Optional Comprehensive Plan Element for **Natural Hazard Reduction**

Washington State Community, Trade and Economic Development

Building Foundations for the Future

Optional Comprehensive Plan Element for

Natural Hazard Reduction

Department of Community, Trade and Economic Development

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TABLE OF CONTENTS

Page

Page

FIGURES AND TABLES

Chapter 1

Chapter 2

Chapter 3

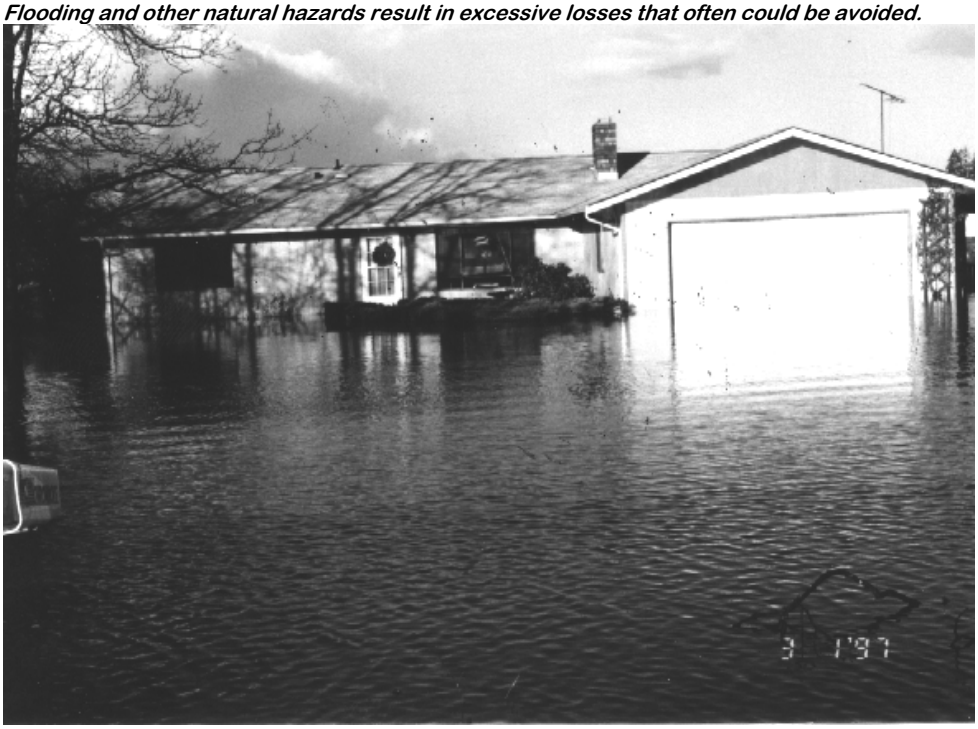
Chapter 4

APPENDICES

CHAPTER 1: OVERVIEW

Immediately after the disaster, giant bulldozers pushed the wrecked houses into the bay or burned them in great funeral pyres; sand dunes were re-formed, streets exhumed from under the overburden of sand and slowly houses reappeared to fill the selfsame sites of those that had been swept away. The commonest problem was the exposure of foundations; those houses that had sat high on the dune, commanding a view of the sea, found sand swept from under them and there they stood, floors fifteen feet above the sand, grotesquely leaning, supported on their exposed telegraph pole foundations. But not all of them. In a remarkable example of wisdom and virtue rewarded, in those rare cases where the dune was stable and unbreached, clothed in grasses, the houses endured, suffering only broken windows and lost shingles.

Flooding and other natural hazards result in excessive losses that often could be avoided.



Source: FEMA

The evidence is there to be read. The record of cause and effect constitutes the common knowledge of natural scientists. But the status quo ante is being reconstituted without direction or constraint. The future seems clear: the New Jersey Shore lies in the path of hurricanes. Winter storms are even more regular. Sandbars are recent and ephemeral, there is no reason to believe that the last storm was the worst. In the Netherlands it was a thousand-year storm, which took almost two thousand lives and caused untold damage, all but inundating this best prepared of people . . . . We hope for the best, but it would be sanguine to expect anything less than disaster.

May it be that these simple ecological lessons will become known and incorporated into ordinance so that people can continue to enjoy the special delights of life by the sea.

Design With Nature, Ian L. McHarg, 1971

PURPOSE OF GUIDEBOOK

This Guidebook provides local government planners with tools that can be used to address hazard avoidance and mitigation in their community comprehensive plans. While the Guidebook is primarily intended for use by cities and counties planning under the Growth Management Act (GMA), the principles and methods can generally be applied to jurisdictions not planning under GMA. The preparation of the Guidebook is supported by federal and state agencies involved in hazard-reduction planning to provide better communications between these agencies and local planners.

The primary audience for the Guidebook is planners working for cities and counties in Washington, who may or may not be trained professionals. In many small jurisdictions, the planning function is performed by elected officials, planning commissioners, public works administrators, and sometimes city clerks. Comprehensive plan amendments are developed by planning commissions and city councils through different processes depending upon community resources and outside funding. Approximately 170 of Washington's cities and towns have populations less than 5,000 and 20 counties have populations less than 50,000. This Guidebook provides tools appropriate to the resources that are available for planning in these areas.

Hazards Addressed

This Guidebook will assist in planning for flood, wildfire, and landslide hazards. While other natural hazards such as high winds, earthquakes, and volcanic events are not specifically addressed in this Guidebook, many of the principles and techniques described are applicable to these as well.

How To Use This Guidebook

The Guidebook is organized to follow the natural progression of the planning process.

Chapter 1, Overview, provides the background and intent for the Guidebook. It sets the stage for hazard reduction planning with economic and social rationale for engaging in the process.

Chapter 2, Getting Started, addresses the process necessary to set planning in motion. It contains guidelines for assessing jurisdictions' current policy and regulatory framework and for the conducting the community dialogue that will precede the planning process. It also provides a brief introduction to some of the basic resources you will need as you begin to develop your Natural Hazard Reduction Element.

Chapter 3, Foundation, provides an introduction to the terminology of hazards and provides an overview of conditions that contribute to flooding, landslides, and wildfire. This chapter also includes mitigation techniques that may be used for hazard reduction.

Chapter 4, Policy Framework, uses the technical foundation provided in Chapter 3 to provide guidance on how to develop policies relating to hazard avoidance and mitigation to fit within the current GMA comprehensive plan framework. Planning tools such as digital Geographical Information System (GIS) maps, soils information, databases, and other resources are also discussed.

Chapter 5, Implementation, contains guidance for drafting action plans, strategies, regulations and standards based on the policy framework. It includes tools such as code and ordinance formats based on real-world examples and presents outlines for the integration of hazard plan components into comprehensive plans. Several approaches are provided.

The **Appendices** contain funding information; hazard-related contacts; a glossary; examples of codes, hazard policies, and implementation strategies; a Model Flood Damage Protection Ordinance; a Model Natural Hazard Reduction Element; and a property protection scoring system.

RELATIONSHIP TO GMA PLANNING

This Guidebook provides information on how to fold hazard reduction planning into a community's comprehensive plan and development regulations. In the spirit of regulatory reform and the integration of growth management planning with environmental review and shoreline planning, planners are working towards bringing all community plans together in one place to reduce redundancy and simplify administration. This consolidation will simplify the process when comprehensive plans and development regulations need to be updated.

State and federal offices and agencies provide funding for hazard planning, mitigation, and damage insurance programs. For this reason, hazard reduction planning conducted within the GMA framework must also address federal and other state regulations, policies, and guidelines pertaining to specific hazard issues.

ELEMENT OPTIONS

Each comprehensive plan reflects local decisions about how to develop a plan that best serves local needs, while resting within the framework of GMA goals. In developing a new Natural Hazard Reduction Element for your plan, there are decisions you will need to make about how the element will best fit with your existing plan. These choices relate to the element's format and its compatibility with other elements in your plan. The level of detail to be contained in the plan as it relates to the capabilities of your jurisdiction's staff and volunteer capacity also will need to be considered. These issues will be discussed further in Chapter 2.

WASHINGTON'S HAZARD EXPERIENCE

Natural disasters can result in significant, even devastating, loss of property, livestock, and human life. In addition to human suffering and environmental devastation, natural disasters can generate serious financial impacts that can cost private property owners and local, state, and federal governments millions of dollars every year.

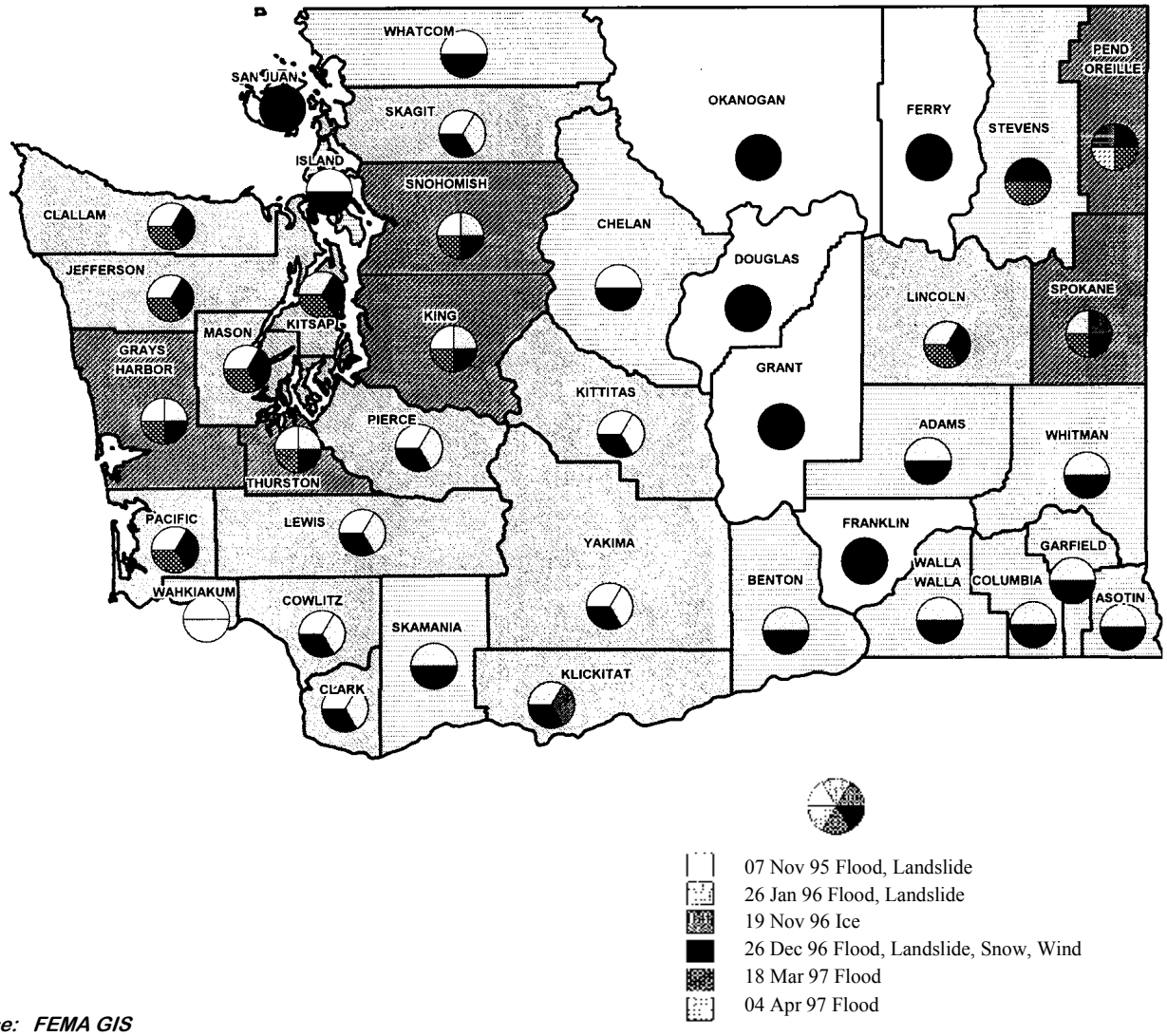
Recent disasters in Washington state have included landslides, coastal and riverine flooding, wildfires, wind damage, and ice storms. In only three years, between November 1995 and May 1998, Washington experienced six federally-declared disasters, plus two fires. Riverine flooding and/or groundwater flooding, often accompanied by landslides, caused five of the disasters. The November 1996 event was an ice storm.

Most counties in the state experience one to two serious events per year. With the exception of five sparsely populated counties in Eastern Washington, every county has suffered multiple federally-declared disasters; six counties suffered four federally-declared disasters in three years. Recurring disasters cause undue hardship on thousands of Washington state residents; result in enormous business, agriculture, and other commercial losses; and cost millions of local, state, and federal tax dollars to repair.

The financial impacts of these disasters seem to increase every year. The annual cost of all natural disasters in the United States has doubled in the past decade, from roughly $25 billion a year to $50 billion. The reasons for the increase in costs are not clear. Many experts contend that increased urbanization in vulnerable areas is responsible. A possible explanation for these increased costs includes our increased dependence on man-made structures, such as utility lines, which are fragile in the face of disasters. Another cause could be the extensive development we have allowed in high-risk areas as a result of our belief that the measures taken to tame or control natural phenomena, such as rivers or steep hillsides, will ensure our protection.

Disasters trigger costly immediate and long-term relief actions by government agencies to repair, replace, and compensate for losses. Agencies expected to respond during a disaster must maintain constant readiness, which involves planning, resource stockpiling, and staffing.

Figure 1-1 Washington State Repetitive Disasters 1995-1997



Source: FEMA GIS

Natural hazards will always be with us. Studies of past events often link the severity of the damage to inadequate or inappropriate land management and to land use strategies that have been based on unrealistic expectations of engineering to control natural phenomena. The result is that some natural hazard events can result in disasters that could either have been avoided or whose consequences could have been significantly reduced. McHarg's book, *Design with Nature*, describes landscape-appropriate principles and methods that should be part of any planning process; many of these measures are common sense. These principles and methods provide direction for linking natural systems, community visions and values, and functional needs through planning.

The purpose of this Guidebook is to enable communities to reduce disaster losses and repetitive losses. A significant percentage of households suffering losses have experienced repetitive events, especially from flooding. According to the Federal Emergency Management Agency (FEMA), Region X, more than 230 housing units have filed repeat claims for disaster damage between 1990 and 1996.

The majority of housing damaged during most flood events are single-family homes. However, the housing units experiencing the majority of substantial damage (over 50 percent of total value) are in the other residences category which includes mobile homes, trailers, and recreational vehicles. Figure 1-2 indicates percentages of loss by housing types that occurred in the 1995-1996 flooding and landslide events.

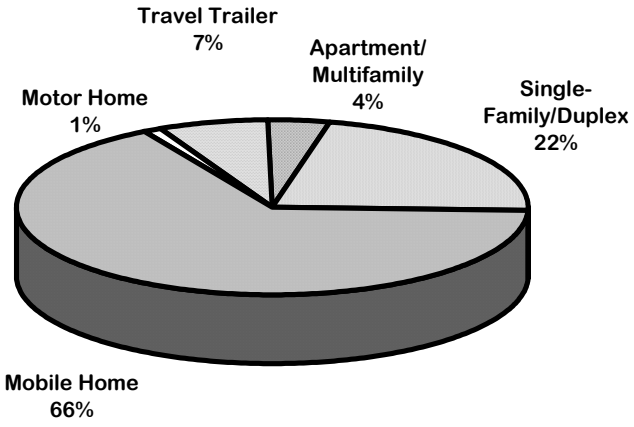
Small steps, such as this grassy swale, play a role in an overall hazard reduction plan.

Source: URR

Older mobile homes suffer a disproportionate percentage of units totally destroyed during disasters.

Source: URR

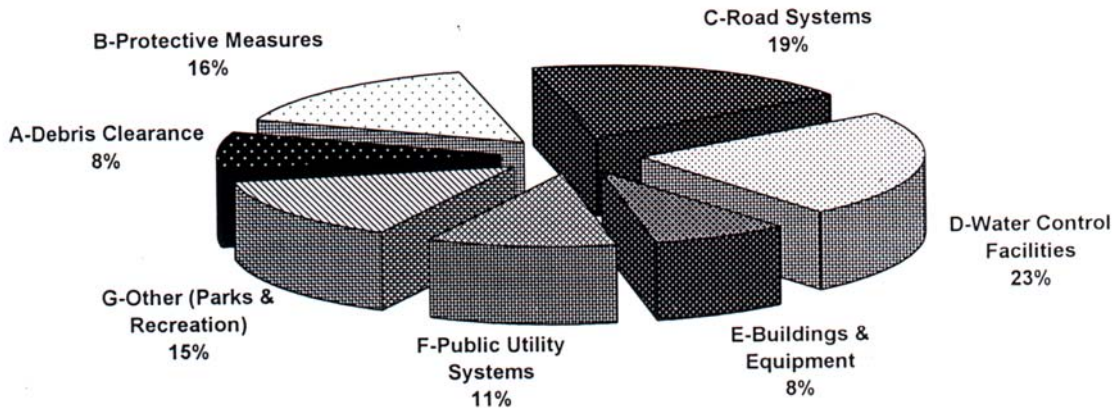
Figure 1-2 Housing Units Losses



Source: FEMA, 1996

While the costs of disasters to homeowners and businesses are significant, it is important to understand that most of the costs are borne by the public sector. Public facilities suffer extensive damage and often such damage results in secondary impacts. For example, damage to water facilities results in loss of water supply for drinking and sanitary use, while flooding of utilities may result in power loss. Loss of power may take pumps out of action – thereby exacerbating the flooding. Debris clearance from landslides, floods, and other events is a major public sector cost. Figure 1-3 provides a breakdown of expenditures in FEMA's seven Public Assistance Categories for Washington disaster designations 1995-1997.

Figure 1-3 Proportional Allocation of Public Sector Costs



Source: FEMA GIS

CHAPTER 2: GETTING STARTED

Welding the Land Use Plan

After the mapping, surveying, classifying, tabulating, and estimating procedures, there still remains the important task of welding the land use plan. The allocation of land use and reuse must be reviewed in relation to a meaningful open space network and an efficient transportation network. The basic questions to be asked, and answered, are:

- *Do the various elements of the plan fit together?*
- *Is there a logical organization of land use activities, open spaces, and transportation movements?*
- *In terms of the community's goals, does the plan really succeed in tackling basic problems and issues?*
- *Can the community afford to pay for carrying out the improvements envisioned in the plan?*
- *Have public and private interests been given full consideration?*
- *Is there a place for citizen participation and identification with the program required for carrying out the plan?*

Principles and Practice of Urban Planning, William I. Goodman, ed., ICMA

INTRODUCTION

This chapter provides directions for:

- determining the best approach for incorporating hazard issues into the comprehensive plan;
- deciding what the final product should look like;
- setting up the work program;
- estimating resource needs; and
- outlining the desired linkages between the existing plan and the Natural Hazard Reduction Element.

These items are discussed, and a checklist and summary of work plan considerations are provided to guide you in establishing the framework for your hazard planning.

☑ *Financial Questions: Estimating Cost, Funding, Staff Time Required*

Benefits of a Natural Hazard Reduction Element

Sooner or later, the question will come up: How much will it cost to develop a Natural Hazard Reduction Element for our comprehensive plan? How long will it take? How can we leverage other funding sources? These are all important questions and, of course, there is no easy answer.

A very simple way to estimate the cost of developing the element would be to divide the cost of preparing your comprehensive plan by the number of elements. This would give you the average cost per element. But, since elements are really a fruit basket of apples and oranges, this is not the best way to estimate.

☑ *Identify Cost vs. Value of Disaster Planning*

It is very important to weigh the cost of this planning against the value. Communities can avoid much of the personal, social, and construction costs of disaster recovery by the wise investment in good planning, and effective implementation of that planning, that anticipates and addresses the impacts of natural hazards. The staggering replacement costs of roads, bridges, treatment plants, and other infrastructure, not to mention the liability associated with loss or damage to private property, are good reasons to acknowledge hazardous conditions in comprehensive plans. Replacement and reconstruction after a disaster are expensive especially since most funding sources require a match (see Appendix A). In addition, eligibility for Federal Emergency Management Agency (FEMA) hazard mitigation funds strongly encourages local adoption of a mitigation plan. Preparation of a Natural Hazard Reduction Element in accordance with this manual will also satisfy FEMA's planning requirements (as administered by the Emergency Management Division of the State Military Department).

Disasters impact all elements of a community.

Source: URR

How Planning Can Help

The Natural Hazard Reduction Element planning process can produce a variety of results that have significant value to local governments. The most important is the element itself. But the process also creates some other important opportunities:

☑ *Identify Opportunities That Emerge From Natural Hazard Reduction Planning*

- Public Education – The community can be informed about hazards and disasters in simple, non-threatening language that enables all

constituencies to become aware of the relationships between planning decisions, actions, and future outcomes.

- Risk Assessment – Decision makers can be better prepared to compare the consequences of doing nothing versus adopting hazard avoidance or mitigation provisions.
- Improvement Standards – Better understanding of disaster impacts can produce better design standards for improvements that must be located "in harm's way."
- Eligibility for Additional Funding – Eligibility for reconstruction funding as well as for mitigation grants is greater if a hazard mitigation plan is in place.
- Better Compliance – Comprehensive plans that consider risk to public infrastructure and private property set the stage for public acceptance and implementation.

PRELIMINARY DECISIONS ABOUT YOUR NATURAL HAZARD REDUCTION ELEMENT

Which Approach – A Separate Hazard Element or an Integrated Plan?

A Natural Hazard Reduction Element can be free-standing, or goals and policies on hazard reduction can be integrated in each existing element. The first is a complete free-standing element of your existing comprehensive plan, consistent in format with other plan elements (land use, housing, transportation, capital facilities, etc.). The Natural Hazard Reduction Element would include goals, policies, strategies, standards, and other provisions. In this approach, all the hazard language is available in one concise location, and all the related specialized material can be dealt with together. In this approach, you need to do a thorough job checking the other comprehensive plan elements to make sure that no inconsistencies are created.

☑ *Separate or Integrated?*

The integrated approach places hazard-related goals, policies, standards, etc., in each existing element. This approach has the advantage of linking functionally-related items, for example linking the evacuation routes to the transportation system analysis discussion. However, this approach creates another kind of redundancy when it is necessary to repeatedly describe (or cross-reference) hazard-prone areas in every element.

The Guidebook provides assistance on how to make this choice (see the checklist provided in Figure 2-1). There is no right way to present your hazard plan. As with the current planning documents, each community must live with some level of redundancy in order to properly address complex problems that involve land use, circulation, infrastructure, and human behavior.

Tailoring the Element to Fit Your Community – Level of Detail, Local Staffing, and Public Involvement

Whether you integrate your hazard planning into existing elements or establish a separate element, the substance of the natural hazard reduction planning will be largely the same. It is necessary to determine early on in the plan development process that the level of detail presented in the hazard portion of the plan will be consistent with the level of detail presented in the rest of the plan. Some plans are very broad policy documents while others contain specific analysis and substantial geographic references. Hazard terminology can become very specialized. You will need to balance the level of detail appropriate to meet your planning needs, with the needs of the nontechnical reader (including elected officials). Much of the technical discussion may need to be put into appendices.

☑ *Level of Detail*

An important factor in deciding about the degree of detail is who will have responsibility for implementing the plan. A full-time planning and public works staff and/or experts in hazard considerations may be better equipped to manage a higher level of complexity than a jurisdiction staff that consists of a city clerk, a maintenance superintendent, and volunteer elected and appointed officials.

☑ *Responsibility for Implementation*

Public involvement is another important factor to consider in addressing the question of complexity. Public ownership in the decisions made is important to successful implementation. You will need to provide a basic understanding of hazard issues and determine how much education will be necessary to ensure a proper level of discussion. The checklist in Figure 2-1 provides a useful starting point by focusing on some of the issues you should consider as you shape your hazard reduction plan.

☑ *Public Involvement and Education Needed*

Establishing the Policy Connections

As you begin to develop your Natural Hazard Reduction Element, it is important to understand the existing information and regulatory framework addressing natural hazards. As you think about the natural hazards in your area, you will need to consider how your hazard element will fit within the existing Growth Management Act (GMA) framework. The follow tables summarize the key components of GMA comprehensive planning and identify the relationship between these components and the content necessary to perform hazard reduction planning. The Mandatory Components column contains the state rules for implementation of the GMA, also know as the procedural criteria, found in Washington Administrative Code (WAC) 365-195. These criteria identify the required components of the various plan elements and describe the issues that must be addressed within a plan. The Implications for Natural Hazard Reduction Element column identifies the corresponding planning analysis that may be necessary to thoroughly integrate natural hazard planning into your existing GMA plan. In some cases, there may be several implications for each mandatory GMA plan component identified, and in other cases there may be only one implication suggested. These tables are not intended to be definitive: as you consider the

☑ *Fitting the Natural Hazards Reduction Element into the Existing Framework*

criteria relative to the hazard conditions in your community, other implications for your Natural Hazard Reduction Element may come to mind.

The following pages identify both the mandatory elements of GMA comprehensive plans (Land Use, Housing, Capital Facilities, Transportation, Utilities, and a Rural Element, for a county jurisdiction), as well as those issues that GMA requires to be addressed somewhere in the plan, as appropriate (urban growth areas, siting essential public facilities, rural lands designation, and critical areas designation).

The **Land Use Element** is the portion of the GMA plan where the community's plan for the future meshes with the physical characteristics and limitations of the land. One of the most obvious limitations to future development is the physical location of areas susceptible to natural hazards. Through the collection and analysis of data associated with the natural hazard areas, local communities will be able to identify these areas, assess the risks associated with development, and reevaluate, and possibly change, proposed land uses. In addition, certain land use activities may increase the possibility or severity of natural disasters. Local governments may wish to address these considerations in designating land uses and in the supporting land development regulations.

