plan



WHY DO YOU NEED A WATER MANAGEMENT PLAN DOCUMENT?

There are many good reasons to prepare a document or report describing your water management plan, but the basic reason is so you can explain your plan to other people. Some of the other people who will need to understand your water management plan include:

- Members of the district Board of Directors who will need to approve the plan
- Members of the district staff who will need to implement the plan
- District water users who will want to know how the plan might affect them
- Agencies and lenders from whom the district might be seeking financing assistance
- Other local and regional water organizations with whom the district wishes to establish more cooperation
- Agencies from whom the district seeks permits or approvals
- Agencies and groups who may be unaware of the district's efforts to improve water management

For some of these people, the plan will be mainly an information document. But for others, the plan may be a "sales pitch" used to convince them of the wisdom of cooperating with the district, lending money to the district, etc. Especially in this latter case, the plan document will need to be prepared in a professional way, well-organized and complete, with easy to read text, tables, and figures.

Beyond being a description of what you want to do, putting your plan in writing means that you are making a commitment to do something. It puts the district on record as moving ahead to solve problems in a progressive way. This can be very important in dealing with potential future threats to district water rights and supplies from competing uses.

You will probably also find that the process of writing your plan down will help you see where it is deficient and could be improved.

SUGGESTED OUTLINE FOR THE PLAN DOCUMENT

Your water management plan document can be thought of as a compilation and synthesis of the information developed in Phases 1 through 5 of the planning process. A suggested outline for the plan document is provided below. Each outline item might be constructed as a separate chapter or section in your management plan.

Management Plan Document – Suggested Outline

I. Description of District

II. Inventory of Water Resources

III. District Water Budget

IV. Legal, Institutional, and Environmental Considerations

V. Existing Water Management Measures and Programs

VI. Issues and Goals

VII. Identification and Evaluation of Candidate Water Management Measures

- A. Identification of Candidate Water Management Measures
- B. Evaluation of Candidate Water Management Measures

VIII. Adopted Plan Elements

- A. Selected Measures
- B. Projected Results
- C. Implementation Schedule and Budget
- D. Monitoring Program

IX. Environmental Review

The objective of **Item I (Description of the District)** of the plan document is to provide sufficient background information

on district organization, facilities, and operations so that your reader can understand the opportunities and constraints that exist for water management improvements in the district. This is especially important if your plan document is going to be read by people who are not familiar with the district, such as bankers or lending agencies.

It may not be necessary to write a lot of prose for this part of the document. Some of the information can be conveniently displayed in tabular form. You may also be able to incorporate existing materials, such as policies and organizational charts. Often, a simple paragraph will suffice.

A district map is also a good idea for an easy-to-read management plan document. The map should show facilities, canals, laterals, diversion points, measurement locations, pumping locations, seepage, drains and spill locations, and any identified problem areas.

In addition to those items, a comprehensive district description would include the following:

- District enabling legislation (formation authority) and governance
- Voting and taxing authorities
- Organizational structure and personnel
- Historical irrigated acreage and trends
- Historical population and trends

In summary, the plan should present a clear understanding of the district's particular circumstances within the context of its local setting (history, location, topography, climate, demographics, description of the distribution system, crops, soils, agricultural practices, etc.). The information contained here, along with information in Items II, III, and IV, provide the means for making a working assessment of the district's relevant issues.

Item II (Inventory of Water Resources) is documentation of the water resources inventory that you assembled in Step 1 of the planning process. Much of this information can be displayed in tables or graphs. On the district map, you should also indicate which portions of the delivery systems are unlined, which are lined, and which are piped.

Item III (District Water Budget) is your district water budget. The water budget should clearly depict where the district gets its water and how water is used and lost throughout the project. The budget should also provide sufficient information to identify potential water overuse, supply deficiencies, or system capacity problems. A suggested water budget format was provided in Section Two of this Guidebook. You may find that pie charts or other graphical display methods help you visualize the various components of district inflows and outflows.

Item IV (Legal, Institutional, and Environmental Considerations) is a discussion of any legal, institutional, and/or environmental considerations that place specific requirements or prohibitions on the district. Also, any environmental considerations that may impact the district's decision whether to implement specific water management activities or measures should be discussed as well.

Item V (Existing Water Management Measures and Programs) is a description of the district's current water management practices and programs. The plan should fully describe the water management programs currently being pursued by the district. It should suggest relative effectiveness of these programs. It could also discuss any activities that have been tried and later abandoned explaining the reasons for abandoning the activities.

Item VI (Issues and Goals) should be a brief but complete description of the apparent water management issues identified in Step 3 of the planning process. If any of the fundamental measures are not part of the current water management program, the lack of these measures should be included in the list of issues. Note that the conditions generating these issues should have been discussed in the first five sections of the plan. Where necessary, the issues should be prioritized so that the district and the reader can focus on the issues of greatest importance. Finally, the plan should also include your water management goal statements for each of the issues that the plan indicates are of concern to the district.

Item VII (Identification and Evaluation of Candidate Water Management Measures) should be a discussion of the evaluation you have made of candidate water management measures. The first part of this section should list all of the candidate measures (measures described in Section 3 of the Guidebook plus others not listed) that you consider could have potential to resolve each of the goals described above.

The second part of this section should contain a comparative evaluation of the candidate measures. The strengths and weaknesses of each candidate measure should be discussed in sufficient detail to support a decision whether to adopt each measure as part of the district's water management program. It would be appropriate to include a summary of the evaluation process and tabulations of any quantitative data analyses you conducted. In addition to the technical and financial evaluations, you may want to include a discussion of the legal, institutional, and environmental concerns that may be associated with the measures under consideration.

Item VIII (Adopted Plan Elements) should be a description of the elements (existing and new) that finally make up the water management plan you have adopted. The programs and measures that make up the plan should be described in detail, as should the expected effects and implications of those programs and measures. You should describe as clearly as possible how those measures will help you achieve your goals.

You should present a detailed schedule for implementing the plan. The schedule should be reasonable and achievable considering resources available to the District. There should also be a description of the budget and financing that will be required. This discussion should identify all resources (funds, staff, equipment, etc.) that would be required to implement the plan.

Finally, this section should discuss how implementation progress will be monitored and results evaluated. It should also describe the process for revising the district's water management plan based upon a periodic evaluation of program results.

Item IX (Environmental Review) identifies and evaluates the environmental effects (both positive and negative) of implementing the plan. It should also discuss the environmental compliance activities that will be required to implement specific elements of the plan. You may want to consult with Reclamation's local Water Conservation Coordinator for direction as this section is developed.

CHARACTERISTICS OF A WATERSHED MANAGEMENT PLAN
SUMMARY, CONSOLIDATION AND RESTATEMENT OF SUGGESTIONS FROM THE
RARITAN WATERSHED MANAGAMENT AREA COMMITTEES, MAY 2001

DESIRABLE CHARACTERISTICS (Not in priority order)				
General Topic	**N&S Branch WMA**	**Lower Raritan WMA**	**Millstone WMA**	
Realism	Plan must be credible and reflect realistic goals and timelines	Realistic economically, physically, and timely	Do-able/Realistic-so things get done -- affordable/economic, technically, politically, socially	
	Achievable/measurable goals	Workable	Results-based objectives (not just regulations adhered to)	
	Implementable; do-able			
Living Document	A "living" document (generally accessible to the public); not static		Evolving/Adaptive/Flexible-continuing, interactive, and responsive to new information.	
	Flexible enough to accommodate changes			
Goals and Visions	Contains goals/vision statement	Inclusiveness	Clearly defined and stated goals, objectives, and priorities	
	Reflect where we've been, where we are, and where we're going		Problem statement	
	Articulates dreams for watershed		Mission statement	
	Designed to be integrated into municipal planning processes			
	Compatible with regulatory framework			
	All inclusive			