Land Use Element	
Mandatory Components of GMA Plan	**Implications of GMA Requirements for Natural Hazard Reduction Element**
GMA plans require:	Natural Hazard Reduction Element should include:
• Land use designations	• Identification of hazard prone areas (historical experience and/or scientifically defined susceptible areas including floodplains, flood fringes, landslide and other geologically unstable areas, and wildland-urban interfaces)
• Planned density and intensity of development	• Risk assessments and correlation of hazards with vulnerability in terms of location, use, population, and building types
• Protection of water supply quality and quantity	• Linkages to utility plans and identification of factors that contribute to risk, e.g., water availability, access limitations, in addition to underlying hazard • Buffering or delineation of protection zones related to hazard event history • Hydrologic changes that may affect risk
• Storm drainage/water quality provisions	• Impacts of hazards on water supply

The **Housing Element** blends the population forecast data received from the Washington Office of Financial Management, as allocated to the various jurisdictions by each county, with local trends to determine the projected population and future housing needs for the area. Each jurisdiction also should plan for its share of its county's affordable housing allocation. The Housing Element will assess the community's residential land capacity and incorporate the information on identified hazard areas and the risks associated with developing in those areas. This assessment will provide a more realistic view of existing and future housing capacity. The information generated for the optional Natural Hazard Reduction Element will increase understanding of how certain development activities can exacerbate hazard vulnerability. This information is relevant to both the siting of various land uses and to accompanying land development standards and regulations. This analysis will provide insight on areas that may represent an unacceptably high level of risk to future and existing housing. In these areas, the community should consider if acquiring land is appropriate, or if it should provide suggestions and development standards that address how vulnerability to damage in a natural hazard event can be reduced.

Housing Element	
Mandatory Components of GMA Plan	**Implications of GMA Requirements for Natural Hazard Reduction Element**
GMA plans require:	Natural Hazard Reduction Element should include:
• Inventory and analysis of housing needs	• Future acquisition of high hazard lands (e.g., in floodways), and an analysis of the loss of population capacity • Evaluation of vulnerability to high risk by housing type, density, and value (single- family, multifamily, manufactured, group homes, etc.)
• Goals, policies, and objectives	• Policy framework for "disaster-proofing" existing housing, especially low-cost housing including mobile homes and trailers
• Identification of land for new housing	• Coordination of housing land with hazard mapping and mitigation

The inventory of existing **Capital Facilities** would be expanded to reflect facilities that may be located in areas of high risk due to natural hazards. This information is critical to the jurisdiction's ability to ensure that facilities and services continue in the event of a natural disaster. The jurisdiction may determine that critical government services would be jeopardized and that facility relocation or structural reinforcement is necessary. An understanding of circumstances that contribute to disaster susceptibility may also impact siting and other development decisions. These possibilities may impact how capital funds are allocated and may refocus local efforts on planning strategies for minimizing potential damage and disruption of service.

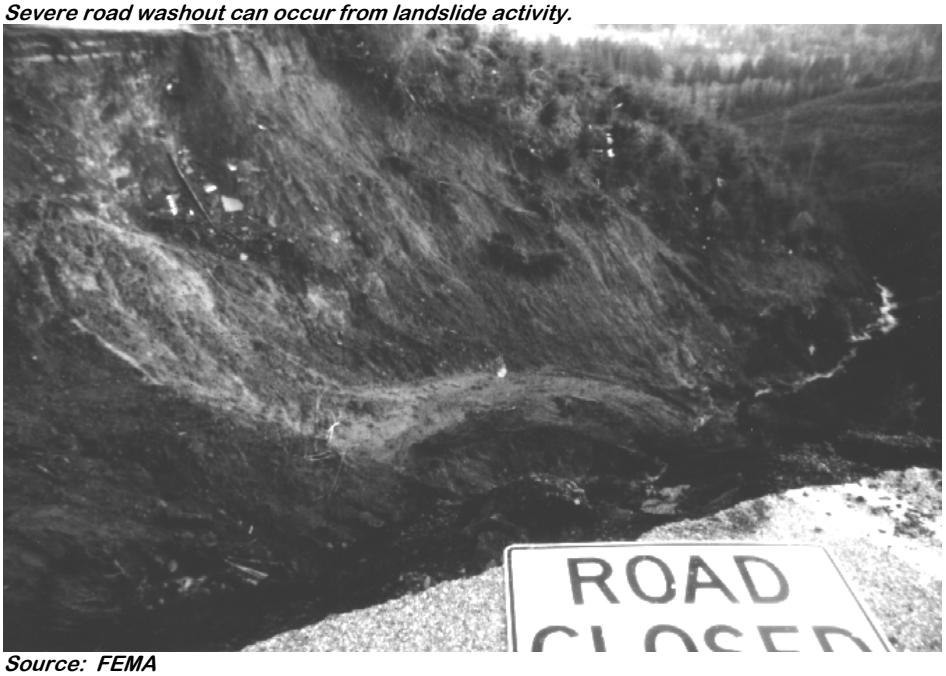
Capital Facilities Element	
Mandatory Components of GMA Plan	**Implications of GMA Requirements for Natural Hazard Reduction Element**
GMA plans require:	Natural Hazard Reduction Element should include:
• Inventory and analysis of existing facilities	• Analyses of facilities essential to the provision of emergency services and access located in high hazard areas
• Forecast of future needs	• Vulnerability assessment and related future needs of existing facilities at risk
• Locations for new facilities including parks and open space	• Acquisition of open space in hazard areas, buffers for protection zones, and agricultural easements consistent with hazard reduction. Coordinate proposed acquisitions with hazard mapping and mitigation
• Six-year financing plan	• Discussion of cost and financing changes resulting from hazard analyses
• Relationship between land use and current and future facilities needs and the financing plan	• Evaluation of need to change projects and financing resulting from hazard analysis

Under the GMA, the **Transportation Element** of a comprehensive plan provides an inventory of the various local transportation facilities and identifies future needs. Data gathered for the Natural Hazard Reduction Element will indicate if disaster emergency routes are truly reliable, or if they are prone to damage in certain disaster events. Hazard reduction planning will permit local authorities to develop alternative routes, plan for relocation or reinforcement of vulnerable facilities, and improve preparation for likely hazard scenarios.

Transportation Element	
Mandatory Components of GMA Plan	**Implications of GMA Requirements for Natural Hazard Reduction Element**
GMA plans require:	Natural Hazard Reduction Element should include:
• Inventory of air, water, and land transportation facilities and services, including transit alignments	• Identification of alternative routes into and out of hazard susceptible areas • Development of a method for storing data in manner that provides easy access during emergencies
• Forecast of future facility needs	• Evaluation of emergency services agencies' transportation requirements

Transportation Element	
Mandatory Components of GMA Plan	**Implications of GMA Requirements for Natural Hazard Reduction Element**
GMA plans require:	Natural Hazard Reduction Element should include:
• Level of service standards for arterials and transit routes	• Criteria for establishing priorities for upgrading existing bridges and roadways (in terms of both hazard reduction and safety) • Criteria for prioritizing new routes that includes hazards analysis
• Forecasts of traffic for at least 10 years	• A method for updating WSDOT on the impacts of local hazard reduction plans on traffic flows

Severe road washout can occur from landslide activity.



Source: FEMA

The **Utilities Element** identifies the capacities and locations of existing utilities and evaluates proposed utility development relative to forecast population. As with the Capital Facilities Element, data gathered for the Natural Hazard Reduction Element will better identify if there are vulnerabilities in the locations of utilities and provide a better picture of how well utility service would be provided in the event of a disaster. Equipped with such information, local governments may choose to reevaluate how and where utility service is provided and reassess land use decisions (for example, the locations of hospitals, fire stations, etc.) based on hazard-related limitations of utility service.

Utilities Element	
Mandatory Components of GMA Plan	**Implications of GMA Requirements for Natural Hazard Reduction Element**
GMA plans require: • Existing and proposed utility locations • Capacities of existing and proposed utilities	Natural Hazard Reduction Element should include: • Facility vulnerability and impact assessments

Counties planning under the GMA must include a **Rural Element**. This element provides land use designations and development densities and locations appropriate to the rural area. Information regarding the locations and nature of hazards and development activities that may exacerbate hazard vulnerability will provide guidance on how best to site and locate development in rural areas.

Rural Element (County Plans)	
Mandatory Components of GMA Plan	**Implications of GMA Requirements for Natural Hazard Reduction Element**
GMA plans require: • Rural land designation and densities	Natural Hazard Reduction Element should include: • Identification of hazard vulnerabilities (agricultural levees, etc.), floodplain dimensions, crop selection, and other hazards • Future acquisition, easements

In cooperation with cities, counties must designate those areas to be reserved for urban levels of development as **Urban Growth Areas** (UGAs). Because these areas are reserved to absorb future development, it is important that the data gathered for the Natural Hazard Reduction Element realistically reflect the capacity of that area to accept the proposed level of development. In addition, since these areas are usually less developed than urban areas, jurisdictions may wish to apply land development standards that protect future development from increased hazard risk.

Urban Growth Areas	
Mandatory Components of GMA Plan	**Implications of GMA Requirements for Natural Hazard Reduction Element**
GMA plans require: • Designation of UGAs that include incorporated cities and any additional land sufficient to permit the urban growth expected in the next 20 years	Natural Hazard Reduction Element should include: • An examination of potential growth areas from the standpoint of hazard reduction and vulnerability, for example, conversion of flood storage to impervious surface, changes in runoff patterns • Identification of opportunities to mitigate hazards within the UGA • A determination of whether the identification of vulnerable areas reduces the estimated land needs for urban growth

All comprehensive plans are required to provide a process by for identifying and siting **Essential Public Facilities**. No local plan may preclude the siting of these facilities. The information gathered for the optional Natural Hazard Reduction Element would provide important information on appropriate siting relative to hazard risks.

Siting Essential Public Facilities	
Mandatory Components of GMA Plan	**Implications of GMA Requirements for Natural Hazard Reduction Element**
GMA plans require: • A process for the identification and siting of essential public facilities	Natural Hazard Reduction Element should include: • Correlation of siting with access issues during floods and other disasters, as well as potential to exacerbate disaster

All cities and counties in the state with **Resource Lands** of long-term commercial significance must designate them under the Minimum Guidelines to Classify Agriculture, Forest, Mineral Lands, and Critical Areas (WAC 365-190). Generally, counties are most affected by this requirement. Information developed for the Natural Hazard Reduction Element may make recommendations for how these activities should be managed to prevent environmental impacts that may exacerbate hazard susceptibility.

Designation of Resource Lands (Counties)	
Mandatory Components of GMA Plan and Development Regulations	**Implications of GMA Requirements for Natural Hazard Reduction Element**
GMA plans require: • Designation and conservation of agricultural, forest, and mineral lands of long-term commercial significance	Natural Hazard Reduction Element should include: • Correlation of management practices with possible hazard generation, for example, erosion • Areawide resource management, e.g., watershed • Criteria for assessing use impacts on public infrastructure Note: Management practices in forest lands are governed by the Department of Natural Resources under the Forest Practices Act. Local ordinances only apply to certain forest practices applications.

All cities and counties in Washington must also designate, classify, and protect **Critical Areas** (WAC 365-190). Most jurisdictions completed this work, adopting critical area ordinances (CAOs) in the early 1990s. Those jurisdictions planning under GMA which adopted CAOs before their GMA plan was adopted should have re-addressed this initial work within the context of their GMA plans and adopted permanent ordinances. The level of detail used in mapping and regulating critical areas varies considerably throughout the state. In addition, the linkage between CAOs and shoreline master programs requires review to assure consistency in the use of definitions and provisions mandated by the guidelines from state agencies.

Critical areas are defined as 1) wetlands, 2) aquifer recharge areas, 3) frequently flooded areas, 4) geologically hazardous areas, and 5) fish and wildlife habitat conservation areas. There are obvious overlaps among these categories – particularly wetlands, frequently flooded areas, and fish and wildlife habitats. Clearly, there are important linkages between these designations and the related analysis and policy development for flood, landslide, and wildfire hazard mitigation described in this Guidebook.

Mapping, land use designations, and regulatory provisions adopted by local governments as part of the CAO should be the basis for the implementation of more specific hazard reduction provisions in your new element. This will require a thorough review of the existing CAO within the context of these guidelines to determine if there are inconsistencies in methodology or in the policies and strategies used to promote reduction of hazard events. This more detailed hazard reduction planning could result in reevaluation of critical area locations, management methods, and development standards.

Counties and cities are required to review, and if needed, revise their comprehensive plans and development regulations no later than September 2002, and at least every five years thereafter [RCW 36.70A.130(1)]. This would be a good opportunity to review for natural hazard areas.

Designation of Critical Areas	
Mandatory Components of GMA Plan and Development Regulations	**Implications of GMA Requirements for Natural Hazard Reduction Element**
State guidelines require classification, mapping, and regulations to protect:	Natural Hazard Reduction Element should include:
• Wetlands	• Identification of multipurpose functions, for example, flood storage
• Frequently flooded areas	• Criteria for prioritizing public acquisition of sites that experience repetitive damage • Procedures to avoid development in hazardous areas
• Aquifer recharge areas	
• Geologically hazardous areas	• Procedures to evaluate potential for hillside slump, any other geologic disasters, that may impact development
• Fish and wildlife habitat conservation areas	• Standards for habitat management

This framework will also be used to connect hazard reduction planning with environmental analyses under the State Environmental Policy Act (SEPA) and other provisions of the GMA, including county-wide planning policies, urban growth boundaries, and siting for essential public facilities. In each case, the Guidebook will provide suggestions that local planners can use to identify issue areas in their current plans and regulations that need to be addressed within the hazard reduction planning process.

THE BASIS FOR PLANNING

Assessing Your Current Plan and Regulations

Unless you have added other new elements to your plan since initial adoption, your annual amendments have probably been focused on policy and map changes related to community growth and change or annexations. Annual amendments also include updating the six-year capital investment plan and the addition of new information generated by subarea plans. For many communities, upcoming work programs will also include the integration of GMA comprehensive plans and shoreline master programs. King, Kitsap, Pierce, Snohomish, Thurston, and Clark counties, and the cities and towns within their boundaries, will be including new data from buildable lands surveys mandated by RCW 36.70A.215 into their existing comprehensive plans.

☑ *Determine How the Hazard Element Will Fit Into Your Existing Plans and Regulations*

For Natural Hazard Reduction Element planning, you will need to take a fresh look at your plan to define the framework within which hazard planning is to be formed. Some jurisdictions' plans are broad policy documents that provide relatively few details. Others contain technical analysis and geographically specific information. Some have many maps while others have very few. Some jurisdictions prepare subarea (neighborhood or community) plans that are adopted as part of the comprehensive plan; others do not specifically adopt these.

The level of detail devoted to implementation actions and strategies, critical areas, county-wide policies, and the other possible GMA components varies widely. It is important to step back and take a look at your plan and regulations as you consider how the Natural Hazard Reduction Element may be incorporated. The following checklist will help you.

Working through this exercise will produce other questions that need to be addressed. The more completely you can answer these questions, the greater understanding you will have as you consider how your hazard element should fit within your current GMA framework, and what other changes may also be necessary in your plan. You certainly do not need to address all of these issues to determine how to proceed with your hazard planning. As you take a fresh view at how your plan, regulations, and supporting information are interwoven, you will begin to see how your hazard plan can be best integrated into your overall planning effort.

Figure 2-1: Comprehensive Plan and Development Code Assessment Checklist

Does your comprehensive plan contain:

____ Policies and/or goals related to hazard avoidance?
____ Technical analysis documentation about physical features and land capacity?
____ Linkage to related policies and information of adjacent jurisdictions?
____ Mapping of critical areas?
____ Definitions and designation criteria for hazard or critical areas?
____ Shoreline Master Program goals and policies?

Does your development code (zoning, subdivision, CAO, SEPA, PUD) contain:

____ Provisions consistent with the plan policies?
____ Definitions consistent with federal and state regulatory definitions?
____ Shoreline Master Program regulations?
____ Provisions for hazard avoidance (setbacks, buffers, density, or site coverage limits)?
____ Clear directions for permit application submittal information?
____ Mitigation standards for ensuring minimal risk when development in or near hazard prone areas is unavoidable?
____ Outreach plans for conveying community needs and plans to state, federal, tribal, and local partners?

Does your planning toolkit contain:

____ Paper or digital mapping of floodplains, steep slopes, landslide hazard areas, forest land, etc. (FEMA, United States Geologic Survey, Natural Resources Conservation Service, National Wetlands Inventory)?
____ Hazard or disaster susceptibility reports or analyses?
____ Indexed project applications containing parcel-level information on geotechnical, flood survey, or other analyses?
____ Records of public involvement from prior planning efforts that can be used to generate advisory committees?
____ Linkages to other databases or special studies such as watershed plans, regional plans, or system plans?
____ Historical information on previous disaster events including newspaper articles, photos, damage reports, and maps?
____ Correspondence from federal or state agencies pertaining to hazard issues?
____ Grant applications for similar planning processes that might help in developing the work program?

Adoption of the Element and Its Development Regulations

The ultimate objective of this planning process is to develop a Natural Hazard Reduction Element and the development regulations that comply with, and implement, the objectives and strategies of the element. The mechanism of how your community will adopt the implementing ordinances should be decided before you begin the element's development. There are two alternatives – first, you could develop the element and its supporting regulations at the same time and complete SEPA review on the two items together. Adoption of the new element can then be completed as a part of the annual comprehensive plan update and be combined with adoption of the development regulations at the same time. The second alternative is to prepare the element, incorporating environmental review under SEPA, and then adopt it as an amendment to the comprehensive plan. Once the element has been adopted, you would proceed to making the changes necessary to your development regulations to ensure consistency with the new element.

☑ *Determine How You Will Adopt the Natural Hazard Reduction Element and Its Implementing Regulations – Together or One at a Time?*

While the first alternative may enable local governments to complete the plan/regulation development and adoption process all at once, other governments, especially smaller jurisdictions, may find completing these two projects at the same time to not be workable. These communities may want to complete the Natural Hazard Reduction Element development in two phases. If the two-phase model is selected, these governments will need to develop and adopt interim land use regulations to carry out the goals and policies in the Natural Hazard Reduction Element until permanent regulations are adopted.

Visioning

GMA plans are intended to define long-term visions of how we expect our communities to grow and change into the next generation. Clearly, hazard reduction planning has a different perspective. Hazard planning requires that we review the adopted comprehensive plan vision and determine if any parts of the plan work in opposition to the principles and standards of hazard avoidance or mitigation. An example of such a conflict would be a plan's designation of high-density residential uses in an area that has slopes and soils that may be landslide prone. The original land use decision could have been based on proximity to infrastructure, transit service, views, nearby parks, and other amenities which support higher densities. Hazard reduction planning requires that such land use decisions also consider site-related hazard potential.

Hazard reduction planning raises the need for some additional decisions. Can development consistent with the plan be adequately conditioned with mitigation measures to ensure that the hazard risk is minimized (for example, require the private developer to provide the mitigation in a landslide area)? Are there public investments that are needed to address the hazard mitigation issue (that is, investments that the community should provide so that development can occur)? Should the land use designation be changed to reduce exposure to the risk? Or, is there enough information to make that decision? If not, the planning process should include the steps necessary

to conduct the analysis. An examination of the adopted vision within the added perspective of hazard assessment should be part of the beginning work.

Establishing a Work Program and Schedule

Now, you can begin to shape a work program that will produce the element. This can be accomplished with in-house staff, volunteer assistance, or consultants. Many jurisdictions will probably use a mix of all three. The work program is necessary so that you can develop a budget and schedule. The following a list of tasks is intended as a starting point for this thinking (Figure 2-2). You can add or subtract tasks within your local context.

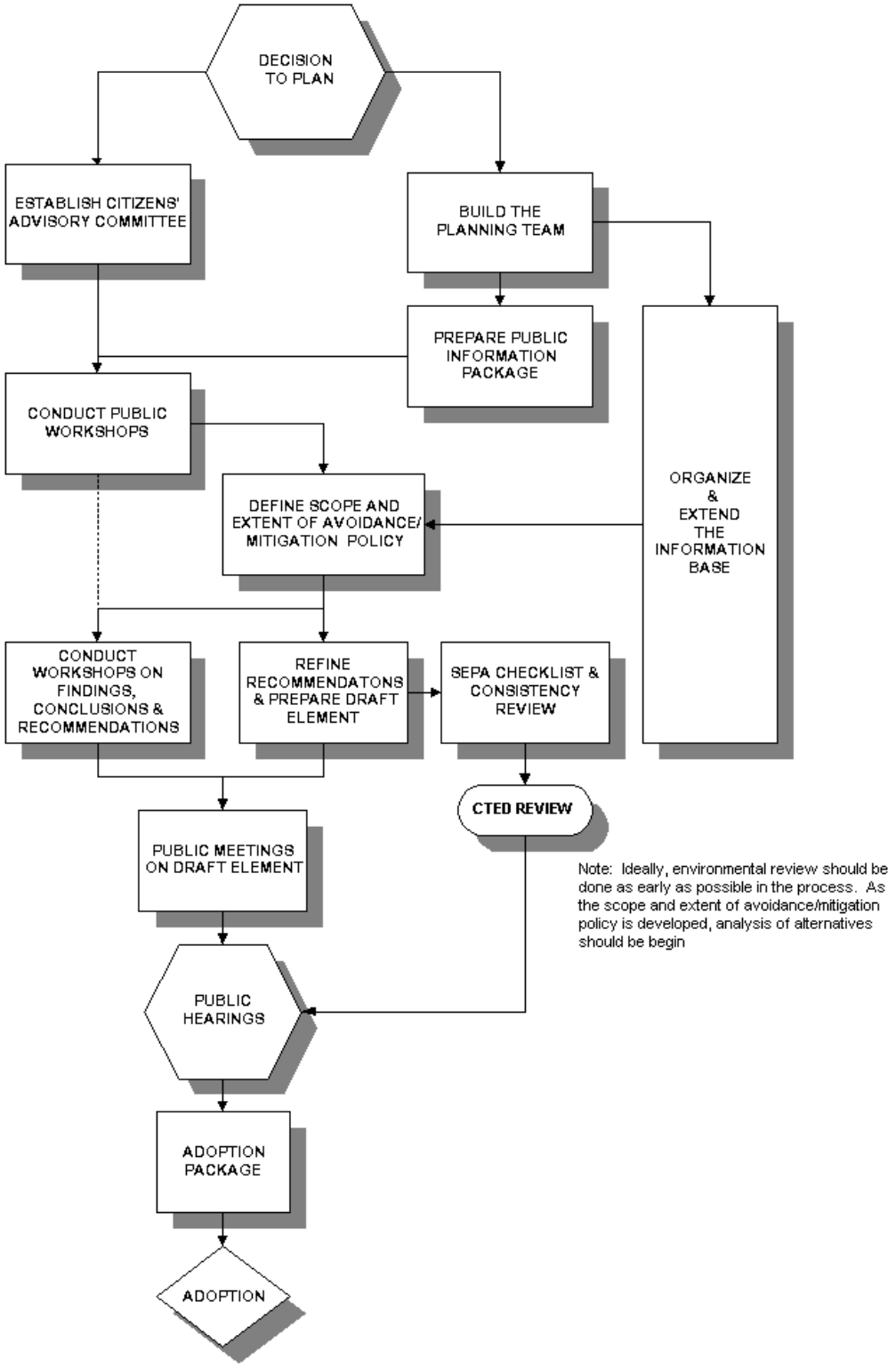
☑ *Develop the Detailed Work Program*

Figure 2-2: Work Program — Sample Tasks

1)	Establish a citizens' advisory committee or use the planning commission. Consider forming a technical advisory committee of local, regional, state, and federal resources to provide professional guidance or resolve issues that have a joint impact.
2)	Build the planning team (staff, volunteer experts, and consultants).
3)	Define the scope of hazard avoidance and mitigation measures that are a good fit with your community (discussion paper).
4)	Prepare an information package including objectives of the process, schedule, contacts, and anticipated milestones and products.
5)	Use the public (e.g., conduct public workshops) to present the process, seek vision statements, hear about concerns and issues, and attract more participants.
6)	Organize and extend the data base (maps, technical reports, models, related plans, etc.). Use community members to help inventory and identify hazards.
7)	Conduct advisory committee workshops to discuss your research conclusions and recommendations for plan policies, area designations, and regulations to address hazard concerns.
8)	Prepare a SEPA checklist. Environmental review early in the process will help identify hazard areas and the impacts of development in these areas.
9)	Refine the recommendations and prepare a draft Natural Hazard Reduction Element for public review and comment. The draft should include any environmental analysis of alternatives considered, possibly a draft environmental impact statement.
10)	Conduct public meetings or workshops to explain and discuss the recommended element. Submit the draft element to CTED for review.
11)	Conduct public hearings.
12)	Revise the draft based on CTED and public comments.
13)	Adopt the element and accompanying development regulations or if developing regulations after adoption of element…
14)	Start over with a similar process to revise the development code.

The steps do not need to be completed in this order. It will work well if parts of the process are completed simultaneously. Figure 2-3 presents a diagram of the process.

Figure 2-3 Comprehensive Plan Element Development Process



Once the preliminary work program is completed, you can then determine how to schedule the process and make estimates about what it will cost. The following worksheet (Figure 2-4) provides a method to complete the estimate.

☑ *Develop the Work Program Schedule*

Completion of the preliminary work program sets the stage for the launch of the process.