DESIRABLE CHARACTERISTICS (Not in priority order)				
General Topic	**N&S Branch WMA**	**Lower Raritan WMA**	**Millstone WMA**	
Evaluation	Measure to determine success	Milestones	Clearly defined metrics for assessing success – evaluation piece up front	
	Contains milestones and progress reports	Use milestones as way to encourage progress and success		
Fairness	Fairness, equitable	Equitable		
		Everyone shares in benefits and burdens of implementing		
		Share responsibilities and rewards		
Document Quality for Users	Must be simple and easy to understand and read; no legalese; accompanied by an executive summary (but backed by scientific data and tables)	Less technical summary of each section, plus an executive summary for the general public	Identifies audience and is written appropriate to the audience-tailored to different levels of expertise.	
	Concise and precise	Well documented: not boring or redundant	Easily accessible to all	
	Fully and accurately describes watershed	Simplicity and clarity	Simple as possible while technically and scientifically robust	
	Easily accessible to general public; different formats for different audiences	Well written	Incorporates a public education piece	
	Written in "exciting" common language – No acronyms	Readable		
		Focus on different audiences		

DESIRABLE CHARACTERISTICS (Not in priority order)				
General Topic	**N&S Branch WMA**	**Lower Raritan WMA**	**Millstone WMA**	
(Document Quality Cont'd)		Understood by non-technical people		
		Glossary, definitions, pictures		
		Foster excitement		
Integrity	Integrity in document	Clear recommendations and conclusions	Adequate technical support	
	Trustworthy, based on real data and real science	Scientifically acceptable data	Based on good science	
		Consistency		
		Solutions are based on clear underlying principles that give the plan universality		
Buy-in	Something stakeholders (all people in watershed) will buy into	Openness	"Positive" Plan	
	Realistic - meets everyone's needs	Address public questions	Defensible/Justifiable	
	Clear benefits and public appeal (gain something by using it)	Socially and politically sensitive		
		Focus on what people care about for a particular place/things		
		If controversial or sensitive, need response with rationale		
		Address controversy, determine if resolvable		

DESIRABLE CHARACTERISTICS (Not in priority order)				
General Topic	**N&S Branch WMA**	**Lower Raritan WMA**	**Millstone WMA**	
Public Involvement	Public outreach to identified groups	Foster participation by general populace	Identifies and accommodates public participation/input	
	Summary of process; Legally defensible		All players/stakeholders involved in developing the plan	
Nature of Strategies	"Flexible" deadlines	Identify and prioritize all issues, problems, and solutions	Takes advantage of lessons learned	
	Practical	Implemented	Identifies means of dispute resolution	
	Identifies costs; source of money		Reproducible strategies	
	Regional significance (reflect culture of area); locally friendly			
	Provide direction			
	Offers solutions; strategies for achieving goals			
	Must be implementable by diverse watersheds			

CHARACTERISTICS TO AVOID				
General Topic	**N&S Branch WMA**	**Lower Raritan WMA**	**Millstone WMA**	
Level of Public Participation	Avoid isolated plan (known by a few)	Secrecy		
	Avoid complacency			
Realism and Support Level	Unrealistic or unsupported (lack of public support – should have consensus)	Setting unrealistic goals	Inconsistent government buy-in/commitment	
	Avoid draconian measures (punishment & hammer)	High cost/ low results	Includes measures not achievable	
	Not absolutist	Overly comprehensive – do everything	"Beautiful" but not practical or usable	
	No deadlines just to meet deadlines		Inflexible Implementation	
			Regulatory Inconsistency-conflicting regulations	
Poor Goals	Avoid vague and unreachable goals	Extremely long term goals		
		Project and goals not clearly defined		
Offensiveness	Not elitist, high pressure, or condescending	Antagonizing stakeholders	Confrontational	
	Avoid negatives			
	Not be judgmental			
	Not dwell on past failures (concentrate on positives)			
	No finger pointing			

CHARACTERISTICS TO AVOID				
General Topic	**N&S Branch WMA**	**Lower Raritan WMA**	**Millstone WMA**	
Document Size and Style	Not too long	Drowning in minutiae	Not user-friendly	
	Not too technical	Repetitious and redundant	Inconsistent use of terms and science	
Favoritism	Avoid favoring one group over another (fairness); win-win for everyone	Assuming same level of knowledge, readiness to move on to next step, and inconsistencies with the state plan	Plan that favors one special interest group	
	Avoid brownie points – should not appear to favor one group	Ambiguity in characterizing area and problem		