Figure 2-4: Work Program Schedule

Task	Completion Date	Meetings			Staff Time	Other
		Advisory Committee	Planning Commission	Council		
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16 …						
TOTAL						

Goals and Policies

Chapter 4 contains a detailed discussion of how to incorporate hazard avoidance and mitigation principles within the existing policy framework of the plan. This incorporation needs to be based on the research and analysis of the hazards as described in Chapter 3. As you get started, it is useful to reconsider the way in which your plan links the goals and policies with actions and strategies for implementation. As you modify the policy framework to accommodate the hazard principles, you will want to make certain that any policy changes ripple throughout the plan policies.

☑ *Identify Resources Appropriate to Your Planning Effort*

Basic Resources

There are many federal and state agencies and other organizations that can provide information on hazard analysis, disaster avoidance, and other tools. Throughout this Guidebook, numerous citations to other sources of information and examples are provided for finding out more about specific topics. Appendix A provides a summary of emergency funding sources. Appendix B provides information about additional resources, agencies, and offices with responsibilities for, and expertise in, emergency response, natural hazard analysis and reduction, and planning issues. The majority of these agencies also have resources for mitigation. Appendix C is a glossary of planning and related terms. Appendix D presents examples of flood, landslide, and wildfire reduction codes used by local communities, with discussion. Appendix E presents the Model Flood Damage Prevention Ordinance prepared by FEMA, Appendix F provides a Model Natural Hazard Reduction Element, and Appendix G offers a property protection scoring system.

☑ *Examine and Understand Your Plan's Linkage Between Goals and Policies and Implementation Strategies*

CHAPTER 3: FOUNDATION

INTRODUCTION

A thorough understanding of the nature, impacts, and principles of planning and mitigation of a natural hazard is the foundation for effective management of that hazard. This chapter provides details on three hazards addressed in this Guidebook (flood, landslides, and wildfires). A few definitions are useful to ensure a shared language of hazards planning.

> ***Natural Hazard*** – A naturally occurring or man-made geologic condition or phenomenon that presents a risk or is a potential danger to life or property (American Geological Institute, 1984).
>
> ***Event*** – A specific occurrence of loss resulting from the action of a natural hazard.
>
> ***Natural Disaster*** – An event or group of related events which requires response and/or recovery efforts beyond the capabilities or resources of the effected community. A natural disaster may also be declared a disaster at the state or federal level (by the Governor or President, respectively). Such declarations are necessary to trigger a response by their respective emergency resources.
>
> ***Vulnerability*** – The extent of the community (people and resources) which is placed at risk by a hazard**.**

FLOODING

Overview of the Hazard

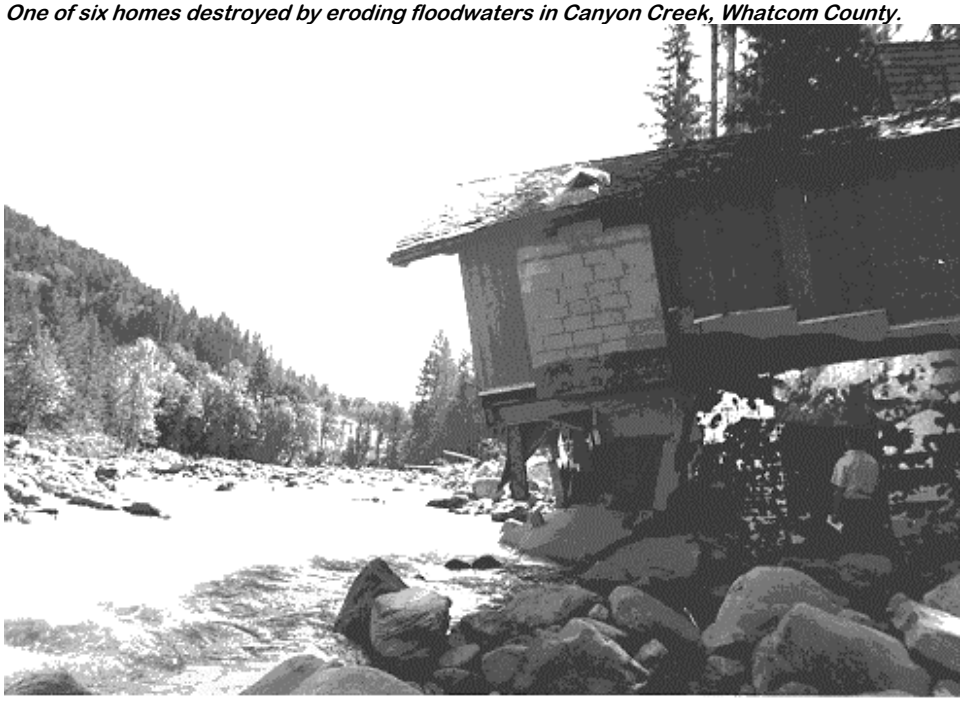
In Washington, there are two types of significant flooding:

- Large riverine events
- Ground water flooding events

Riverine flooding occurs when an increase in the volume of water in a river or stream channel occurs, and the river or stream overflows its banks and spills onto the adjacent floodplain. Large riverine floods can have great impact due to their scale, association with densely populated areas, and the possibility of secondary hazards (such as landsliding and structural fires). Factors influencing damage from these events include high flow volumes and velocity, aggradation, bank erosion, and in-stream debris. Not surprisingly, a comparison of the locations of Washington state rivers (as shown in Figure 3-1) and counties experiencing repetitive flood disasters, indicates that

those counties with the most extensive river systems, such as King, Snohomish, Lewis, Skagit, and Grays Harbor, are also the counties which experience the most frequent flood events.

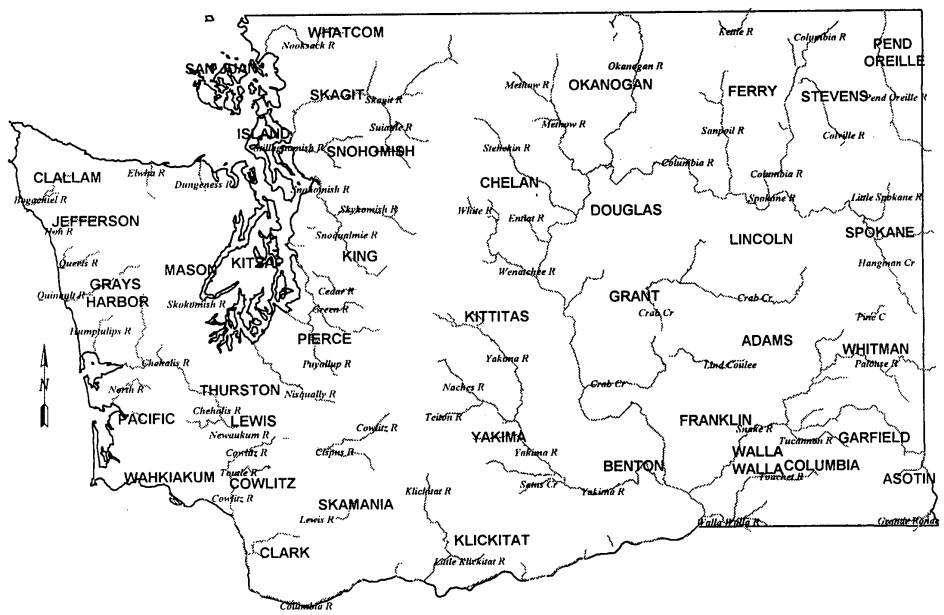
One of six homes destroyed by eroding floodwaters in Canyon Creek, Whatcom County.



Source: GeoEngineers

Despite the division of Washington by the Cascade Mountains into wet and dry halves, riverine flooding does occur throughout the state. The differing climates do, however, create different flood regimes east and west of the Cascades. Western Washington, which is characterized by wet winters with major rainfall in the lower elevations and heavy winter snowfall in the higher elevations, sees nearly 70 percent of its floods between November and February. The rivers that flow out of the Olympic Mountain Range and off the western slopes of the Cascade Mountains flood frequently. Large riverine floods are the flood events most commonly associated with major storms, such as the floods that resulted from 1995-1996 storms in Western Washington. Some of the most significant flooding occurs when rain falls on early snows, leading to an unseasonably early melting of the snowpack. The relatively dry winters of Eastern Washington make direct, large, storm-related flooding uncommon. Although the February 1996 floods occurred during winter, the meteorological conditions were actually spring-like, with heavy, warm rains on snow. Eastern Washington is particularly subject to flash floods, such as occurred in 1998 in Ferry County and Ephrata. It is also vulnerable to spring snowmelt, such as occurred in the Methow and Okanogan valleys.

Figure 3-1 Washington State Major Rivers

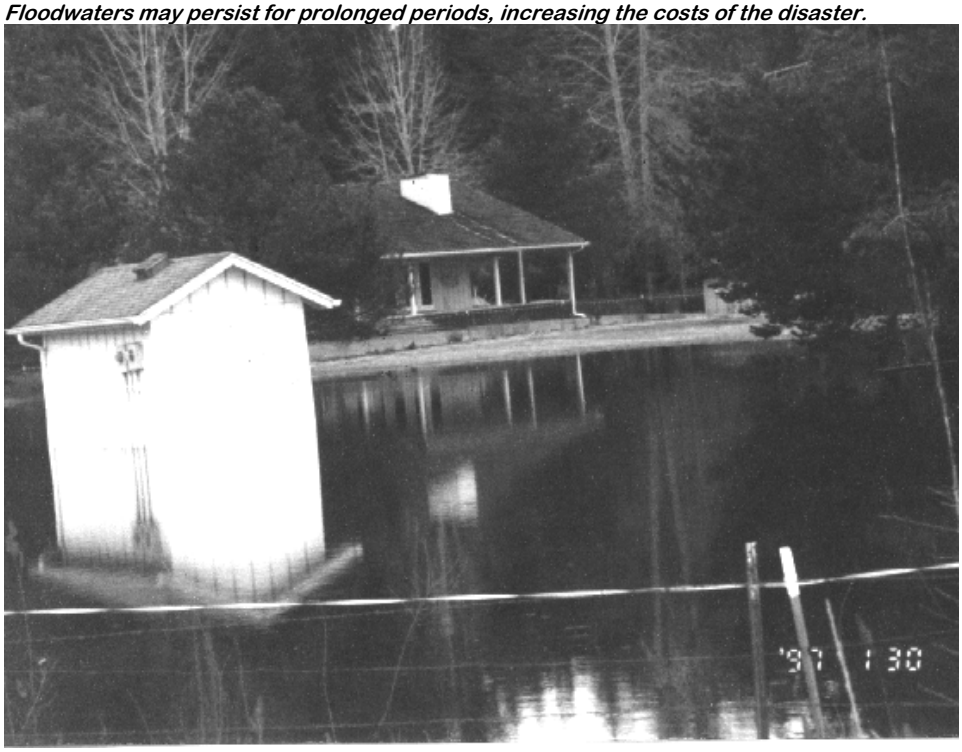


Source: FEMA

Low level topographic events, referred to as ground water flooding, occur in flat areas of the lowlands of the Puget Sound region. These areas were formerly glaciated and have developed a poorly drained landscape that is characterized by numerous small depressions. These depressions are generally (or naturally) occupied by wetlands whose water levels fluctuate with the seasons, filling with runoff in the spring and drying out in the summer and fall. Ground water flooding is exacerbated where there are large areas of impervious surface due to development. In these areas, the natural infiltration of the water into the soil is restricted, causing a concentration of runoff. Ground water floods can affect many urbanized areas, such as what happened in Pierce and Thurston counties after the winter storm of 1997. The previous year (1996) had been unusually wet, overfilling the wetlands and reducing the capacity of the landscape to absorb the storm runoff.

Both riverine and ground water flooding are the result of the landscape's need to accommodate more water than is normally present. When precipitation or snowmelt patterns are average in terms of timing, amount, and distribution, the water stays where we expect it to be. On the other hand, when the patterns deviate from the norm, water may encroach on our activities and development which grew to coexist with the normal situation. It is important to remember that our definitions for average and normal conditions are often based on fairly short-term records. It is not unusual (and should not be unexpected) for a river to leave its banks and occupy its floodplain even though this has not occurred recently.

Floodwaters may persist for prolonged periods, increasing the costs of the disaster.



Source: FEMA

Understanding the Hazard

Unlike some hazards such as earthquakes, floods rarely come without warning. Weather and climate forecasting can help foresee the likelihood of unusual precipitation or snowmelt patterns. The existing capacity of the landscape to accommodate additional water can also be forecast through a water balance analysis comparing rainfall and snowpack, stream flow, and reservoir storage data. As the above discussion on flood types indicates, soils, terrain, and topography impact storage capacity and the dissipation of excess groundwater.

The nature and extent of a flood event is the result of the complex hydrologic response of the landscape to the storm or melt runoff. In general, the more quickly water from a drainage basin concentrates in a stream or depression, the greater the level of flooding. Factors affecting this hydrologic response include:

- land use and land management practices
- hillslope gradient and aspect
- drainage patterns and density
- surficial deposits

- soil texture and permeability
- water storage capacity
- land cover and vegetation

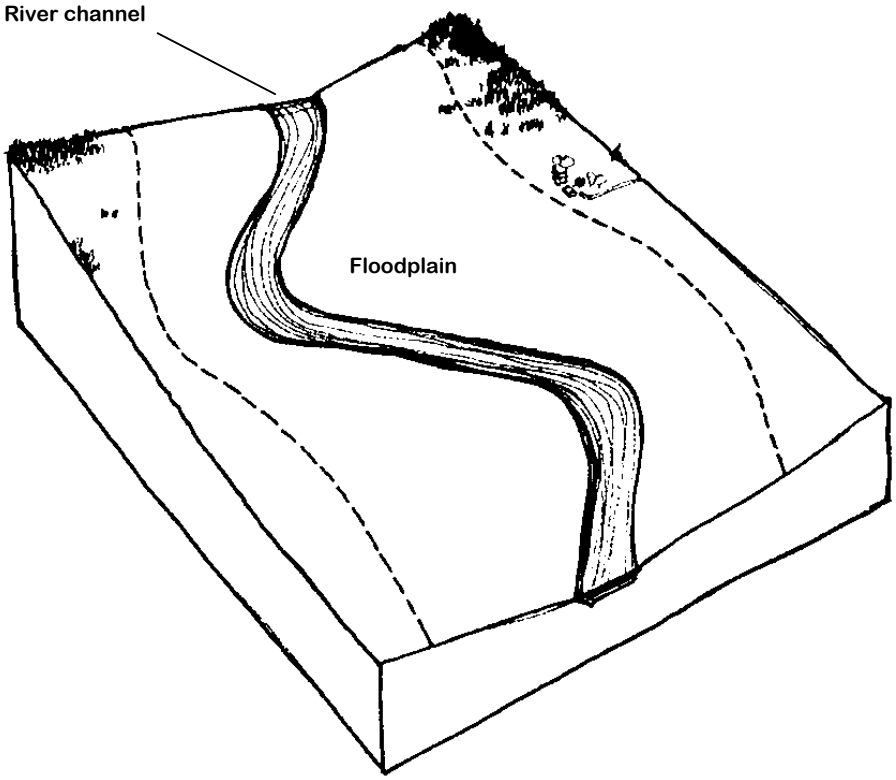
Runoff follows one of three paths, or a combination of these paths, from its point of origin to a stream or depression: overland flow, shallow subsurface flow, or deep subsurface (ground water) flow. Each of these paths delivers water in differing quantities and rates. The landscape factors cited above will influence the relative allocation of the runoff and will, accordingly, affect the hydrologic response of the landscape. For example, a parking lot has an impervious (nonporous) surface so all precipitation landing on this surface leaves as overland flow. Such flow results in a rapid and complete delivery of the runoff to the destination. In contrast, a forested area with well-developed soils offers a highly porous surface and a significant portion of the runoff enters a deep subsurface flow path. Such flow is characteristically slow and some of the runoff may be intercepted (such as through uptake by plants). These two surfaces – paved and forested – are radically different in hydrologic response. And equally apparent is the fact that landscape changes will modify the hydrologic response of an area, especially if they occur over a wide region.

Small flood events generally occur more frequently than large, devastating events. Statistical analysis of past flood events can be used to establish the likely magnitude and recurrence interval (period between similar events) for riverine floods. These analyses can be used to help direct avoidance and mitigation efforts by giving planners and decision-makers some insight into what they can expect in the future.

The following illustrations represent key elements of the language of flooding, flood management, and flood mitigation.

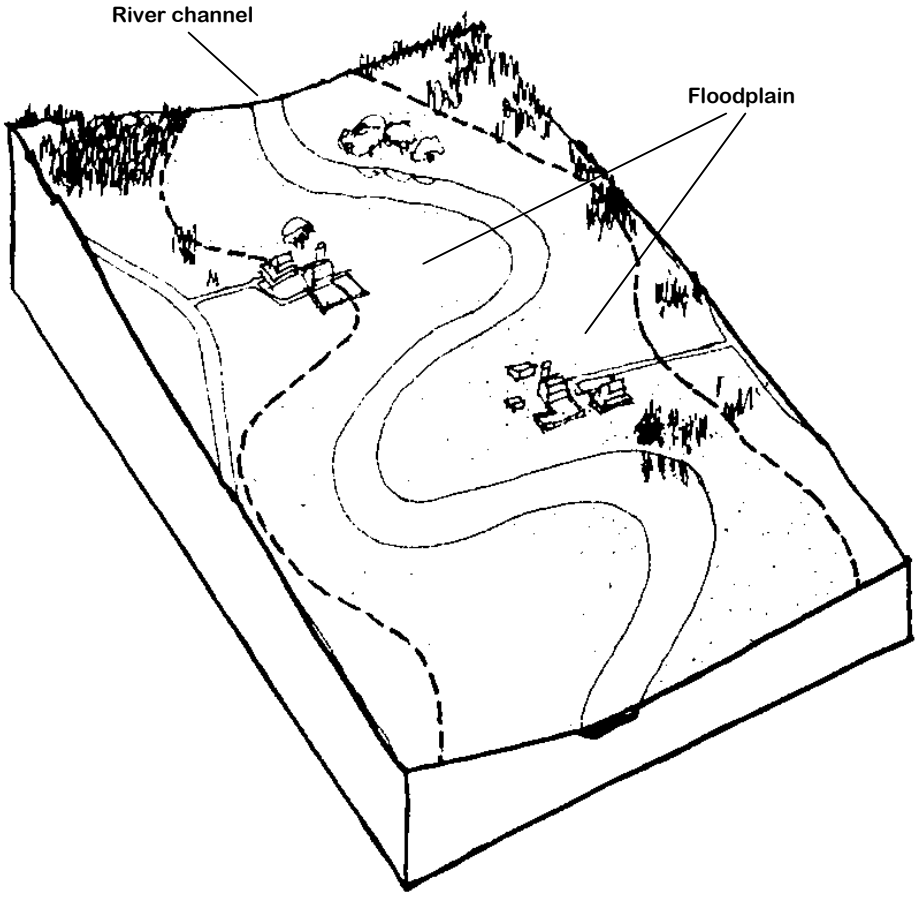
☑ Key Flooding Concepts

Floodplain. *Floodplains are overflow areas that have been created over time, formed as moving water carved channels out of the landscape and deposited sand, silt, and other material. They are lowlands adjacent to rivers, streams, oceans, or other water bodies. It is important to note that the river channel is defined by the features established during the one-and-one-half- to two-year flow; the river's occupation of the floodplain is not uncommon. A "rule of thumb" is that a river flows over its banks every two years..*



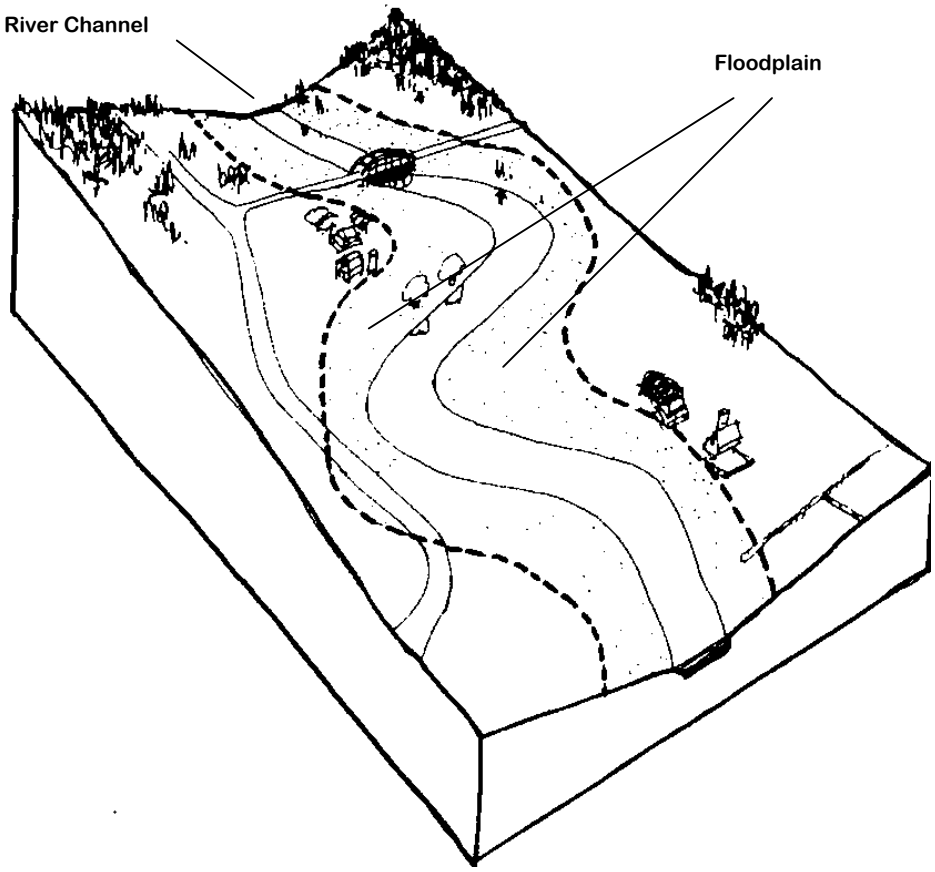
Source: ASFM and URR

***Broad Floodplain**. The width of the floodplain depends largely on topography. Flat terrain in areas along major rivers or on the coastal plain results in wide floodplains.*



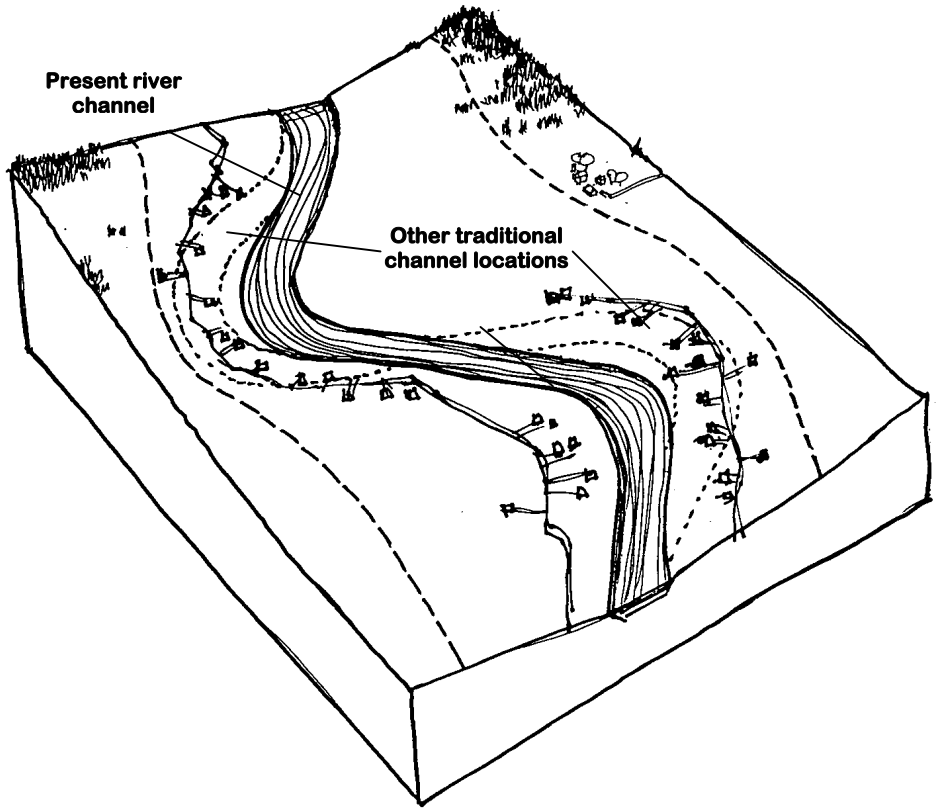
Source: ASFM and URR

Narrow Floodplain. *Mountainous or hilly areas have narrow, confined channels in which floodwaters concentrate. In these steep channels, waters are confined and tend to reach considerable velocities with relatively small increases in flow.*



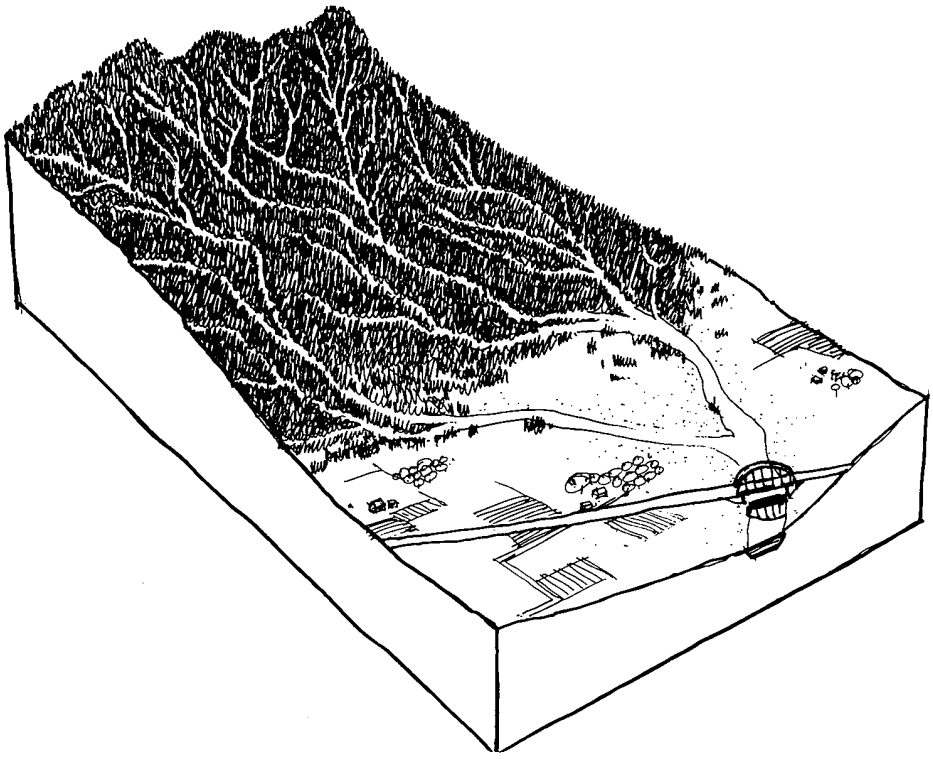
Source: ASFM and URR

Meander Belt. *The location of many river channels changes over time – they migrate, or more precisely, they meander. The meander belt is that portion of the floodplain that can be identified by the evidence of present and previous course movement and includes the present stream channel. An area that is flood prone and has similar topographic characteristics to present and historic stream channels is considered a meander belt.*



Source: ASFM and URR

Watershed. *A floodplain is part of a larger watershed. A watershed is a region or area that drains into a particular river or other water body. Watersheds can encompass thousands of acres and can cross numerous political jurisdictions. Development in the watershed upstream changes the surface of the land, increasing the amount and rate of runoff. Other uses in the watershed can significantly add to soil erosion. These conditions overload both the natural streams and the man-made ditch and sewer systems.*



Source: URR

Planning and Mitigation

Where the surface of the land is relatively undisturbed, flood-prone areas can be recognized by a well-defined natural floodplain, by natural levees along streambanks, by alluvial fans, or by the distinctive soil types that are associated with the floodplains. Unfortunately, in many communities these natural features have been altered by development. Furthermore, where structures have been placed within the floodplain, including structures elevated on fill, the storage capacity of the floodplain has been reduced.

Natural features of the floodplain are often concealed by development.

Source: URR

Effective implementation of hazard reduction planning involves manipulation of existing features to compensate for changes that have occurred in the floodplain. These changes may be the result of development or other activities, including land use practices, that either have increased the likelihood or extent of flooding or that have placed residents or businesses within the reach of flood waters.

Floods tend to be localized both by the effects of topography and by storm location. The first step in planning for flood hazard reduction requires assessment of the current flood hazard (timing, extent, and location of anticipated events); modeling of potential future hazards (based on forecasted or planned changes); and identification of vulnerable areas. Accurate mapping of flood-prone areas is the first phase of mitigation and depends on knowledge of the depth and extent of past floods and of the normal patterns of streamflow.

Flooding results when streamflow exceeds the capacity of the stream channel. Damage and disruption occur when the natural storage areas are unavailable. Thus, the underlying objective of mitigation is to maximize storage capacities. In general, the impacts of flooding may be mitigated by keeping humans and structures separate from floodwaters through controls on land use, actions to

☑ *Elevation of Structures Above Flood Waters (Without Relocation) is One Method to Reduce Flood Impacts*

increase water storage capacity, removal of structures in the floodplain, and controlling development in meander belts, as well as judicious use of structural measures such as levees and dikes. There are a number of structural and nonstructural tools, including bioengineering, that can be used to achieve these storage objectives.

Traditionally, over centuries rivers have changed their course and been allowed to meander. Now human habitation/structures are located within the river's meander path. In these traditional meander zones, acquisition of lands and removal of homes and other structures is used to mitigate the flood hazard. Some communities have used open space plans and zoning setback provisions to create greenways. Such open spaces can minimize the effects of streambank erosion while providing additional buffering against the effects of overbank flows, as well as community recreation opportunities.

Greater protection can be achieved through a combination of tools, such as setback levees combined with a greenway. In this composite solution, the greenway provides additional storage, recreation and/or habitat opportunities, while the levee provides protection for inland uses.

Setback levees may offer multiple use opportunities.

Source: URR

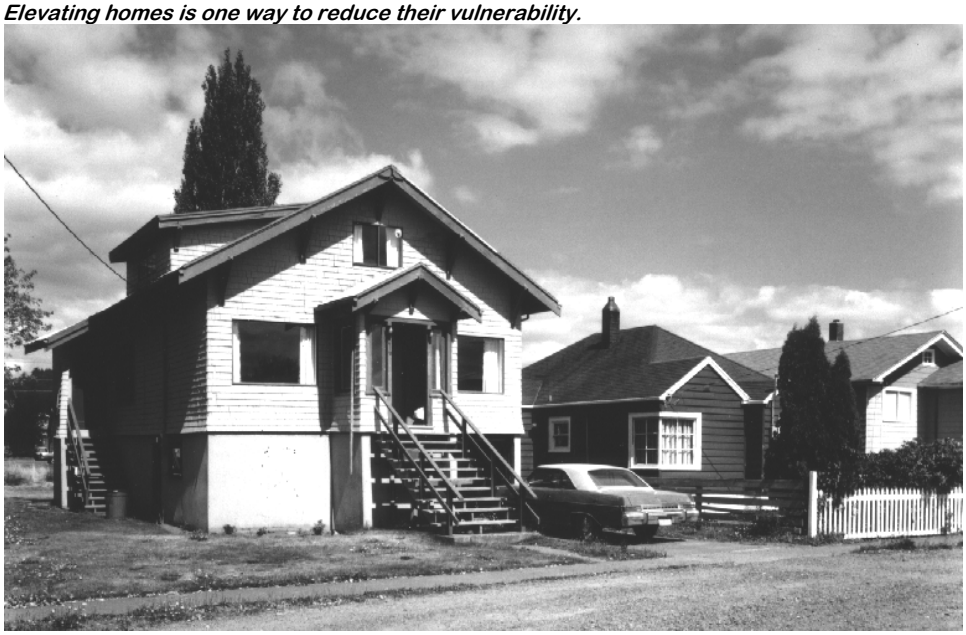
Where acquisition and increase of flood water storage capacity is not possible, elevation of homes can significantly reduce the effects of flooding.

☑ *Activities in the Upper Watershed Also Influence Flooding*

The previous discussion of mitigation has focused on actions in the floodplain. It is critical, however, to recognize that activities in the upper watershed (such as those which generate additional surface water runoff debris or sedimentation) influence the volume of downstream flow, as well as the rate of flow. Activities in the upper watershed thus significantly impact communities in the lower floodplain areas, which means that the limits of the flood hazard reduction planning area must be defined to include the entire watershed. An important aspect of flood hazard reduction planning is to adopt a coordinated policy with those adjacent communities that may impact your planning and which will be impacted by the activities in your community.

Federal and state programs supporting flood hazard mitigation efforts exist and may already be active in your area. These programs may provide funding and criteria for developing mitigation strategies. Although each program has its own mission and objectives, the products of participation in each are likely to be similar and complimentary. Careful coordination can result in an overall decrease in your administrative workload and speed up implementation (especially when one of these programs is already in place in your community). Of particular interest in Washington are the federal National Flood Insurance Program (NFIP) and the state's Flood Control Assistance Account Program (FCAAP).

Elevating homes is one way to reduce their vulnerability.



Source: URR

National Flood Insurance Program

NFIP was created in 1968 to fulfill a twofold purpose:

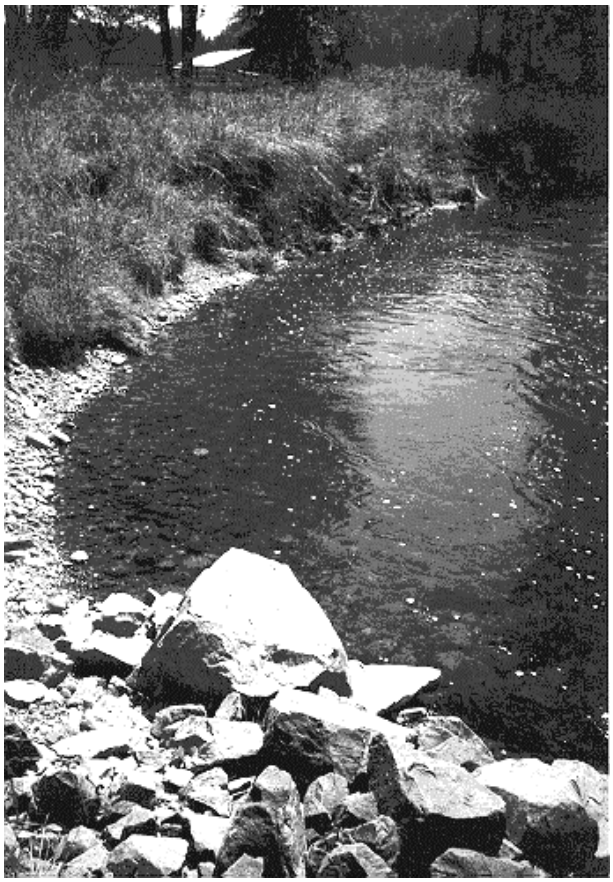
1. To provide the general public the opportunity to obtain flood insurance coverage to cover flood damages to buildings and their contents, and
2. To reduce future flood damages by requiring local regulation of new development in flood-prone areas.

This federal program was established in an attempt to control flood losses and disaster assistance costs which had continued to rise despite decades of flood control efforts. These earlier efforts were generally ineffective at reducing damage to existing development and at discouraging inappropriate floodplain development. This floodplain development, in turn, led to continuing losses during flood events. NFIP is designed to be an alternative to disaster assistance and as a tool

to promote responsible floodplain management in participating communities. Insurance is made available to property owners in communities which have agreed to adopt and enforce a floodplain management ordinance that will reduce future flood risks due to new construction. The program is available to all flood-prone communities in the nation and most eligible communities have elected to participate. NFIP insurance is overseen by the Federal Insurance Administration (FIA) and sold through state-licensed insurance companies.

FEMA has been responsible for the identification and mapping of flood hazard areas in support of the NFIP. To many planning and community officials, the most familiar products of this work are the flood insurance rate maps; other products include the flood hazard boundary maps and flood boundary and floodway maps. These maps identify the special flood hazard areas; also known as the base or 100-year floodplain (a base flood or 100-year flood is defined as the flood having a one percent chance of being equaled or exceeded in any given year). FEMA mapping may also identify a regulatory floodway, which includes both the stream channel and adjacent lands sufficient to contain the projected flood volume without increasing the flood level by greater than one foot. The areas within the special flood hazard area, but outside of the floodway are referred to as the floodway fringe. As development regulations are tied to these designations, these maps can have an influential impact on current and future property owners in a community, and are invaluable in hazard reduction planning.

Flood flows in the Green River eroded nearly 200 feet of private property and threatened to create a new flood channel that would have destroyed a residence and accessory buildings. The stream bank was reconstructed with riprap and biotechnical methods.



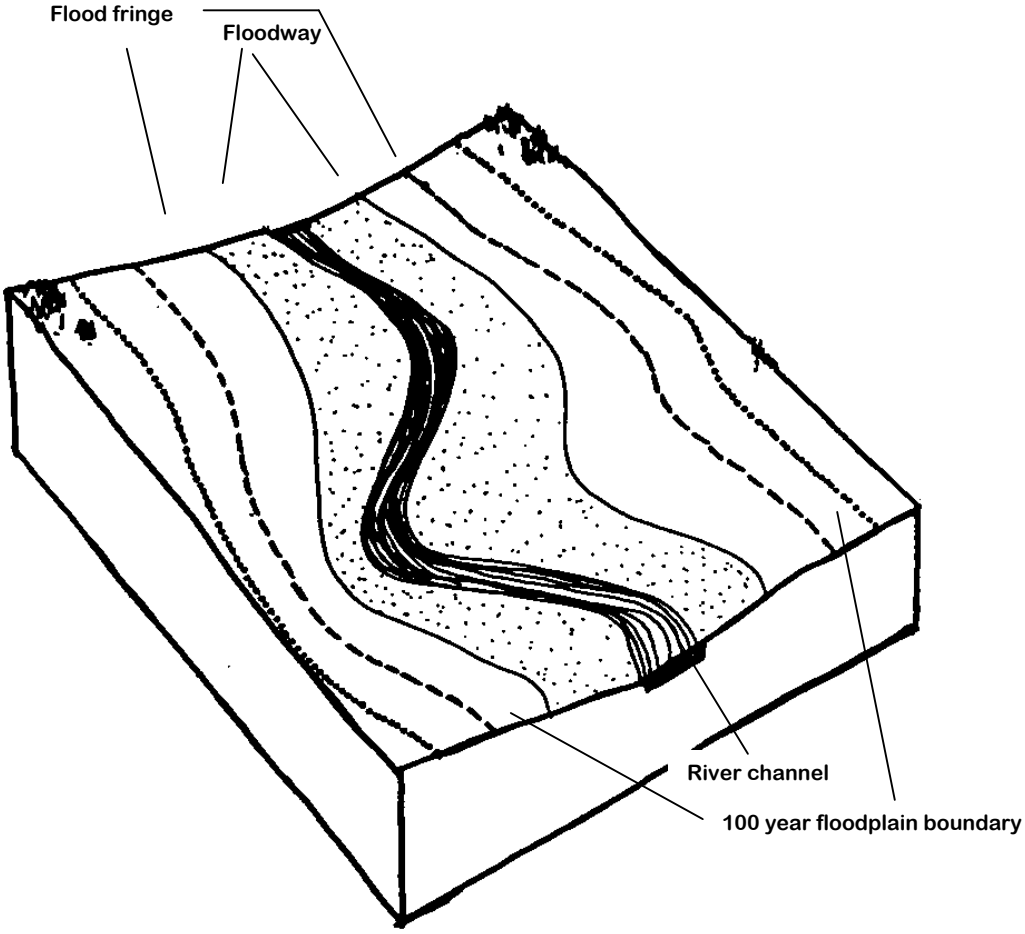
Source: GeoEngineers

NFIP insurance is only available in those areas where the community (through its appropriate public body) has adopted and enforces floodplain management regulations that meet FEMA standards. In order to assist communities in developing appropriate regulations, FEMA has prepared a model ordinance to provide an example of suitable language (Appendix E). Currently, 276 Washington communities participate in the NFIP. Only 13 mapped communities (those where documented flood hazard exists) in the state are not participating in the NFIP and the majority of these have little to no development in the floodplain. The requirement of community participation is needed to ensure that the flood loss reduction efforts of some are not offset by the careless building of others; flooding generally occurs to such an extent that individual mitigation efforts

could be rendered ineffective. Community-wide participation also serves to keep insurance premiums at affordably low levels.

☑ *The NFIP Requires Community and Individual Participation*

Floodway. *The normal stream channel and that adjoining area of the natural floodplain needed to convey the waters of a regional flood while causing less than one foot increase in upstream water surface elevations is known as the floodway. Some local jurisdictions adopt other definitions for the floodway that define the allowable increase as a quantity other than one foot (for example, a "zero-rise floodplain"). The floodway definition legally adopted by a jurisdiction is referred to as the Regulatory Floodway. The area within the floodplain but outside of the floodway is known as the flood fringe.*



Source: FEMA and URR

A community's participation in NFIP is voluntary, but participation status can significantly affect property owners located in special flood hazard areas (that is, the floodway, floodplain, or floodway fringe) by either imposing new development controls or limiting flood recovery assistance. If a community elects to not participate, no federal financial assistance will be available for acquisition or construction within the special flood hazard areas (this includes, for example, loans guaranteed by the Veteran's Administration and/or insured by the Federal Housing Administration). Further,

in the event of a presidentially declared flood disaster, no financial assistance will be available for permanent reconstruction or repair of insurable buildings in the special flood hazard areas.

The minimum level of floodplain regulation that a community in the NFIP is required to impose is dependent on the level of hazard mapping and designation that has been conducted. When a community first applies for participation, it is enrolled in the Emergency Program. During this initial phase, limited flood insurance is offered while the flood studies and detailed maps are prepared. The community is required to adopt limited floodplain management requirements based on the flood hazard boundary map (a preliminary map) to control future use of the floodplains. Once the more detailed delineations and maps are complete, the community adopts more stringent ordinances and moves into the Regular Program. Of the 276 communities in the state that participate, 265 are in the Regular Program and 11 are in the Emergency Program. Details on the requirements at each phase are available from FEMA.

FEMA requirements are confined to development within the identified Special Flood Hazard Area, where development is defined as:

> *Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation, drilling operations, or storage of equipment or materials.*

In general, the floodplain management requirements within the special flood hazard area are designed to prevent new development from increasing the flood threat and to protect new and existing buildings from anticipated flood events. These requirements may be met through zoning, subdivision, or building regulations, and special-purpose floodplain ordinances. The community must require permits for all development in the special flood hazard area and ensure that construction materials and methods used will minimize future flood damage. Local permits may be granted only after any required federal and state permits have been obtained. All insurable new development within the special flood hazard area must be insured through the NFIP. Where a floodway has been designated, the community is responsible for prohibiting encroachments into that floodway, including fill, new construction, and substantial improvements, unless it can be shown through hydrologic and hydraulic studies that the proposed development will not increase flood levels within the community. RCW 86.16.041 prohibits new or substantially improved development in the floodway.

☑ *CRS Rewards Community Hazard Reduction Efforts With Insurance Rate Reductions*

Communities which apply more stringent protection standards than those required by the NFIP are eligible for reduced insurance rates for property owners through the NFIP's community rating system (CRS). Insurance premium discounts may range from 5 to 45 percent, and are offered for undertaking some or all of the 18 public information and floodplain management activities described in the CRS Coordinator's Manual, or other approved flood loss reduction activities. Currently, 21 Washington communities participate in the CRS and receive discounts of between 5 percent to 20 percent. RCW 86.16.041 prohibits new or substantially

improved residential development in the designated floodway. This provision is based on FEMA's model ordinance.

To participate in the community rating system, a community must participate in the NFIP, appoint a coordinator to serve as liaison with FEMA, and complete an application. At a minimum, a community participating in CRS must maintain FEMA elevation certificates for new construction in the floodplain. Other activities include:

- Provide flood insurance rate maps information to people who inquire and publicize this service.
- Give inquiring property owners technical advice on how to protect their buildings from flooding, and publicize this service.
- Require freeboard (building elevations higher than the designated flood level).
- Keep flood and property data on computer records and maintain elevation reference marks.
- Devote special attention to repetitively flooded areas.
- Provide early warnings to the public and have a detailed flood response plan keyed to flood crest predictions.

Additionally, communities are eligible for extra credit (and higher rate reductions) if they coordinate their activities through a comprehensive floodplain management plan.

Property owners generally experience the direct benefits of the NFIP through insurance claims. Current limits are $250,000 for residential buildings ($250,000 per unit for residential condominium buildings) and $500,000 for nonresidential buildings. In the event of a presidentially declared disaster, a number of benefits for the property owner may be available. Major flooding may trigger the need and/or desire to consider mitigation actions such as relocation, acquisition, or elevation of flood-damaged structures. Funding for such actions is available on a case-by-case basis. The NFIP establishes a mechanism through the Flood Mitigation Account for the buyout of properties that suffer repetitive or especially severe damage.

Questions concerning these programs may be directed to the Hazard Mitigation Division of the FEMA regional office in Bothell and Emergency Management Division (EMD) of the Washington State Military Department.

Hazard Mitigation Grant Program and Flood Mitigation Assistance

☑ *The HMGP Helps Develop Mitigation Projects*

EMD administers the Hazard Mitigation Grant Program (HMGP), a program that provides the opportunity to seek federal grant funding for long-term projects that will minimize or even eliminate future damages due to natural disasters. This program is made available to applicants (state or local governments,

special purpose districts, tribal governments, and nongovernmental organizations with government-like services) in an effort to encourage long-term planning and mitigation measures to reduce future damages from disasters. Regardless of the size or fiscal strength of the applicant, the basis for grant success is weighed primarily on past disaster damage. The applicant must illustrate that the proposed project will reduce future damages by at least as much as the project will cost. These funds are also available for mitigation of other hazards (seismic retrofits and major landslide mitigation projects are eligible and have received funding).

After a presidentially declared disaster, FEMA provides to HMGP 15 percent of its total expenditures from that disaster. Project costs are shared on a 75 percent federal and 25 percent non-federal basis. The non-federal share of 25 percent is then split equally between the state and the applicant. An applicant can use a variety of resources, including Community Development Block Grant funds. In-kind services of up to 50 percent can also be used as the local match.

The Flood Mitigation Assistance program, which began in 1997, provides limited funding to help communities address flood damage issues. As with the HMGP, the federal share of the funding is 75 percent. In contrast with the HMGP, the remaining 25 percent is the sole responsibility of the local applicant; the state makes no contribution. Additionally, the applicant must have an approved flood damage reduction plan.

Since funds are limited, FEMA and the State Emergency Management Division may prioritize certain types of projects. In 1997, for example, when only $159,200 in federal funds was available for Flood Mitigation Assistance, the focus was on the acquisition of structures that were both flood-damaged and insured under the NFIP.

Flood Control Assistance Account Program

The state's Flood Control Assistance Account Program (FCAAP), administered by the state Department of Ecology, provides funds for local flood hazard management efforts. The foundation for these efforts is a comprehensive, watershed-based flood hazard management plan (as provided for in Chapter 86.12 RCW) prepared by the local community. These plans must include the following:

- Description of flood damage history and area characteristics;
- Designation of flood-prone areas;
- Description of relevant regulatory and capital improvement programs;
- Inclusion of effective interagency and public involvement process; and
- Evaluation of flood hazard management alternatives, including their public benefits and environmental impacts.

☑ *FCAAP Assists Communities Develop Watershed-Based Flood Hazard Management Programs*

The overlap and possible coordination of such a document and the flood hazard portions of a Natural Hazards Reduction Element are obvious. In addition, the community and property owners may reap benefits under the community rating system. Typically local hazard mitigation plans contain more specific language than the comprehensive plan, but the comprehensive plan is an excellent vehicle for bridging the gap between general policies and the on-the-ground implementation of the FCAAP plan. The flood hazard management plans may address flood hazards through a variety of techniques, including:

- Non-structural flood damage reduction techniques, such as wetland restoration;
- Prioritized home acquisition and structural elevations; and
- Land use controls which prohibit or condition development in flood-prone areas.

More details on FCAAP and flood hazard management plans are available from the Department of Ecology. Appendix A lists the criteria considered in funding FCAAP.

LANDSLIDES

Overview of the Hazard

Landslides result when slope instability and loading combine to produce a failure of the slope and a release of material. Topographic and weather conditions in Washington make landslides a frequent problem throughout the state. The term landslide encompasses a variety of forms of movement of soil, rock, and related materials downslope. Landslides may be sudden and dramatic, such as debris flows rushing down mountain stream channels, or slow and continuous, moving large volumes of earth over the course of years.

The February 1996 storm event represents a recent example of the types of conditions that can result in severe landsliding. An unusual combination of heavy early mountain snowpack (greater than 100 percent of normal in many areas) and prolonged, high-intensity rainfall with mild temperatures led to extreme quantities of soil moisture and surface water flow. Landslides occurring during that storm event included debris flows, rotational slumps, block slides, rock falls, soil slides, and soil falls (see the text for complete descriptions of these types). Landslides vary in size from small (associated with a single property) to huge; the largest event was a block slide of 100,000 to 200,000 cubic yards of earth.

Heavy rains caused failure of roadway embankment and underlying hillside with loss of roadway in the City of Everett.

Source: GeoEngineers

Understanding the Hazard

Landslides basically include any type of slope movement. To a significant degree, the various types of landslides are influenced by the underlying geology. Basic geological characteristics result in a general correlation between landslide types and seven geographic regions within Washington state as described below and illustrated in Figure 3-2.

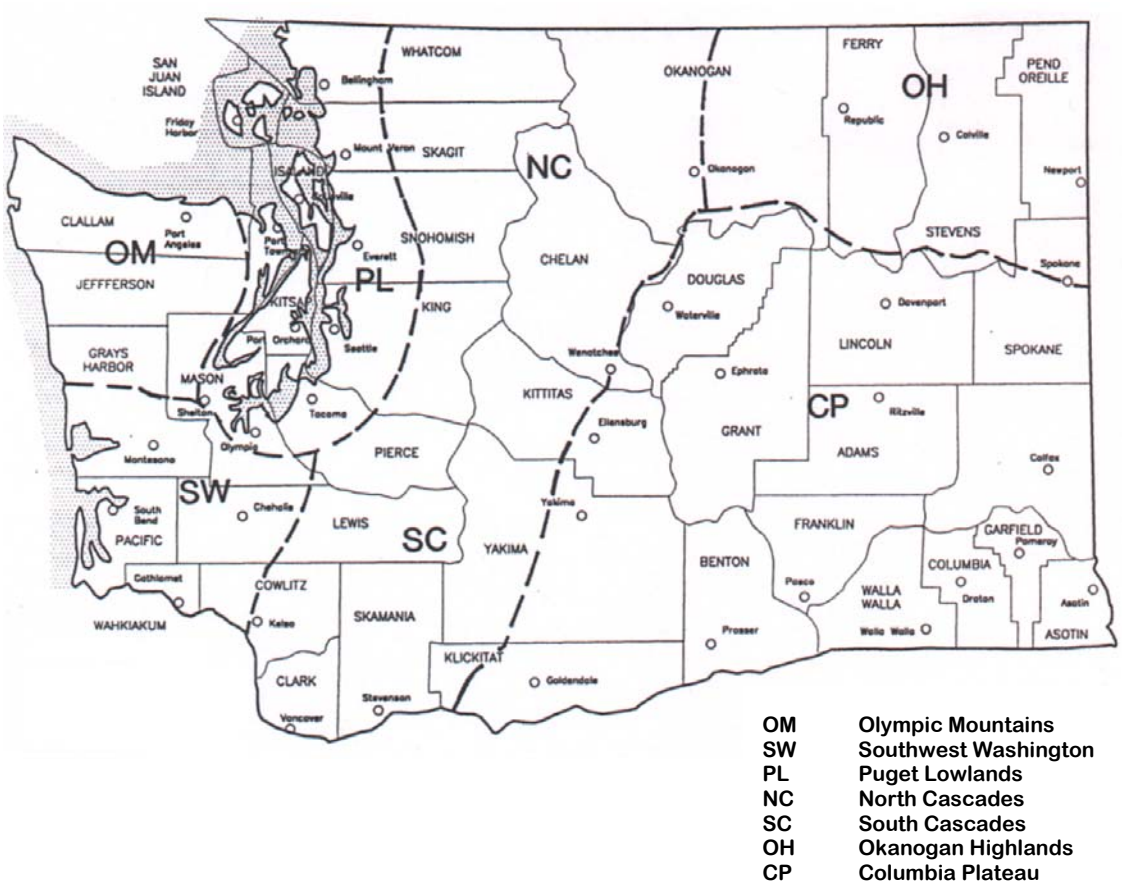
(PL) Puget Lowlands: characterized primarily by glacial soils on steep slopes. Glacial soils are prone to debris flows and shallow landslides.

(SW) Southwest: characterized by older geologic sedimentary units prone to shallow and deep seated landslides.

(NC) North Cascade, (SC) South Cascade, (OM) Olympic Mountains, and (OH) Okanogan Highlands mountainous regions: prone to rockfall, topples, rock avalanches, and debris flows.

(CP) Columbia Plateau: characterized by colluvium (loose sediments deposited by gravity) and alluvium (sediments deposited by water). Prone to debris flows, translational, rotational slides, topples, and lateral spreads.

Figure 3-2 Correlation Between Landslide Types and Geographic Regions

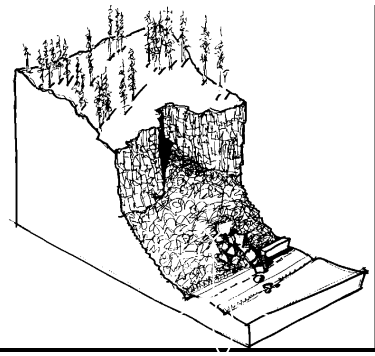
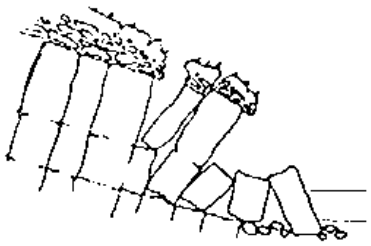
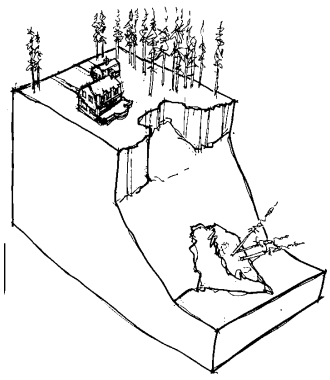


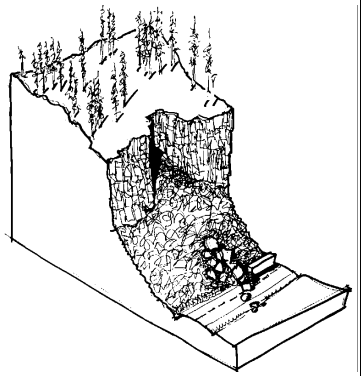
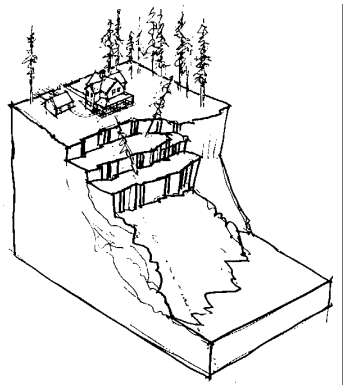
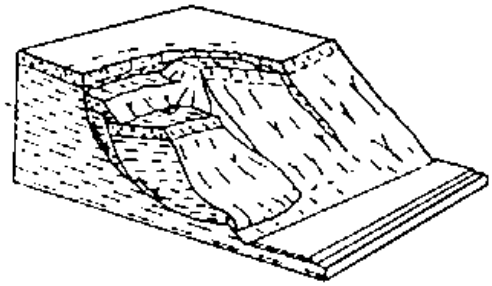
Source: GeoEngineers

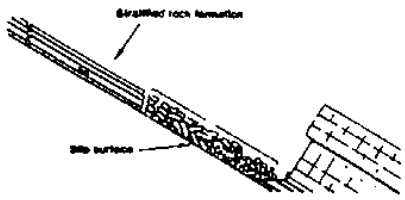
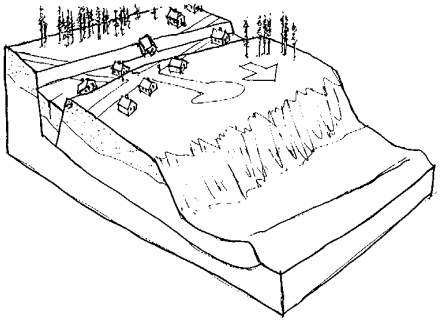
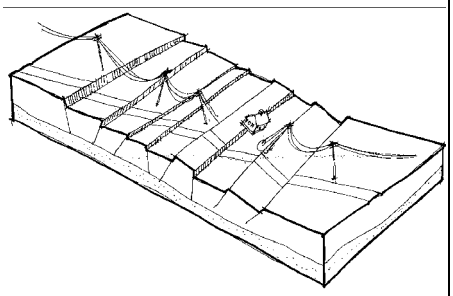
Table 3-1 provides a detailed description of landslide types. The columns of the table contain the following information:

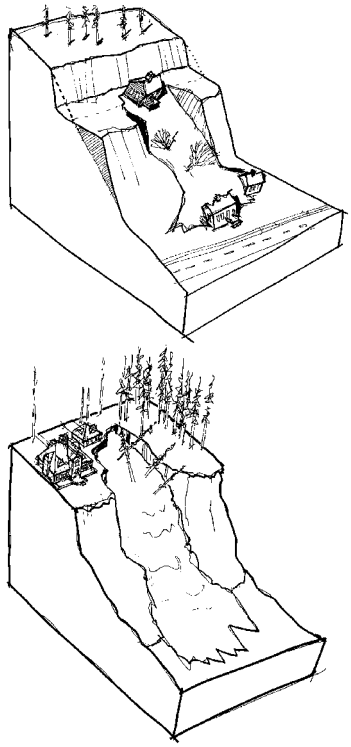
- *Slide Type*
- *Material Type* – material from which the landslide originates
- *Failure Mechanism* – the mechanism which produces the landslide
- *Speed* – the speed with which the material travels
- *Runout* – the extent and nature of the slide material deposition zone
- *Terrain* – the type of terrain where the landslide is likely to occur

Table 3-1 Slide Description, Material Types, and Failure Mechanisms

Slide Type	Material Type	Description			
		Failure Mechanism	Speed	Runout	Terrain
FALL 	Rock	Detachment of rock from steep slope. Caused by displacement from water and ice in cracks. Descent by bouncing or rolling down fall line of slope.	Rapid	Depends on size and velocity of material and gradient of runout area; runout generally equals the height of the slope.	Very steep rocky slopes; rock outcrops and faces; and roadcuts.
TOPPLE 	Rock	Forward rotation of rock or soil away from slope face caused by displacement from water or ice in cracks. Descent by bouncing or rolling down fall line of slope.	Rapid	Same as Fall	Same as Fall
	Soil		Rapid	Same as Fall	Precipitous slopes, e.g., coastal bluffs, river bluffs, glacial and fluvial terraces.

Slide Type	Material Type	Description			
		Failure Mechanism	Speed	Runout	Terrain
ROCK AVALANCHE 	Rock	Downslope movement of broken rock which follows a well-defined channel. May include debris avalanche.	Rapid	Same as Fall	Same as Fall
SLIDES – ROTATIONAL 	Rock	Downward movement of rock or soil mass along a typically deep-seated curved and concave-up failure surface. Generally forming in previously unfailed native and fill materials.	Moderate to Slow	Typically ranges from 2 to 10 times the vertical offset.	Undercut steep to precipitous shoreline bluffs, glacial, and fluvial terraces; fill embankments.
	Soil		Moderate to Slow		

Slide Type	Material Type	Description			
		Failure Mechanism	Speed	Runout	Terrain
SLIDES - TRANSLATIONAL 	Rocks (weak, layered)	Downward movement along inclined planar or undulating surface of rupture. Failure is typically shallow and through weak or previously failed rock or soil. Displaced mass rapidly disintegrates as velocity and water increase. Failure surface often the contact between bedding planes in rock and/or soil units.	Rapid to Moderate	Less than topples or falls but greater than rotational slides, typically approximately 1/2 of slope height.	Moderate to steep slopes.
	Soil (colluvium overlying rock substrata)		Rapid to Moderate		Moderate to steep slopes.
LATERAL SPREADS 	Soil and rock	Extension and separation of more or less intact blocks of cohesive soil and/or rock on a nearly flat zone of weak underlying material. May result from seismic liquefaction. Spread may develop into flow at toe.	Slow to Rapid	Runout from associated flows (same as Flows).	Low gradient slopes. Terrace surfaces.

Slide Type	Material Type	Description			
		Failure Mechanism	Speed	Runout	Terrain
CHANNELIZED FLOWS (debris flow) (mud flow) (debris avalanche) 	Soil	Soil flows occur as dry soil or water-saturated events. Both flow types follow or develop well-defined channels.	Rapid	Depends on flow viscosity, soil volumes, and slope gradient. Large volume flows can travel great distances.	Initiate on moderately steep slopes.

Notes:

Speed
- R = Rapid slide, with movement measured in feet per second and feet per minute. Faster events are inescapable by foot.
- M = Moderate slide, with movement measured in terms of feet per minute to feet per day.
- S = Slow slide, with movement in feet per day or slower.

Source: GeoEngineers, URR (after Transportation Research Board, *Special Report 176, Landslides, Analysis, and Control)*

The damage resulting from a landslide event will depend on the type, size, and frequency of recurrence of the landslide. Table 3-2 provides a general overview of the types of damage associated with the different landslide types.

Table 3-2 Potential Damage By Landslide Type

Material Type: / Damage:	Slide Type										
	Fall	Topple		Rock Avalanche	Rotational		Translational		Lateral Spreads		Channel -ized Flows
	Rock	Rock	Soil	Rock	Rock	Soil	Rock	Soil	Rock	Soil	Soil
Damage to structures from impacts	●	●	●	●			●	●	●	●	●
Damage to utilities from impact	●	●	●	●			●	●	●	●	
Obstruction/displacement of transportation facilities							●	●	●	●	●
Obstruction/alteration of roads	●	●	●	●	●	●	●	●	●	●	
Obstruction of watercourses	●	●	●	●	●	●	●	●	●	●	
Loss of ground support					●	●					
Displacement of buried utilities							●	●	●	●	
Water and mud inundation											●
Fish habitat destruction due to extreme erosion and/or sediment deposition											●

Planning and Mitigation

As is the case with flooding, the conditions that lead to landsliding are generally understood and somewhat predictable. A significant portion of the damage, especially in urban areas, occurs in areas that show evidence of either past landsliding or recent instability, such as coastal bluffs in the Seattle area. Figure 3-3 demonstrates the correspondence between landslide events in Seattle during the period 1996-1998 and mapped potential slide areas. It should be noted, however, that landslides also occur at the sites of prehistoric slides, as was the case in a damaging slide that occurred in Kelso in 1998 and in slides that occurred in the Methow and Okangoan valleys in 1948 and 1972.

Planning for landslide hazard reduction requires assessment of the current hazard (timing, extent, and location of anticipated events); modeling of potential future hazards (based on forecast or planned changes in development, landscape, and climate); identification of areas, structures, and people at risk from these hazards and the likelihood and severity of such risk. Following this process, goals and implementation strategies may be developed as described in Chapter 4.

☑ *Assessing the Hazard and Identifying Areas, Structures, and People at Risk Lay the Foundation For Hazard Reduction Planning*

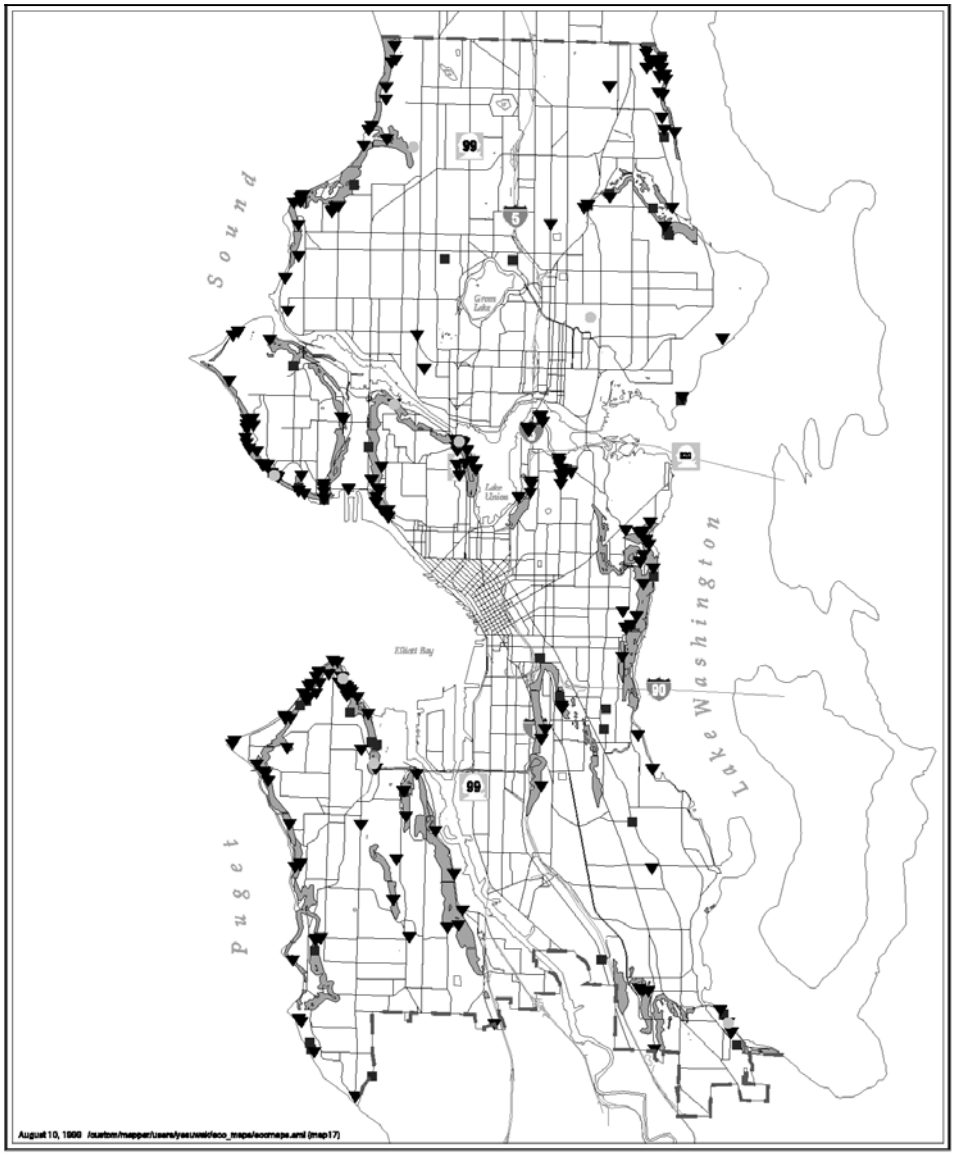
The choice of any mitigation approach should be based on a thorough investigation of each site in order to evaluate all pertinent characteristics of a specific landslide. Three basic strategies are available, the specific characteristics of which are determined by a geotechnical engineer:

- avoidance (creation of buffers)
- diversion of debris
- landslide/slope stabilization

Avoidance

Mitigation by avoidance involves designation of landslide hazard area buffers and building setbacks or, in more extreme cases, may involve the total restriction of use or occupation within the hazard area. Buffer placement and width should be determined based on the mechanism of the landslide type, physical characteristics at the top of the slide, the speed of the event, and the distance of landslide runout (deposition zone). All of these factors must be based on a geotechnical analysis. In general, the width of a buffer should be widest where the potential for damage is greatest; this is typically greater at the top and toe. Buffer zones should be established for individual sites, and must adequately consider head scarp retreat (the up- or in-slope recession of the slope face) and the distance that the slide debris may runout (travel from the base of the slide).

Figure 3-3 City of Seattle – Location of Landslides



Potential Slide Areas
Landslide in 1996
Landslide in 1997
Landslide in 1998
City Limit Boundary

Source: City of Seattle GIS

Diversion

Mitigation by diversion of the landslide debris involves redirecting the debris from its runout path to avoid damage. Diversion structures vary in size and components may include earth dams, timber barriers, and structural walls. Structure design will depend on landslide type, size, and the extent and nature of debris runout. In general, the debris of small to medium volume rock falls, topples, and channelized flows are most successfully diverted. Diverting large or very large debris volume requires bigger diversion structures and correspondingly greater, and potentially prohibitive, costs.

A retaining wall restores a roadway damaged by embankment and hillside slope failure.

Source: GeoEngineers

Stabilization

Mitigation by stabilization of a landslide or an unstable slope area may involve any one or more of three strategies: drainage control, regrading of the hazard area, and mechanically restraining slope movement. The landslide size and failure mechanism and the occurrence of surface water and/or ground water seepage at the site will determine the choice of mitigation strategy.

Drainage control includes the conveyance of surface and shallow ground water away from the site. Methods include surface ditches, horizontal drains, curtain drains, and dewatering wells. The purpose of drainage control is to increase the stability of the slope by reducing the amount of surface and ground water within the slope area.

Regrading unstable slope and landslide hazard areas involves removing soil from the slope in order to reduce the weight of the slide mass and lower slope gradient, both of which will increase slope stability.

Fill failure results in extensive property losses.

Source: FEMA

Methods of mechanically restraining slope movement include: vegetation of slope surfaces, wire mesh slope screen, shotcrete surfaces, rock bolts and anchors, and retaining walls. Revegetating unstable slopes or landslide scarps can improve the stability of slopes and is most successful when applied to surface erosion that can lead to debris flows. Wire mesh screen may be used to reduce the bounce height of falling rocks. Shotcrete and rock bolts and anchors are typically used to stabilize the slope and reduce the occurrence of loose rock fall. Retaining walls include gabion walls, rock buttress walls, soil nail walls, and soldier pile walls. They are used to mechanically stabilize or restrain slope movement. The size and depth of the landslide feature will determine the size of the wall and, correspondingly, the cost. The cost of stabilizing very large unstable slopes or landslides may be prohibitive.

Table 3-3 summarizes the appropriate mitigation techniques for each landslide type.

Table 3-3 Mitigation Techniques By Landslide Type

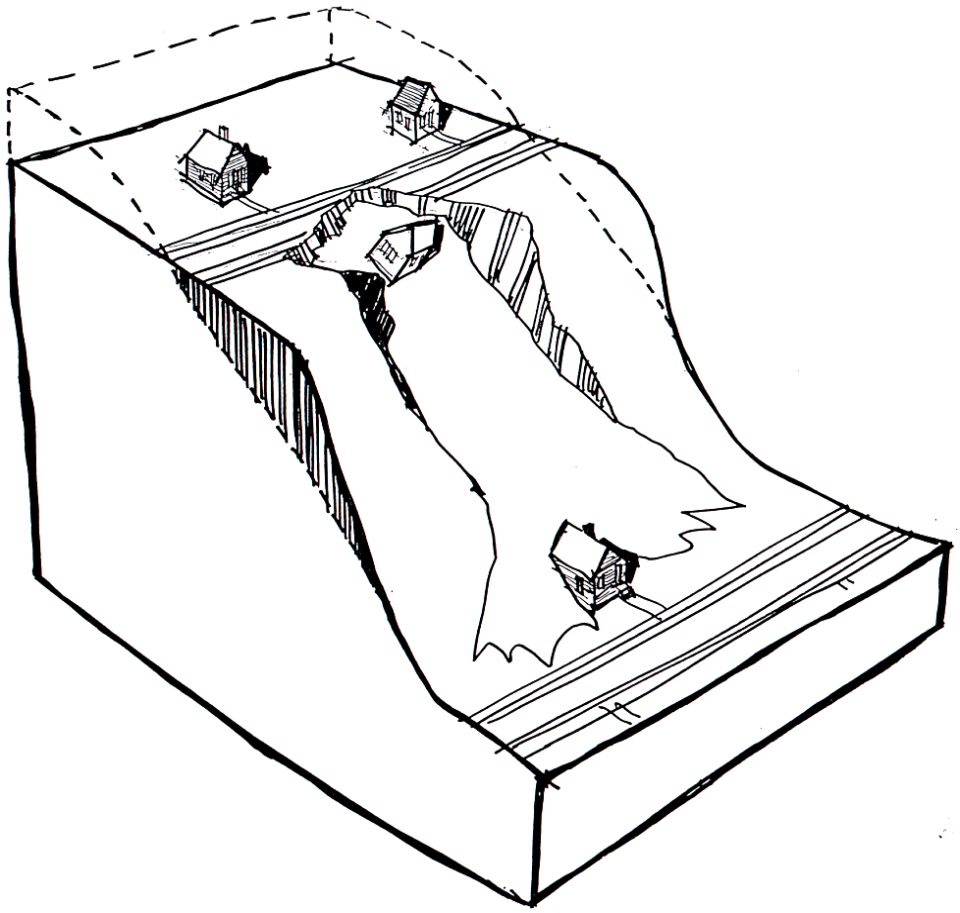
	Slide Type										
Material Type:	Fall	Topple		Rock Avalanche	Rotational		Translational		Lateral Spreads		Channel-ized Flows
Mitigation Type:	Rock	Rock	Soil	Rock	Rock	Soil	Rock	Soil	Rock	Soil	Soil
Avoidance	●	●	●	●	●	●	●	●	●	●	●
Diversion											
Divert runout	●	●	●	●					●	●	●
Divert small flow											●
Stabilization											
Drainage Control					●	●	●	●	●	●	●
Regrade					●	●	●	●	●	●	
Slope Restraint:											
Slope Screen	●	●	●								
Rock bolts - Anchors	●	●		●							
Shotcrete	●										
Retaining Walls		●	●	●	●	●	●	●	●	●	
Vegetation											●

Finally, three typical problems which are encountered in the state have been identified and are described below, along with potential mitigation techniques for each:

Case I: *Fill Failure Rotational slide*

Typical development in the 1940s and 1950s included grading the top of a slope to make a level building site and depositing the excavated material down slope. The sidecast fill was not compacted. When saturated, such fill tends to fail, that is, the fill material slips off the site.

Case Study I - Fill Failure



Source: GeoEngineers and URR

Mitigation:

- Geotechnical studies to define the soil underneath the surface.
- Since slope tops recede, property owners should not build to the edge of the slope. A buffer zone should be established from edge of slope to protect both structures and slope integrity. The recommended dimensions of the buffer zone should be determined by the geotechnical analysis.
- Saturation of unconsolidated material is a principal cause of failure. Water should be routed away from unconsolidated and potentially hazardous soils by an adequate drainage system.

***Case II**: Rotational slide*

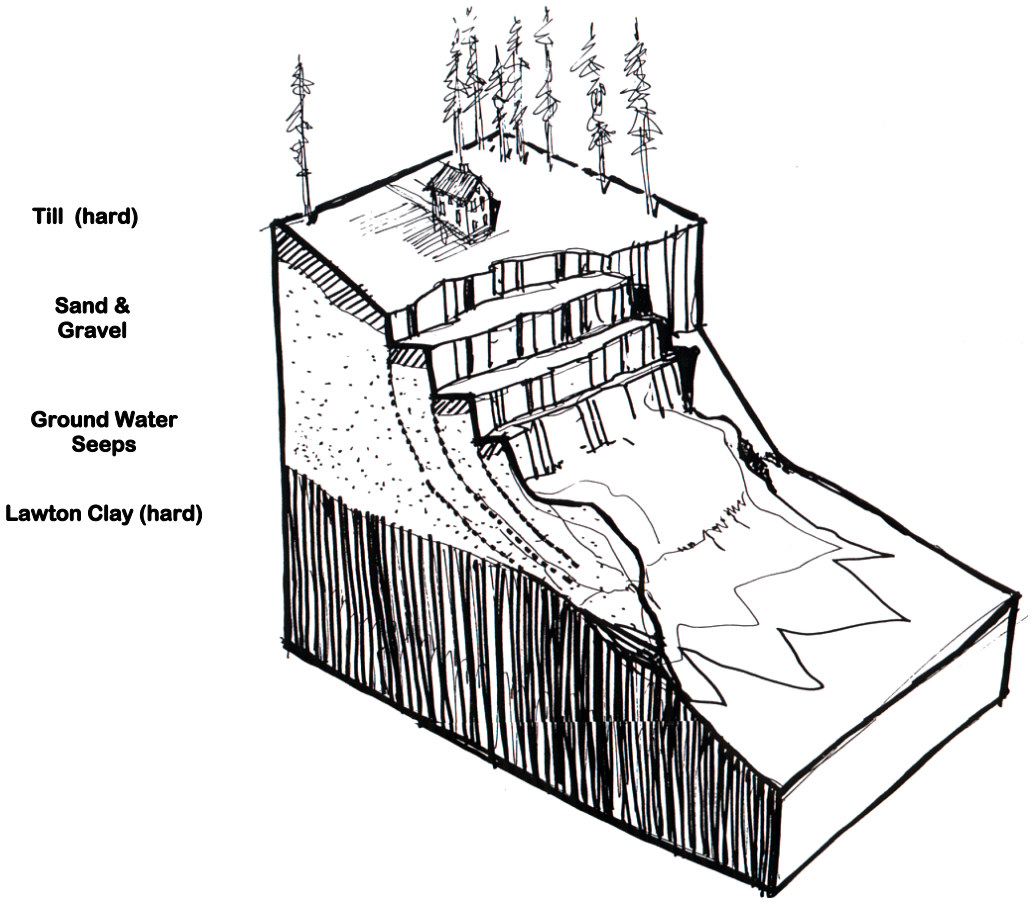
Utilities may be damaged by rotational slides and debris flows. Debris flows particularly take out transportation facilities. Typical sites, such as in the Puget Lowlands, which are vulnerable to rotational slides and debris flow, are characterized by multiple layers consisting of:

Layer 1: Till (sand, gravel, and silt that are very hard and have low permeability)

Layer 2: Sand and gravel outwash (which has high permeability – water fills the pore spaces)

Layer 3: Clay (which has low permeability)

Case Study II – Rotational Slide



Source: GeoEngineers and URR

Water cannot permeate Layer 3 soils and accumulates, creating perched ground water. When the accumulation is near the slope face, an unstable slope may result.

Mitigation:

- Use a geotechical study to identify unstable slope area and mitigation strategies.
- Define development setbacks based on geotechnical analysis.
- Require drainage control.

WILDFIRES

Overview of the Hazard

The 1991 fire storm in Spokane County and the 1995 fires in Chelan County vividly demonstrated that Washington, like Oakland and Southern California, is vulnerable to disastrous fires. But such disasters are not a new occurrence. Large, destructive fires have been recorded as far back as 1902 and all portions of the state experienced natural wildfires prior to the arrival our modern cultures. In the period 1970-1994, more than 400,000 acres burned, resulting in fatalities and loss of homes, other property, and crops. According to records kept by the Department of Natural Resources (DNR) 30 of Washington's 39 counties have a high or extreme risk of wildfire danger, making fire a truly statewide hazard.

Dangerous wildfires occur throughout much of the state.

Source: Jack Shambo, Washington DNR

Historically, wildfires were generally started by lightning strikes. The vast majority of fires today (approximately 85 percent on DNR-protected lands) can be attributed to human causes. While most of these are accidental, arson fires do pose a significant risk. Figure 3-4 presents a breakdown of fire causes on DNR-protected lands (12 million acres of forested lands in Western, Central, and Northeastern Washington). The *Miscellaneous* fire cause category in this table includes fires caused by: burning buildings, vehicles, and materials from automobiles (non-smoking related); fireworks; electric fences and power lines; spontaneous combustion (excluding sawdust); sparks from automobile exhaust, cutting torches, and welders; land clearing equipment; and all other causes.

The most expensive wildfires occur in locations on the edges of communities. This zone, the urban-wildland interface, may be defined in either of two ways:

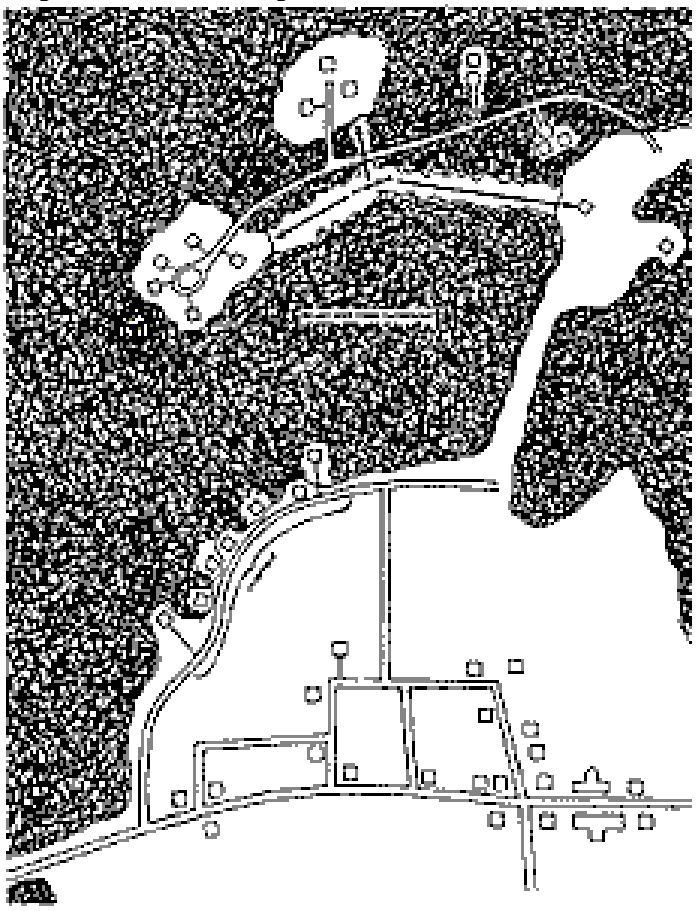
- *From an urban planning/design perspective:* The region on the fringe of urban development where structures occur in a primarily undeveloped landscape.
- *From a fire management perspective:* Any area where potentially dangerous combustible fuels are found adjacent to combustible homes and other structures.

Figure 3-4 Fires on Washington Department of Natural Resources Protected Lands, by Cause

The urban-wildland interface may be distinguished from rural development by the wild or unmanaged quality of the landscape and the fire danger posed by that landscape. Figure 3-5 illustrates the concept of structures mingling with the combustible landscape that characterizes the interface.

Figure 3-5 Structures at the Urban-Wildland Interface

Structures and vegetation intermingle in the interface creating a dangerous mix of fuel and ignition sources.



Source: Firewise

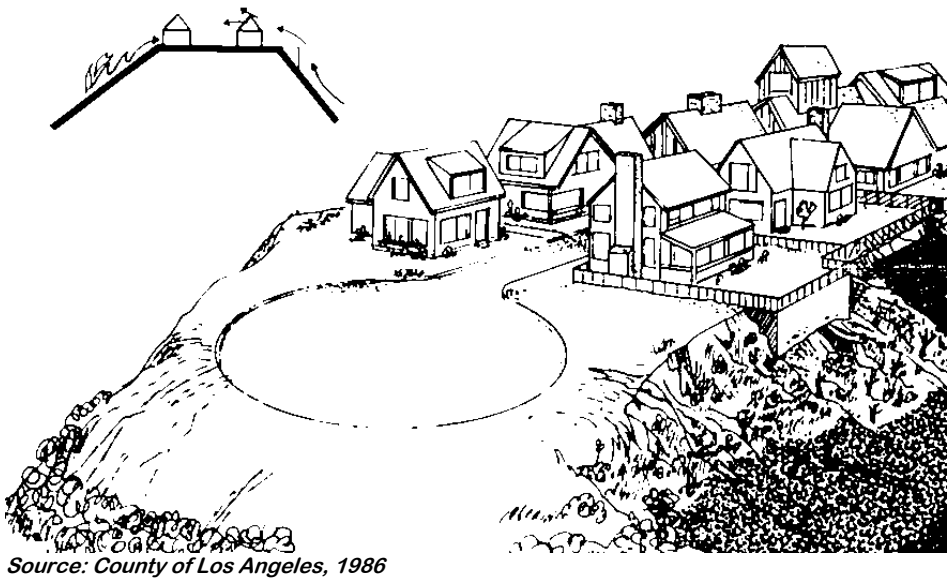
In recent years, growing numbers of formerly urban residents have been drawn to interface areas by scenic beauty, inexpensive land, and relief from urban stress. As the population has shifted to the urban-wildland interface, an increasing number of homes are being lost to wildfires, and this trend is expected to continue. Development in these areas not only places structures in the path of existing fire patterns – it also adds numerous potential sources of ignition and complicates the fire control mission. Wildfire suppression costs are escalating as suppression strategies change to protect homes.

An additional significant problem is the limits placed on infrastructure (e.g., access roads and water services) and staffing resources in fringe communities by their small tax bases. Fringe areas, especially those undergoing rapid growth, tend to be under-served by fire protection. Such communities may also have a more difficult time recovering from fire disasters. According to DNR, 80 percent of communities in the state are served by volunteer fire-fighting forces.

Understanding the Hazard

Wildfires result from the interaction of the elements of the fire triangle: fuel, flame, and oxygen. A fire requires all three of these elements to begin and sustain itself. Fuel in a wildland setting is typically vegetation; the type and amount of fuel available and consumed controls the intensity of the fire. The various fuels that occur on a site are referred to as the fuel load. The initial flame may be supplied by lightning or human causes (see Figure 3-6). Oxygen is rarely a limiting factor in wildfires, but a fire's dependence on it does control its behavior, leading to a generally wind-driven and upslope burn pattern.

Structures on narrow ridges are especially vulnerable to fire.



Source: County of Los Angeles, 1986

Wildfire spread is controlled by fuel, weather, and topography. A dry and hot weather pattern or climate can contribute to fire outbreak by increasing the combustibility of fuels. Strong winds can propel the fire quickly across the landscape; gusty, shifty winds can lead to erratic fire behavior that make the fire management and control tasks much more dangerous. Fires will in general burn upslope towards ridge tops in hilly or mountainous areas (although strong winds can alter this). Narrow canyons are especially efficient fire conveyors as they create a chimney-effect to carry the fire forward.

Wildland fires occur in three main forms – as understory fires, crown fires, and ground fires. In general, wildland fires under natural conditions burn at relatively low intensities, consuming grasses and other herbaceous plants, woody shrubs, and dead trees. Such understory fires are natural occurrences in many environments and often play an important role in plant reproduction and wildlife habitat renewal. Left to themselves, these fires will burn themselves out when the fuel

load is depleted or they are doused by rain or snow. Crown fires, where whole living trees are consumed, are less frequent but considerably more destructive. These are typically what is pictured when people think of large, disastrous fires. In areas with high concentrations of organic material in the soils, ground fires may burn in this material, sometimes persisting for long periods out of sight until a surface fire is ignited. As is often the case with natural phenonenom, most fires will exhibit some combination of these characteristics rather than falling neatly into a category.

Wildfires may spawn secondary hazards, such as flash flooding and landsliding, long after they have been extinguished. Vegetation provides a number of physical functions which contribute to the hydrologic and slope stability regimes of an area. When this vegetation is consumed in high intensity wildfire, resulting changes may include decreased rainfall interception and infiltration; faster concentration times and greater volume of peak flows; increased volume and velocity of overland runoff; and loss of reinforcing deep roots. The intense temperatures of wildfire may also cause chemical changes in the soil, resulting in hydrologic changes similar to those described above.

Successful prevention of wildfires depends on the control and elimination of one or more of the elements of the fire triangle. Before a fire begins, the fuel load can be managed through either controlled, intentionally set fires (referred to as prescribed burns) or manual or mechanical harvesting. Breaks in the vegetative cover (fire breaks) are often constructed on ridge tops, as fires will tend to burn upslope. Control of ignition sources can also be effective prevention through restriction of hazardous activities during high-risk periods.

Once the fire is underway, there are limited options for the control and suppression of the blaze. Obviously, nothing can be done to change the weather or topography of the fire site. Control and suppression of burning fires must be accomplished through removal of the fuel load (as above, including the intentional use of small, low-intensity fires to consume fuel) and suffocation (elimination of oxygen) by application of water and suppression chemicals.

In urban settings, fire fighters generally deal with structural fires which are fought directly with water readily available from fire mains and hydrants. Rapid response is a key element in extinguishing fire while it is still manageable. In wildland settings, fire fighters use more indirect techniques to contain the fire within a perimeter and deprive it of fuel. Multiple fire fighting organizations or agencies may be involved, requiring a high level of communication and coordination of resources.

Urban-wildland interface fires offer a mix of conditions that are not wholly suited for either technique. Although structures are often involved, an urban-level of water and staff resources is rarely available, especially when multiple structures are threatened. Even if sufficient resources are present, rapid response is often compromised by the distances and qualities of roads available in the area. In addition, wildland techniques, which require the sacrifice of some areas for strategic gain, are not suited to preserving structures scattered throughout the fire zone. Fire managers may find themselves with difficult choices between saving structures or large tracts and their natural resources. The situation may also be complicated by residents who are unfamiliar with the level of

fire protection available. They assume that the urban standards with which they are familiar apply, and fail to take adequate precautions (such as storing water on site and clearing a defensible space around their home). When limited resources are challenged by high-intensity fire storms, they are easily overwhelmed, resulting in evacuations and loss of property.

Historically, wildfire management has meant immediate fire suppression. When wildland fire control and prevention are successful, the risk of dangerous, high-intensity fires can actually increase as fuel loads build. These high-intensity fires take on an entirely different character than their low-intensity cousins, consuming all vegetation in their paths and erupting as fire storms. Such conflagrations are driven by winds that they produce and can move quickly and erratically. It may not be possible to stop them once they begin, and it may be impossible or foolhardy to try to save structures that lie in their paths; winter rains and snow might provide the only viable suppression technique. Unfortunately, large fuel loads are often associated with the fringes of the urbanizing areas due to historical suppression efforts setting the stage for high-intensity interface fires. To avoid the possibility of these high-intensity fires, land managers and oversight agencies practice and promote vegetation management techniques that maintain the fuel load at an appropriate, controllable level.

Interface fires combine the worse characteristics of both urban and wildland fires and make structure preservation difficult and potentially dangerous.

Source: Washington DNR

Adequate defensible space plays a vital role in saving structures.

Source: URR

Planning and Mitigation

☑ *Understanding of How Fires Start and Behave Provides the Basis for Fire Prediction, Avoidance, and Mitigation*

As with floods and landslides, an understanding of the factors which control fire ignition and behavior forms the basis for fire prediction, avoidance, and mitigation. Hazard reduction planning for fires requires:

- identification of the current hazard (characterization of fuel loads, topography, and meteorological patterns);
- modeling of potential future hazards (based on forecasted or planned development or other types of land conversion, vegetation management plans and practices, and long-term meteorological forecasts);
- identification of areas, structures, and people at risk from these hazards and the likelihood and severity of such risk; and
- identification of resources available for fire response and recovery and documentation of shortfalls in these resources.

These steps will give the community a sense of the nature of the problem and offer options for how they may address it. Documentation of the current situation, especially in terms of foreseeable future damages, will be helpful in pursuing outside assistance. After this process is complete, goals and implementation strategies may be developed as described in Chapter 4.

Fire hazard mitigation may involve fireproofing, control of ignition, and facilitation of response. Each of these approaches is explored in greater detail below (Table 3-4). DNR has resources available to help with risk assessment and mitigation planning. Additional details and further ideas for hazard reduction may be obtained from DNR or the *Firewise* website (*www.firewise.org*) sponsored by the National Fire Protection Association, the National Association of State Foresters, and various federal agencies. Also, a model Urban-Wildland Interface Code, prepared by the International Fire Code Institute and available from the International Conference of Building Officials, may help.

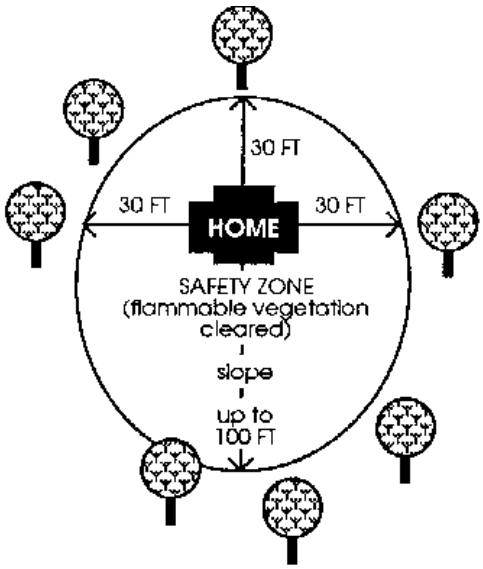
Table 3-4 Fire Hazard Mitigation Approaches

Approach	Techniques
Fireproofing Development	
Building Material and Location Restrictions	• Require Class B or better roofing materials. • Enforce general fire-resistant building design criteria (e.g., limited window surface and fire-resistant materials). • Set back structures on hill and ridge tops at least 30 feet from edge of slope (steep slopes require 100-foot or larger setbacks).

Table 3-4 Fire Hazard Mitigation Approaches	
Approach	**Techniques**
Building Material and Location Restrictions (continued)	• Provide adequate access roads and ensure that gates can be opened by emergency crews and negotiated by fire apparatus if necessary. • Implement fire flow requirement reduction incentives for fireproof development
Landscaping Maintenance Programs	• Maintain a cleared zone/defensible space (low, irrigated ground covers or inflammable materials only) of 30 feet around structures (steep slopes require 100 feet or larger zone). Prune and carefully space any trees (especially around chimneys). • Maintain a buffer of low, fire-resistant plants gently transitioning into well-spaced trees and the natural landscape beyond the cleared zone. Use selective thinning in the natural zone to maintain an appropriate fuel load. • Avoid ladder fuel situations where a continuous ramp from ground cover to tree crown is provided. • Use fire-resistant design elements such as driveways, walkways, and lawns as fuel breaks. • Maintain the landscape (e.g., remove leaf clutter and mow regularly). • Maintain natural or reduced fuel load through harvest or controlled burns. • Maintain cleared paths in vegetation (fire breaks), generally on ridgetops and in defensible locations. • Properly store and dispose of flammable materials
Property Owner/Occupant Education	• Educate the public about building material and location and landscaping concerns. • Implement a real estate disclosure program to ensure that new property owners are aware of the hazard and the availability of response resources.
Controlling Ignitions	
Activity Restrictions for High Risk Periods	• Educate the public about fire concerns and the necessities of activity restrictions.
Building Material Restrictions	• Adopt and enforce building codes that implement fire-safe building techniques (e.g., ¼-inch mesh screen on chimneys and fireproof roofing materials to avoid spread from structural fires). • Educate the public about fire concerns and appropriate preventative measures.

Table 3-4 Fire Hazard Mitigation Approaches	
Approach	**Techniques**
Facilitating Response	
Fire Equipment Access/Egress	• Ensure appropriate road width, slope, and surface for fire equipment. Maintain these roads free from obstructions (including parked vehicles). • Provide a pattern of connected streets or turnarounds on dead-end streets. • Make sure that all bridges are rated to a sufficient load for responding fire equipment. • Maintain a cleared zone/defensible space (low, irrigated ground covers or inflammable materials only) of 30' around structures (steep slopes require larger zone). Prune any overhanging trees.
Land Use Restrictions for High Risk Areas	• Cluster development where possible to facilitate response and ensure that common open space is accessible and useable by fire apparatus.
Water Supply Requirements	• Develop fire flow requirements that reflect the area and building type characteristics. • Ensure proper water quantity and pressure for anticipated fire flow requirements. Implement these requirements through development restrictions or concurrency provisions in the comprehensive plan. • Consider options for providing sufficient water or decreasing fire flow requirements (e.g., tanker delivery, automatic sprinkler systems, non-combustible roof materials, and increased defensible space).
Coordinated Response	• Develop mutual assistance agreement and coordinated response plans with adjacent communities which address reliable access routes and compatibly of equipment (e.g., hose sizes and manifolds).

Figure 3-6 Residential Fire Safety Zone



Source: Washington DNR

CHAPTER 4: THE POLICY FRAMEWORK: LINKING GOALS TO PLANNING STRATEGIES

The results are easily predictable. When it rains hard cries for help come over the stinking water. Federal, state, county, and local governments are supposed to rally round and move people out, provide credit, dig drainage ditches, throw up dams, install storm and sanitary sewers, man the pumps, patrol the area to protect against looting, fix the roads, and clean up the mess. After things have settled down a little, the demand mounts for multi-million dollar flood control projects on a grand scale.

Sooner or later we will ask ourselves the question: "Why should we go on subsidizing people who persist in building on floodplains?"

If we aren't moved by humanitarian consideration - retirees investing life savings in waterfront homes where the waterfront turns out to come above the furniture, kids exposed to typhoid, wage earners learning how liquid their assets really are - we should consider this: Something we could stop is adding to the rate at which our taxes are going up! There's an argument which ought to get action!

Planning Cities, Fred Bair, 1970

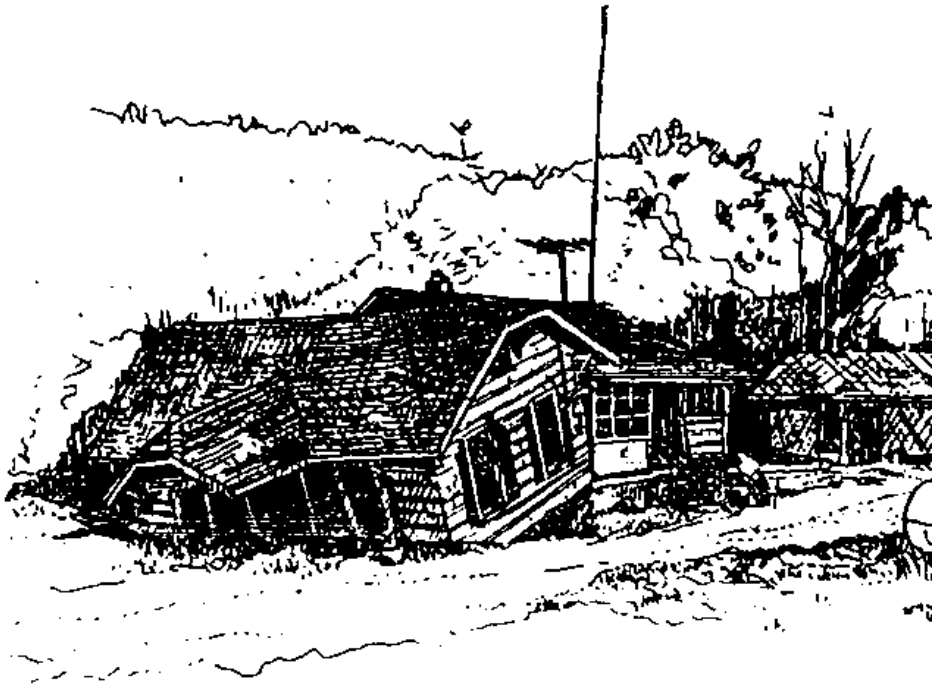
INTRODUCTION

Planning under the Growth Management Act (GMA) is directed by Chapter 36.70A RCW and the Procedural Criteria for Adopting Comprehensive Plans and Development Regulations (WAC 365-195). The Minimum Guidelines to Classify Agriculture, Mineral Lands, and Critical Areas (WAC 365-190) are also instrumental in GMA planning. Other related parts of the planning framework include the Shoreline Management Act rules and guidelines which are now being revised to provide for the integration of master programs and comprehensive plans.

The Procedural Criteria are based on the GMA and speak to the act's requirements including preparation of the mandatory plan elements. Since the GMA varies considerably in the level of detail required of different elements, the criteria are similarly varied (transportation requirements are much more detailed than housing, for example). The criteria include both requirements and recommendations for the preparation of elements, as well as procedural requirements.

Comprehensive plans contain a mix of vision statements, goals, policies, objectives, principles, actions, strategies, analyses, and maps. New optional elements should be framed to be as consistent as possible with other elements in format and substance.

Many hazards are interactive – swiftly flowing floodwaters undermined the foundation of this house and moved its fuel tank.



Source: URR

This chapter describes some methods that can be used to examine and revise comprehensive plan policies, with a new focus on addressing hazard concerns within the plan, while respecting its existing character. This task will be challenging, given the technical and scientific nature of much hazard information.

HAZARD REDUCTION PLANNING AND INTEGRATION WITH THE GMA PLANNING PROCESS

The process of integrating hazard reduction into the overall comprehensive plan runs parallel to the planning process. Planning is an ongoing process that allows and encourages incorporation of new information to update and amend planning decisions. Hazard reduction planning provides new information for consideration, consisting of the following four parts, which are described in this section:

- Hazard Assessment
- Vulnerability Assessment
- Identification of Hazard Reduction Goals
- Implementation

Hazard Assessment

The basic questions to be addressed in the hazard assessment phase are:

Question	Data Necessary to Answer Question	Process
What is happening?	• Define the type of hazard • Define magnitude and characteristics of the problem	*Hazard Analysis (Critical Areas Designation)*
Where?	• Location of the problems	
Why?	• What is creating or contributing to the problem	

The first step in hazard mitigation is to define the presence and characteristics of the hazard. Only when the hazard is known can appropriate hazard reduction measures be identified. To a significant extent, the broad outlines of the hazards should have already been defined in conjunction with designations of critical areas. Recent hazard events have, in all probability, shed light on new characteristics and/or have highlighted the importance of these areas. This hazard assessment phase will verify existing data for specific areas possessing a high probability of problems, such as steep slopes and floodplains. The analysis will identify areas within the community that have a higher probability of specific hazards, for example, landslides or floods. The analysis also will identify those portions of the community where the probability of such hazards occurring could be low.

Methodology and Resources Needed

☑ *Local History and Knowledge Are Invaluable in the Hazard Assessment Process*

Previous local disaster history can be an invaluable tool for framing the hazard assessment. This history indicates the nature of the hazard-prone character of the landscape. It shows where attention should be focused. It may also show good and bad examples of preparation. And, it may provide good source material for illustrating issues, concepts, and solutions. So, before you go further in developing your Natural Hazard Reduction Element, you should tap sources such as the media, libraries, emergency response agencies, and your own citizens to find out what you can about your community and its natural hazard experience. The most important source of information is the public. Develop base maps and a questionnaire for volunteers to record information that can indicate risk areas and past hazard events, such as leaning trees and watermarks on buildings and trees.

Members of your community can help document historic events.

Source: FEMA

Completion of the following checklist will be your first step in documenting whether you have had experience with flooding, landslides, and wildfire hazards (Figure 4-1). Where you are able to document that your community has experienced the type of hazard cited, additional data should be collected to determine where the event happened, determine its extent and impact, and provide a general and detailed description.

Figure 4-1 Hazard Assessment Checklist	
Type of Hazard Experienced	**Past Occurrences**
Flooding	
Out-of-stream flooding at depths to cause damage	
Damage due to failure of man-made flood control works	
Damage due to high tides or storm waves	
Damage from standing water/high groundwater tables and saturated soils	
Damage due to high velocity flows	
Other floods	

Figure 4-1 Hazard Assessment Checklist	
Type of Hazard Experienced	**Past Occurrences**
Landslides	
Coastal or river bluffs prone to soil topples or soil or rock falls or avalanches	
Fill embankments, glacial and fluvial terraces, undercut steep bluffs prone to rotational slides	
Moderate to steep slopes with colluvium or alluvium overlaying consisting of multilayers over clay prone to debris flows	
Other landslides	
Wildfire	
Rural or interface homes and other structures destroyed by fire	
Wildfires in areas that did, or now do, contain homes and other structures	
Wildfires that required outside assistance for control and suppression	

For each of the past occurrences that are recorded, the following characteristics about the hazard event should be identified and analyzed. This information will enable you to begin to develop a spatial understanding of local hazard history and the potential for it to repeat itself.

Figure 4-2 Characteristics of Historic Hazard Occurrences	
Characteristic	**Purpose of Information**
Location of each event (in general and in relation to critical areas)	Identify geographic hazard patterns; evaluate critical area designations
Timing of each event	Establish frequency of events
Amount of impacts (flood crest, duration, etc.; landslide types, cubic yards, etc., wildfire acres, structures lost, etc.)	Evaluate magnitude of event and correlate with other event conditions
Description	Identify the general properties of the hazard event

Vulnerability Assessment

☑ *Define Your Hazard Exposure*

The basic questions to be addressed during the vulnerability assessment pertain to your community's exposure, historic and future, hazard events:

Question	Data Necessary to Answer Question	Process
Who - What is impacted?	• Number (exposed population profile: number, age, and density) • Facilities exposed to the hazard (housing, utilities, essential public facilities, etc.)	*Hazard Analysis (critical areas designation) correlated with comprehensive plan data*

This phase defines the various activities which are vulnerable (susceptible) to damage and disruption during a hazard event. Once the location of potential hazards is identified in the hazard assessment, it becomes possible to relate that information to the functional elements of the comprehensive plan, such as land use, housing, capital and essential public facilities, transportation networks, etc. The correlation of hazards with these functional elements defines the vulnerability. All functional elements should be reviewed for potential vulnerability.

The following is provided to assist in your vulnerability assessment analysis.

Patterns of **Land Use** can be correlated with susceptibility to natural hazards. These correlations must define the specific characteristics of each use, such as demographics (e.g., low-income or elderly housing) and intensity of use (e.g., residential density, agricultural, or industrial). Furthermore, the implications of hazard damage and/or disruption would also be evaluated. In addition to direct losses, secondary impacts should be identified. Including economic losses and disruptions, as well as the implications of losing certain land use functions, such as agricultural production.

Land Use Element			
	Flooding	**Landslide**	**Wildfire**
Residential (for different densities)			
Agriculture			
Industrial			
Tourist/Second Home			
Other			

Vulnerability identifies not only the location of **Housing**, but also the characteristics, such as demographic profile and presence of low-income housing. Condition of the housing and whether it complies with current codes are noted. The condition analysis would also inventory whether structures in the floodplain are anchored or elevated, whether houses in wildfire susceptible areas are surrounded by defensible space, etc. The type of structure, such as manufactured housing, should be identified.

Housing Element			
	Flooding	**Landslide**	**Wildfire**
Single Family			
Low Income			
Multifamily			
Manufactured			

Damage to **Capital Facilities** not only is costly to the taxpayer, but the interruption of functions (e.g., city hall or city garage) is extremely disruptive during emergency conditions when public efficiency is most needed.

Capital Facilities Element			
	Flooding	**Landslide**	**Wildfire**
Fire Station			
Police Station			
Schools and Shelters			
Medical Facilities (hospitals, clinics, nursing homes)			

Roadway alignments and rights of ways of **Transportation Facilities** are defined in relation to susceptibility to flooding and landsliding. Secondary impacts of vulnerability are also defined in terms of redundancy and the availability of alternate routes. In hazard events, road systems are critical for occupants and responders, e.g., in fire fighting. Finally, when alternate routes are used it is important to define the standards to which those routes were constructed, and whether they are vulnerable to damage from the heavy use they will be subjected to during the disaster and the period of time they serve as alternate or detour routes.

Transportation Element			
	Flooding	**Landslide**	**Wildfire**
Surface Roads			
Arterials			
Bridges			
Rail			
Airport			

Utilities such as water, sewer, and electricity are frequently disrupted by floods, landslides, and wildfires. Furthermore, disruption to one utility generally impacts others (e.g., disruption of electricity disables pumping capability which could have been used to reduce flooding; or combined storm and sanitary sewer become overburdened by flood conditions, thereby resulting in health hazards).

Utilities Element			
	Flooding	**Landslide**	**Wildfire**
Existing and Proposed Locations			
Capacities of Existing and Proposed Utilities			

On one hand, **Rural Lands** can be vulnerable to disruption, but on the other hand, they can be valuable flood storage areas. Their respective roles must be identified.

Rural Element (County Plans)			
	Flooding	**Landslide**	**Wildfire**
Rural Land Designation			
Rural Development Densities			

Delineation of lands for **Urban Growth** should consider vulnerability to flooding, landslide, and wildfire. The most vulnerable lands should be reserved in rural land uses which require less protection and would result in less damage to human habitation. Boundaries should also consider creation of buffers to human habitation. If lands vulnerable to flooding, landslides, and wildfires are already in an incorporated area or an urbanized area considered suitable for UGA designation, these areas could be considered for open space designation or lower urban densities.

Urban Growth Areas			
	Flooding	**Landslide**	**Wildfire**
Designation of UGAs			
Designation of open space and greenbelt areas within UGAs			

The greatest demands on **Essential Public Facilities** occur during disasters. Not only the vulnerability of these structures, but the access to such structures, must be delineated. Their respective roles in response must be identified.

Siting Essential Public Facilities			
	Flooding	**Landslide**	**Wildfire**
Process for Identifying and Siting			

In addition to their function as productive lands of long-term commercial significance, the role of **Resource Lands** in reducing vulnerability should be considered (e.g., the role of these lands in reducing erosion and runoff).

Designation Of Resource Lands			
	Flooding	**Landslide**	**Wildfire**
Agricultural Lands			
Forest Lands			
Mineral Resource Lands			

Critical Areas can contribute to an area's hazard potential through steep slopes and frequently flooded areas, but these areas can also lessen the impacts of hazards through such features as wetlands that can serve as water detention areas.

Designation of Critical Areas			
	Flooding	**Landslide**	**Wildfire**
Wetlands			
Aquifer Recharge Areas			
Fish and Wildlife Habitat Conservation Areas			
Frequently Flooded Areas			
Geologically Hazardous Areas			

IDENTIFICATION OF HAZARD REDUCTION GOALS

Based on the vulnerabilities identified, it is now possible to characterize the nature of hazard issues in the community and to develop hazard-related goals to be addressed through each of the comprehensive plan's functional elements. When disaster strikes, every aspect of the community is impacted because the various elements (e.g., housing, land use, transportation, etc.) are functionally interwoven and directly influenced by what happens to the other. To reduce the hazard's impacts on the community it is necessary to address hazard reduction issues in all the functional elements of the overall plan. Hazard reduction goals must be specific and couched in terms that can be applied in each plan element. In some cases, goals can be multi-objective because they can address GMA goals and hazard reduction, as shown in the following example:

GMA Goal	Hazard Reduction Goal
Open space	Surface water detention Fire breaks
Vegetation Management	Wind and storm wave buffer Bank stabilization

The following discussion identifies the procedural criteria for GMA comprehensive plan functional elements and suggests hazard reduction goals that correlate with these criteria for each of the plan elements. Since the hazard and vulnerability assessments you perform will identify the circumstances unique to your community, it is important that you tailor your Natural Hazard Reduction Element's goals to the needs identified. To assist in this, you should conduct public meetings to solicit input on appropriate hazard goals.

☑ *Conduct Public Meetings to Define Goals*

Land Use goals are based on a careful inventory of problems and opportunities. Problems include removal of vegetation, point and nonpoint pollution, and uses which generate debris or contribute to sedimentation. Goals identified to rectify those problems provide opportunities to address hazard concerns.

Land Use Element	
GMA Criteria	**Hazard Reduction Goals**
• Land use designations Residential Commercial Industrial Agricultural Timber Open space Recreation/parks Public facilities	• Minimize residential, industrial, and commercial uses in "harm's way" • Evaluate lands prone to repetitive flooding in relation to open space uses (wetland restoration, recreation, etc.).

Land Use Element (continued)	
GMA Criteria	**Hazard Reduction Goals**
• Storm drainage/water quality	• Ensure that all development can be adequately provided with life safety services (water pressure sufficient for fire fighting) • Provide for comprehensive watershed management and planning • Require new development to control generated runoff • Mitigate increased hazard risk created by development • Adopt a sediment management strategy

The underlying **Housing** goals are to reduce vulnerability by removing or elevating at-risk housing, identifying alternative locations for such housing, and developing strategies to encourage safe housing development.

Housing Element	
GMA Criteria	**Hazard Reduction Goals**
• Existing housing stock inventory • Low cost (including manufactured and mobile homes) • Special needs housing • Identification of land for new housing	• Minimize residences located in designated hazard areas • Identify areas appropriate to accommodate relocated units • Develop programs to acquire high risk homes • Develop programs to retrofit high risk homes

Establish priorities for upgrading or moving **Capital Facilities** that are vulnerable to impacts from flooding, landslides, and wildfire.

Capital Facilities Element	
GMA Criteria	**Hazard Reduction Goals**
• Existing facilities • Facilities to meet future needs and sources of funding • Locations for new facilities, including parks and open space	• Acquire lands which have experienced repetitive flooding • Locate new facilities outside of areas prone to flooding, landslides, and wildfire and maximize water storage attributes of the site plan • Assess impacts of capital facility locations on emergency response capabilities

Transportation planning must establish criteria to maintain access routes through (and to) the community during a disaster. In establishing these routes, priority must be given to facilitating

responses from within the community, as well as from other communities (who are entering the community to provide help). Routes must be of sufficient size to accommodate response vehicles without promoting sprawl in the rural area.

Transportation Element	
GMA Criteria	**Hazard Reduction Goals**
• Existing facilities • Arterials and transit routes • Forecasts of traffic for at least 10 years • Identification of local system needs and funding sources	• Maximize access to disrupted areas (limited to projected need) • Provide for excess traffic during disasters • Identify ways to reduce repetitive damage (flood and landslide)

Resiliency, or minimizing the period of time during which **Utilities** are disrupted, is an important way to maximize response and avoid secondary disruptions to the lives of people impacted by the hazard.

Utilities Element	
GMA Criteria	**Hazard Reduction Goals**
• Existing and proposed locations • Capacities of existing and proposed utilities	• Reduce disruption and maximize reliability • Maximize fire fighting capacity

Since rural development, forestry, and agriculture are allowed in **Rural** areas, goals involve resource management, erosion control, streambank protection, and revegetation, as well as reducing nutrient loading from fertilizers and agricultural runoff.

Rural Element (county plans)	
GMA Criteria	**Hazard Reduction Goals**
• Rural land designation • Rural development densities	• Utilize tools such as agricultural setback easements in flood-prone area to increase flood storage and minimize contamination of streams by livestock • Adopt safe storage polices to minimize contamination by loose barrels, fertilizers, and other products • Utilize timber harvest setbacks in riparian and flood-prone areas to increase flood storage and minimize erosion

The planning area must be identified in relation to uses and activities in the watershed as a whole and the relationship of those activities on the floodplain (and flooding hazards), as well as on the potential for landslides and wildfire. **Urban Growth Area** (UGA) boundaries can be defined to establish the jurisdictional framework to minimize future problems.

Urban Growth Areas	
GMA Criteria	**Hazard Reduction Goals**
• Designation of UGAs	• Review UGA designations in terms of maximizing flood storage and avoiding potentially unstable slopes and flood risk • Review UGA designations in relation to implications for fire response and fuel load

Demand for **Essential Public Facilities** is highest during disasters. Top priority must be given to ensuring that these functions are not prone to being interrupted.

Essential Public Facilities	
GMA Criteria	**Hazard Reduction Goals**
• Process for identifying and siting	• Adopt siting criteria which avoid hazardous areas

Management practices in **Resource Lands** must take into consideration their impacts on hazard generation. This means that natural functions of the floodplain should be preserved through minimizing actions that result in sedimentation and land destabilization, as well as generation of fuel for wildfire.

Designation of Resource Lands	
GMA Criteria	**Hazard Reduction Goals**
• Agricultural lands • Forest lands • Mineral resource lands	• Adopt best management practices which do not contribute to hazards

Designation and Protection of Critical Areas can be important goals to establish prioritization for reestablishing damaged ecosystems.

Designation of Critical Areas	
GMA Criteria	**Hazard Reduction Goals**
• Wetlands • Aquifer recharge areas • Fish and wildlife habitat conservation areas • Frequently flooded areas • Geologically hazardous areas	• Maximize water storage capacities of wetlands • Identify sites which could accommodate water detention • Preserve and supplement wildlife habitat in such a way as to stabilize potentially hazardous sites • Adopt vegetation management programs which will stabilize unstable land and enhance habitats • Adopt vegetation management programs which will enhance habitat and minimize debris generation • Adopt vegetation management programs which will preserve essential habitat and minimize exposure as "fuel" for potential wildfires

IMPLEMENTATION

☑ *Implementation Strategies Should Be Defined to Achieve Goals*

With a clear understanding of the level of hazard avoidance necessary to the local area, cities and counties should define actions or strategies to achieve the goals. These actions and strategies are applied in the implementation of vulnerable area mapping, regulatory codes and standards, and capital investment means. Strategies which can satisfy multiple objectives are important. The focus of this Guidebook is primarily on non-structural measures such as:

- regulatory approaches (zoning, subdivision, grading, and drainage ordinances), and other tools such as vegetation management programs;
- criteria for listing and funding projects in the Capital Improvements Plan and Transportation Improvements Plan as well as the direction of on-going municipal budgeting; and
- non-regulatory approaches such as open space acquisition, conservation easements, or incentive programs.

Reduction of flood and landslide hazards can be achieved through a very wide range of techniques ranging from engineering design standards to the use of prescriptive criteria in evaluating and approving development proposals including:

- avoidance of the problem;
- structural or engineered measures designed to control the problem;
- non-structural measures which rely on land use and vegetation management; or

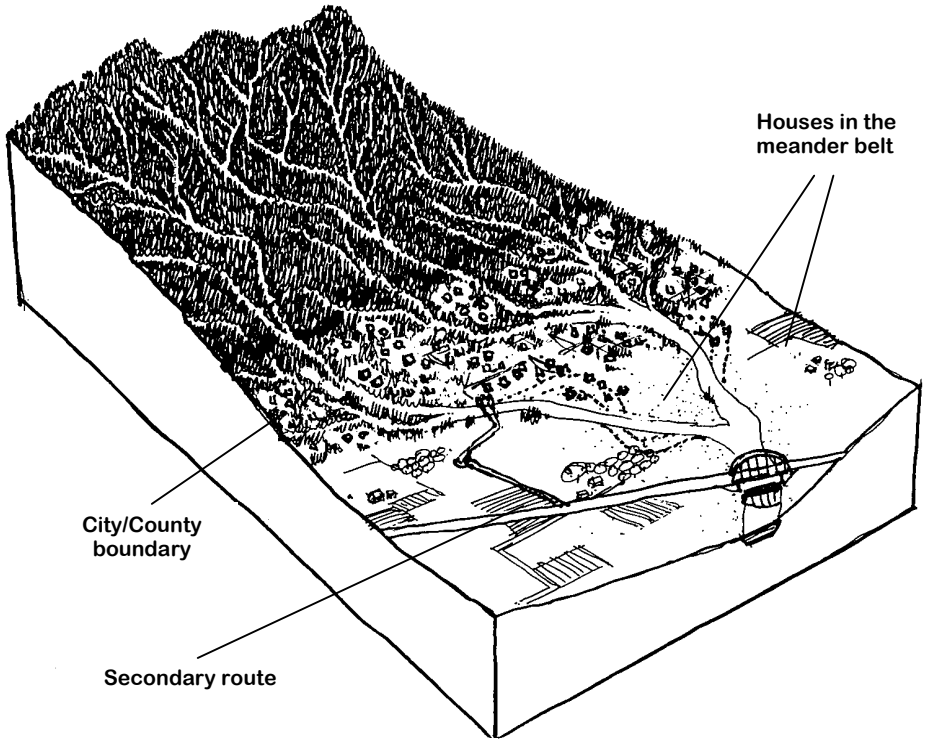
- a combination of approaches.

Tools include:

- **Interjurisdictional Planning**

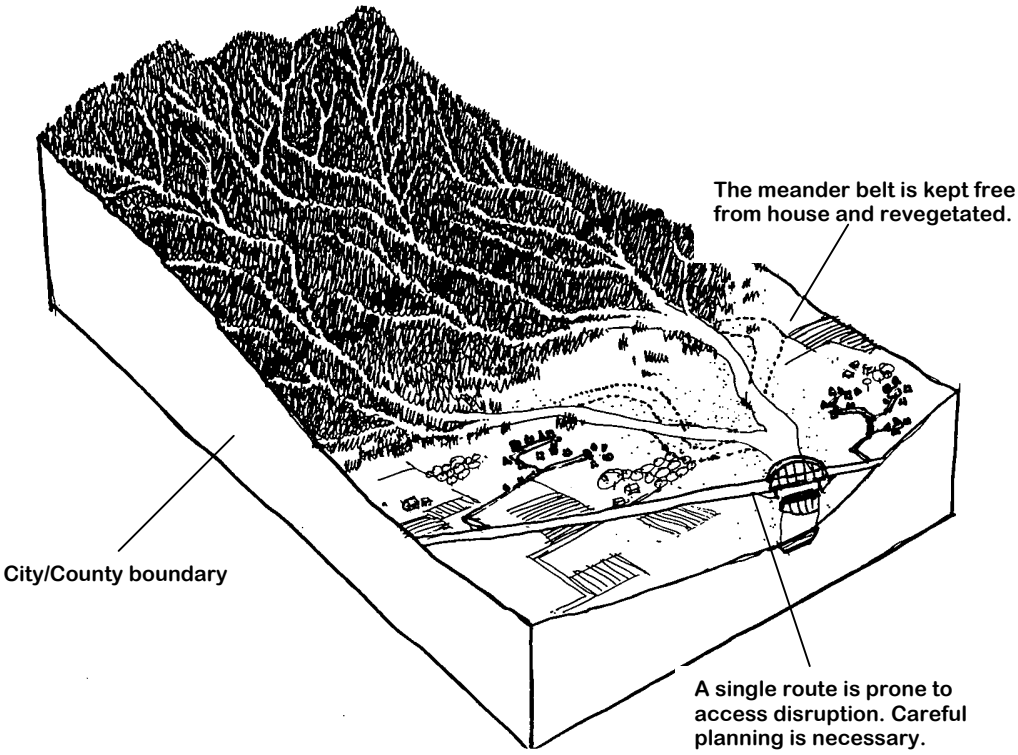
  Coordination between jurisdictions is a critical tool for implementing watershed-wide planning. It is also an important means to ensure that excess traffic during evacuation is planned for, and that incursions into the floodplain can be minimized, while appropriate resource utilization practices are applied in the upper watersheds.

Lack of jurisdictional planning within the watershed increases the likelihood of damage.



Source: URR

Watershed-wide planning enhances opportunities for inter-jurisdictional, multi-objective planning.



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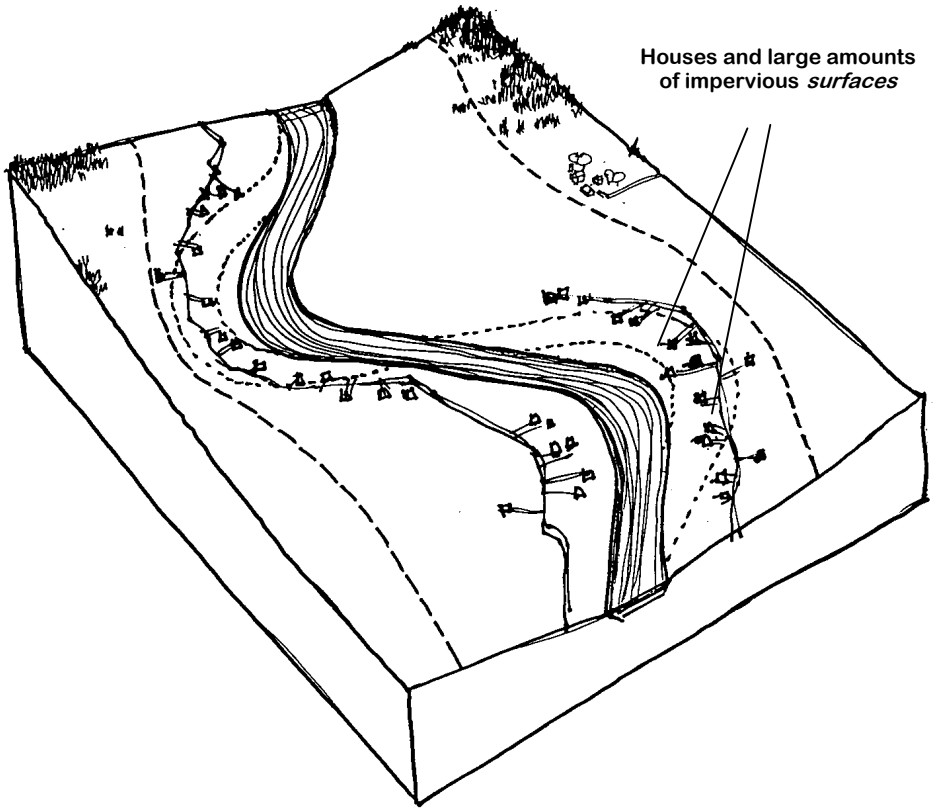
Sources: ASFM and URR

- **Open Space Plan Designation for Acquisition of Hazardous Sites**

  Sites which have experienced or which could potentially experience repetitive damage are identified. Then, appropriate uses of such sites are designated. Finally, based on the urgency of the threat as well as the range of options for reuse of the property, priorities can be established for their acquisition.

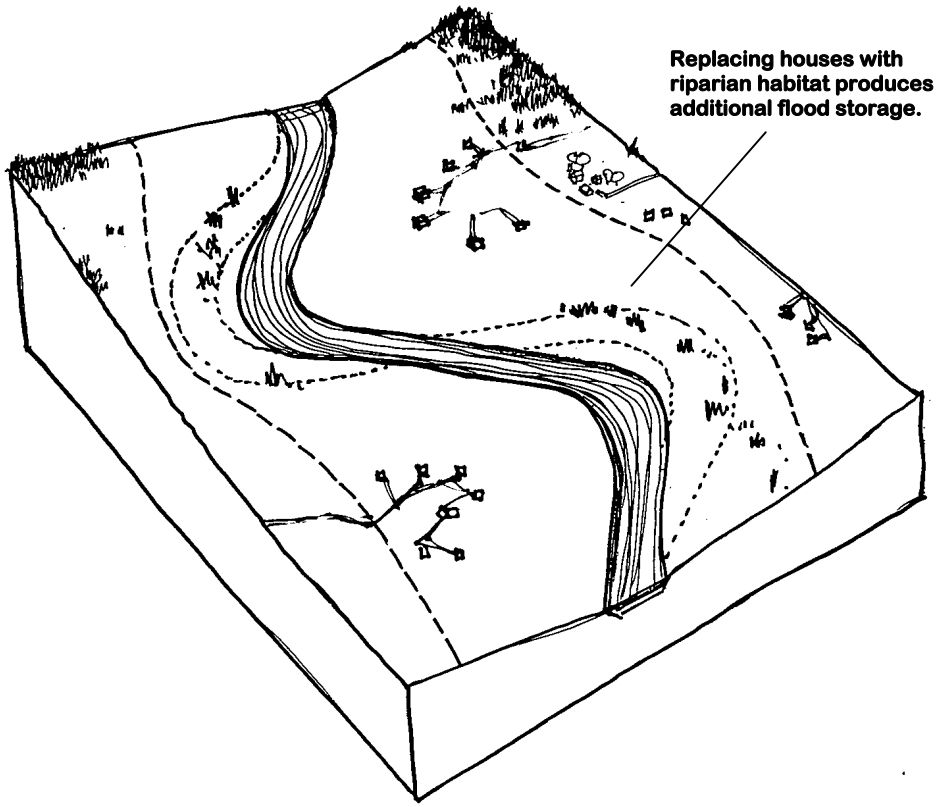
  Sites which are located within the traditional meander belt are prime candidates for acquisition. Multiple objectives to be fulfilled include additional water storage in the floodplain, habitat restoration, and/or recreation. Sites within potential debris flow areas are also potential candidates for acquisition. They can serve as debris channels, run-off conduits, and view corridors.

Houses and other man-made structures within the river's traditional meander belt increase the likelihood of damage and reduce flood storage.



Source: ASFM and URR

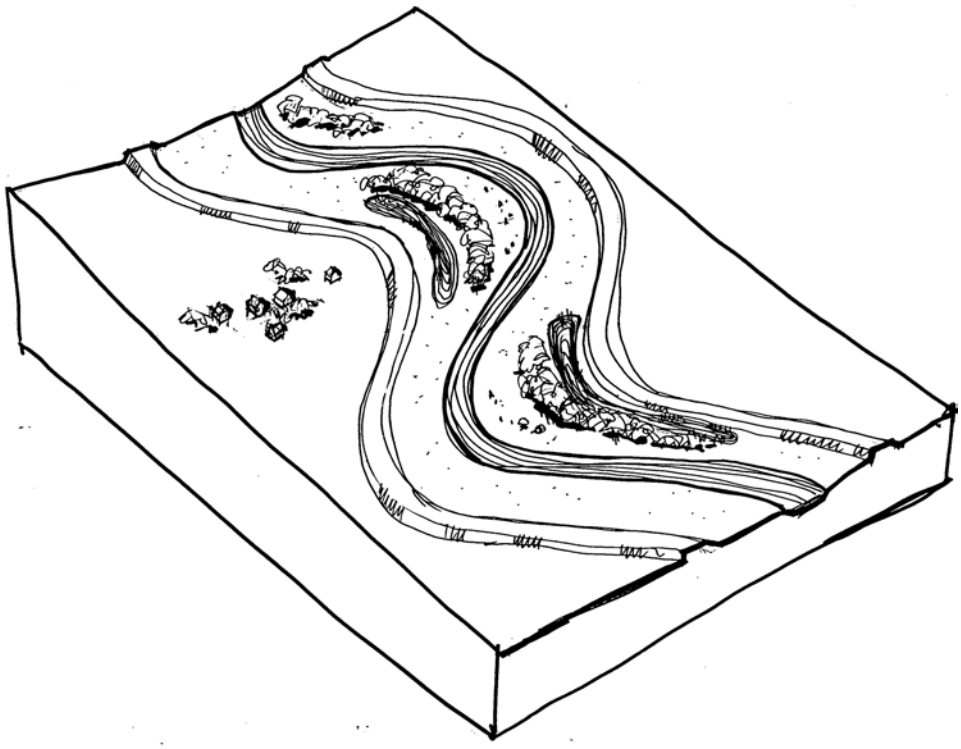
Removal of structures from the meander belt reduces the likelihood of damage.



Source: ASFM and URR

Setback levees are an additional tool which can be used in flood prone areas.

Setback levees are constructed away from the actual channel to allow some inundation of the floodplain.



Source: ASFM and URR

- **Operating Budget Issues**

  Open space, once acquired, must be maintained. For example, acquired sites located in the meander zone can be planted to improve the riparian habitat, while hillside sites can become more stable with proper planting as part of a vegetation management program.

- **Vegetation Management Programs**

  Vegetation management is a critical method of reducing wildfire fuel. Planting can also be a critical tool in catching debris in flood channels.

- **Conservation Easements**

  Conservation easements such as agricultural setbacks preserve critical storage along streams and can be used to protect debris channels or hazardous wildfire areas free of development.

- **Subdivision and Zoning Codes**

  Changes to zoning or subdivision codes may be adopted to modify site utilization standards such as setbacks to permit clustering in new development.

- **Grading and Drainage Measures**

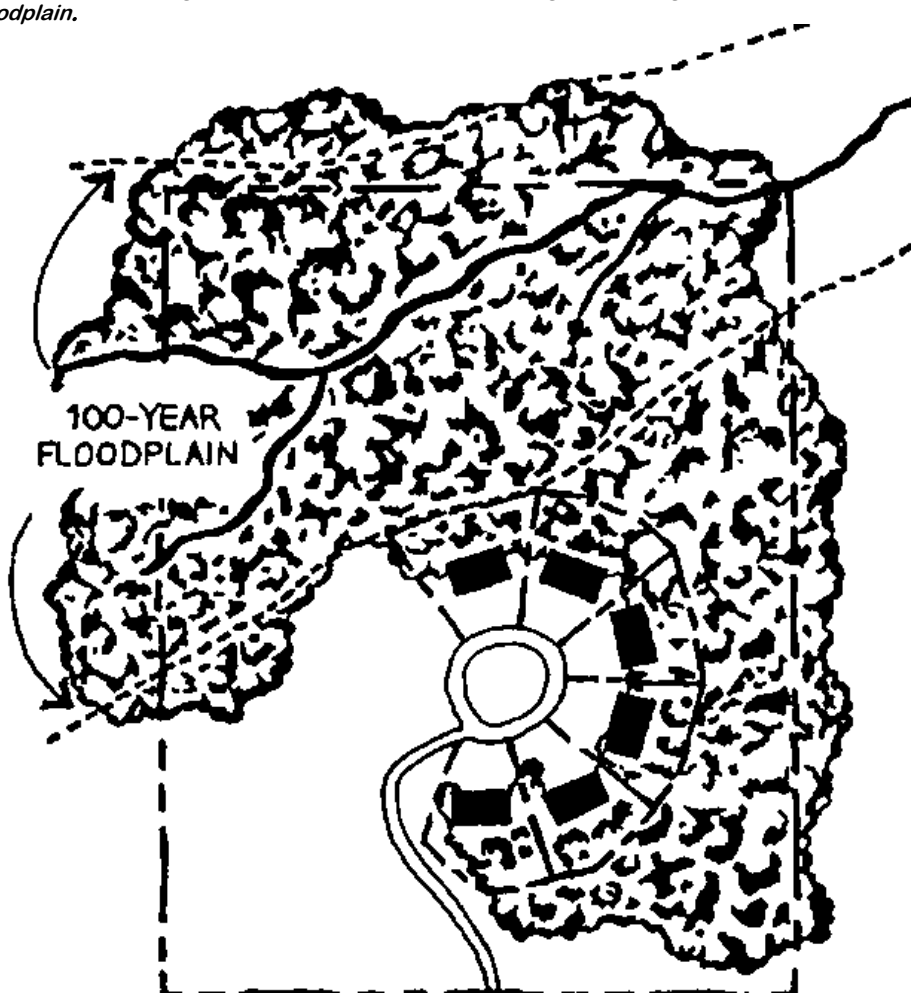
  Best management practices (BMPs) are used to minimize erosion and to control sediments and drainage. These practices can be implemented through engineering investigations which define site conditions. Such investigations by professional engineers are frequently required for new development proposal. These include:

  - Mapping of soils and rock types and their characteristics
  - Subsurface configuration (geologic structure)
  - Ground and surface water conditions
  - Active geologic processes and rates or recurrence
  - Site use suitability assessments
  - Specific recommendations for development
  - Description of additional information needed to approve projects

  Potential recommendations for areas with problems could include standards for:

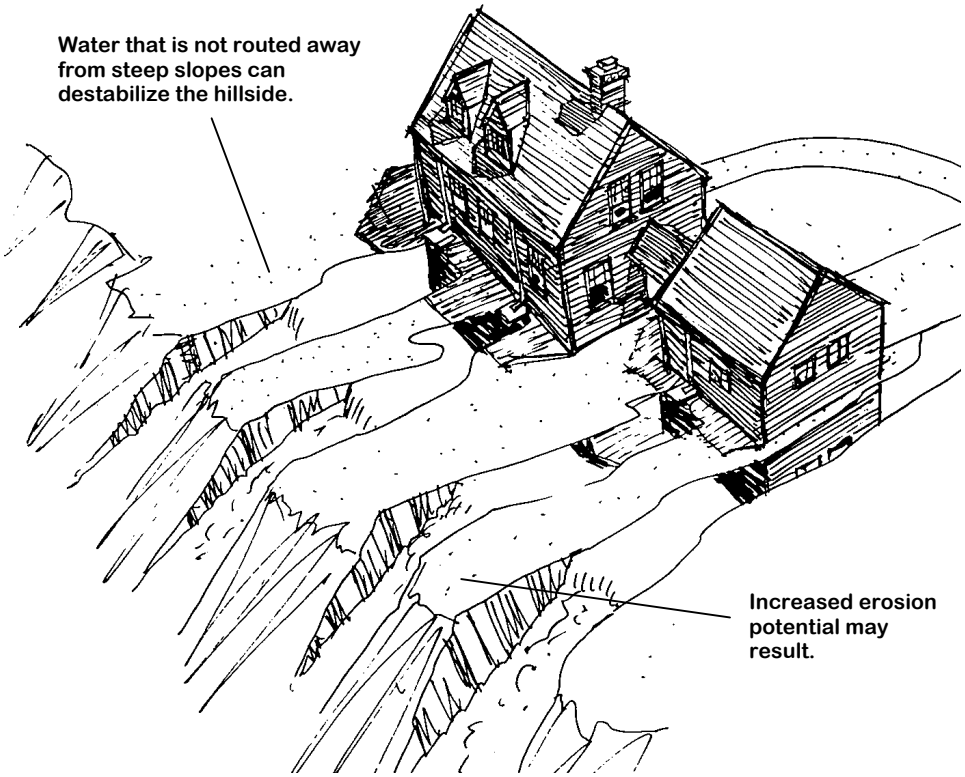
  - Grading and drainage design
    - Surface protection and vegetation
    - Surface drainage ditches and storm drains
    - Curtain drains and perforated plastic pipe
    - Subsurface drainage
  - Retaining structures
    - Soil stabilization
    - Rip-rap buttress fills
    - Retaining walls with drainage
    - Piling
    - Material removal, replacement, and compaction
    - Reduction of slope

Modification of zoning and subdivision codes to encourage clustering outside of the floodplain.



Source: Morris, 1997

The likelihood of slope failure is increased by the lack of a drainage system and insufficient setback.

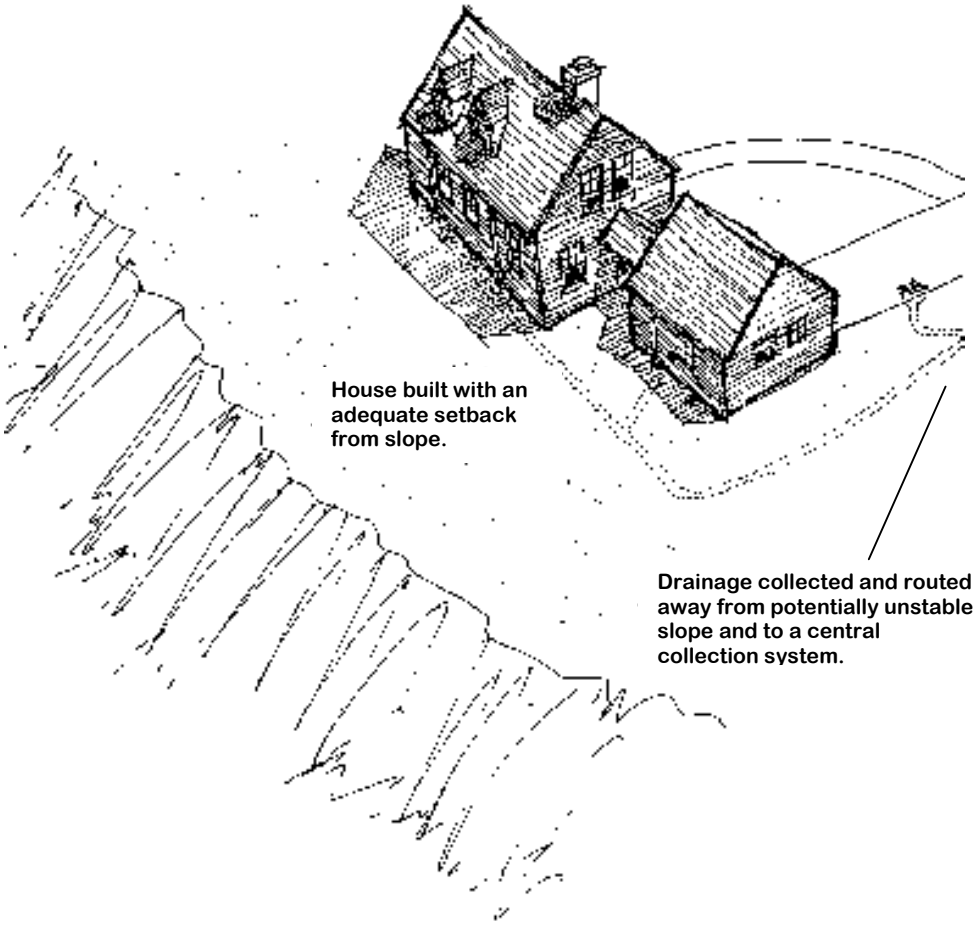


Source: URR

- **<u>Other Strategies</u>**

  - Coordination with the Land Use and Housing elements to target reduction of vulnerable homes in floodplain, landslide prone areas, etc.
  - Building code amendments to establish particular construction requirements associated with specific critical areas
  - Review of the Transportation Improvement Program to include project prioritization based on hazard reduction or response characteristics of projects.
  - Further refinement of surface water management plans to incorporate hazard reduction techniques.

Correct drainage and setback can mitigate the hazards of steep slopes.



Source: URR

CHAPTER 5: IMPLEMENTATION

Plans are worthless.
Planning is essential.

Dwight D. Eisenhower

Completed plans do have value. But the value is directly attributable to the integrity of the process that was used to identify issues, formulate recommendations, and make decisions. The first four chapters present the process and content for drafting a Natural Hazard Reduction Element for the comprehensive plan. Implementation measures also need to be considered. These include ordinances, standards, and action plans addressing specific hazardous conditions or to avoid repetition of past disasters.

INTRODUCTION

This chapter provides a menu of tools for producing and implementing the Natural Hazard Reduction Element, including regulatory and administrative means that local governments use to reduce the risk of hazard events. Case studies and examples that help to define the components of a Natural Hazard Reduction Element are cited and included in the appendix. There is no complete model of a comparable Natural Hazard Reduction Element. The lack of a standard permits planners to be creative in addressing their own jurisdiction's particular needs.

Some jurisdictions may choose to blend hazard planning into their current comprehensive plan format and avoid having a separate free-standing element. This approach was discussed in Chapter 2. The resulting product will be hazard-related goals, policies, strategies, and actions included in other elements. The biggest issue with this approach is to determine where the hazard vulnerability assessment should reside. The decision can be made as you evaluate the current plan. In many cases, the assessment would probably be best located in a technical appendix to the plan which has the advantage of permitting methodological or database updating without the necessity of going through the annual plan amendment process. On the other hand, it separates the background analysis from the plan recommendations, thereby making use of the element for grant applications and interjurisdictional coordination more difficult.

Actions and Strategies

☑ *Integrated Strategies*

Strategic plans and action plans are frequently used to achieve long-term visions. Some actions are implemented through non-regulatory measures such as sub-area plans, Community Development Block Grant plans, and six-year capital improvement programs. Hazard reduction can be addressed within the typical formats for these types of plans, some that cover only portions of the community. This incremental approach may

result in a hazard reduction element, but a Natural Hazard Reduction Element as described in this Guidebook offers a truly integrated approach.

One excellent example of an integrated strategy is acquisition of flood-prone areas for open space uses. This accomplishes several objectives. It provides for low intensity public use of natural areas, protects habitats, and ensures that severe flood damage to buildings, infrastructure, and private property will be minimized.

A Natural Hazard Reduction Element implementation strategy can be organized into three primary components: prevention, protection, and emergency response services. Emergency services are not described in detail here because most jurisdictions have emergency services plans developed by police and fire departments with assistance from federal and state agencies. Emergency services plans should be reviewed and updated as part of the process of developing the prevention and protection components.

Actions and strategies for prevention and protection are describe later in this chapter.

Development Codes

Zoning, subdivision, and building codes – as well as clearing and grading ordinances and the regulatory portions of the critical areas ordinance and Shoreline Master Program – provide the best means for ensuring the prevention of natural disasters and the protection of hazard-prone areas from improper development. These codes need to be framed to require specific measures such as steep slope setbacks, buffers, and restriction of development density and intensity in areas designated as hazard prone.

The National Flood Insurance Program (NFIP) requires adoption of a flood damage prevention ordinance which includes specific requirements for structures built within the 100-year floodplain (the model ordinance is provided in Appendix E). The flood damage prevention suggestions proposed in Chapter 4 go much further than the Federal Emergency Management Agency (FEMA) model ordinance because they address areawide structural and nonstructural flood damage prevention solutions, rather than the more localized site- and structure-specific solutions identified in the FEMA model.

Annual Budget Process

This may be the most important activity in the implementation of the Natural Hazard Reduction Element. The annual budget controls the actions of the jurisdiction in meeting its goals and carrying out its policies. The availability of resources to the operational departments affects both actions taken directly by the jurisdiction and its ability to regulate the activities of others.

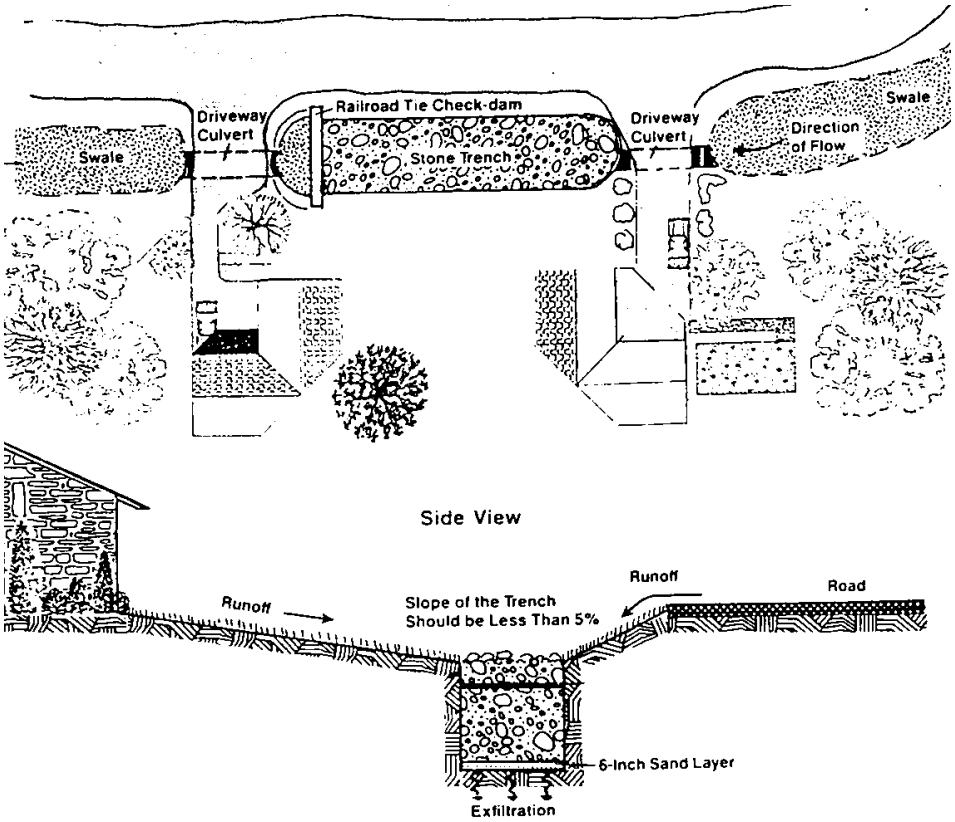
☑ *Policies, Budget Programs, and Regulations*

Funding for natural hazard reduction work may be available from a variety of sources, including some unexpected ones. In addition to traditional emergency management funding sources such as FEMA or Washington State Emergency Management Division, planners are urged to consider public and private nonprofit sources that provide funding for public works, wildlife habitat, and open space projects. See Appendix B for details on block grants and public works funds available through the state Department of Community, Trade and Economic Development. Other agencies such as the Interagency Committee for Outdoor Recreation also have funds available.

Design Standards

Governments also have standards for the design of streets, utilities, and other facilities as well as design guidelines for public and private development. These standards also need to be incorporated into the Natural Hazard Reduction Element toolkit so that appropriate prevention and protection measures are integrated with other standards.

Stormwater runoff from low-density residential development can be managed through grassy swale and infiltration trenches.



Source: Morris, 1997

Capital Programming and Special Purpose Plans

The comprehensive plan's Capital Facilities Element and special plans – such as water and sewer district master plans, state highway plans, watershed management plans, and public transportation plans – can incorporate hazard prevention and protection measures. In Chapters 2 and 4, ideas for assessing the Capital Facilities Program as part of the process are discussed. For the other special plans, the process of defining your local Natural Hazard Reduction Element should evaluate how these plans can be referenced and/or modified to be consistent with the element. Additionally, an Open Space and Parks Element in the comprehensive plan may be an excellent vehicle for pursuing integrated planning strategies. For example, open space acquisition goals can prioritize flood-prone areas that also provide recreational opportunities. Such approaches may help maximize limited funding.

PUTTING IT ALL TOGETHER

This section describes some basic organizational options for developing your Natural Hazard Reduction Element. By working through the process ideas and technical information in the previous chapters, you should have an understanding of the scale of the subject area that needs to be covered for your planning area.

Previous chapters have described the background and the important technical basis for hazard-related planning. Process steps to prepare for and conduct the planning were also outlined. The following is an expanded outline for a Natural Hazard Reduction Element based on the prior chapters. The outline is not intended as a "one-size-fits-all" template. It lays out a format for addressing hazards which can be adapted to fit local conditions and resources. The format can then be adapted to match the organization of the other comprehensive plan elements.

Hazard Element Outline

1. INTRODUCTION AND SUMMARY – Purpose of hazard reduction planning, summarizing the process and key actions proposed.

a. Community Background – Describe the history of local experience with hazard events and disasters. Include information about the costs associated with after-the-fact mitigation and lessons learned. Identify any relevant federal and state program information that is pertinent to the principles used in the element.

b. Definitions – Provide brief descriptions of the hazards/disasters which the element addresses. Refer to other sections of the element which contain more detailed glossaries.

c. Process – Describe the work plan which resulted in the element including the involvement of community members, agency staff, and consultants.

d. Summary – List the major recommendations for actions resulting from the comprehensive plan. Recommendations should include plan goals and policies, as well as implementation strategies and capital investments associated with hazard prevention and protection.

2. HAZARD AND VULNERABILITY ASSESSMENTS – This section should describe the local geographic context of hazard-prone areas along with the uses which will be damaged or disrupted. Based on the possible impacts (especially repetitive losses), the community can rate or prioritize the relative urgency for identifying prevention and protection measures associated with these areas.

Hazard assessment items include:

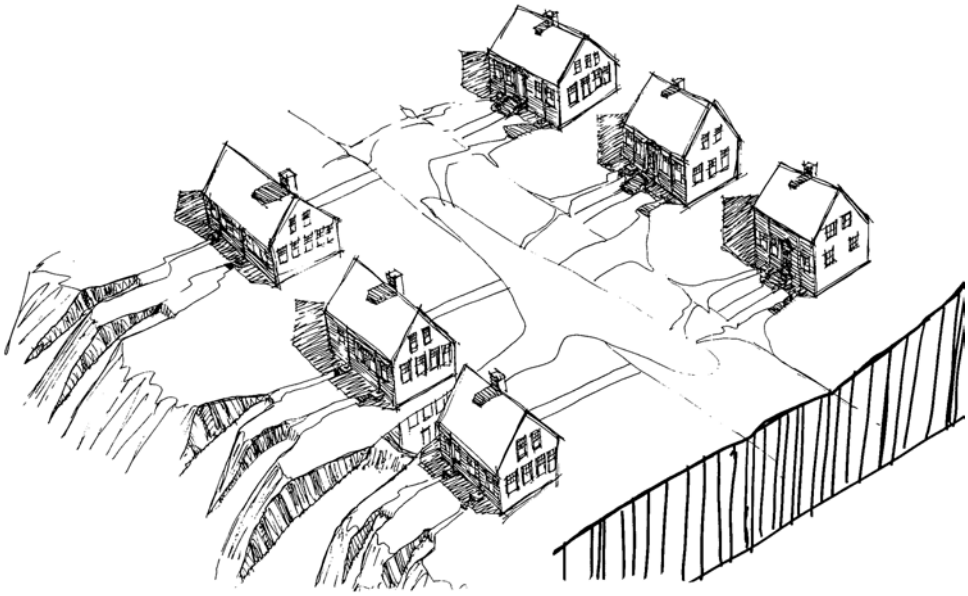
- **Location of hazard areas**
- **Likelihood of hazard events**
- **Magnitude of potential hazards**
- **Characteristics of hazards**

a. Flood Hazard Areas – Describe the areas subject to frequent and/or serious flooding. Coordinate this with existing mapping and designations from the critical areas ordinance, NFIP studies, and surveys prepared as part of development project applications. Overlay this information on land use and building maps to assess the nature and extent of current development that is susceptible to damage. Review reports from prior flooding events and information from local citizens to determine which properties have been affected regularly in recent history. Document existing and planned flood control projects (levies, channels, dredging) and evaluate their relative effectiveness. Compare the values of vulnerable property with the track record of post-flooding repair and replacement and with the costs of protection via new flood control construction. (This last step can be done both on a general descriptive level and on a specific quantitative level depending upon the kind of information that is available in the community and the level of assistance obtainable from federal and state agencies. The Property Protection Scoring System provided in Appendix G could be adapted as a method to assess the effective value of comparative prevention measures.)

b. Landslide Hazard Areas – Describe the areas subject to landslides. Coordinate this with existing mapping and designations from the critical areas ordinance, steep slope and geotechnical or Natural Resources Conservation Service mapping, and studies and surveys prepared as part of development project applications. Note that this mapping generally does not include coverage of developed areas which existed at the time that the survey was done. Overlay this information on land use and building maps to assess the nature and extent of current development which is susceptible to damage. Review reports from prior landslide events to determine which properties have been affected regularly in recent history. Document existing and planned hillside stabilization projects such as retaining

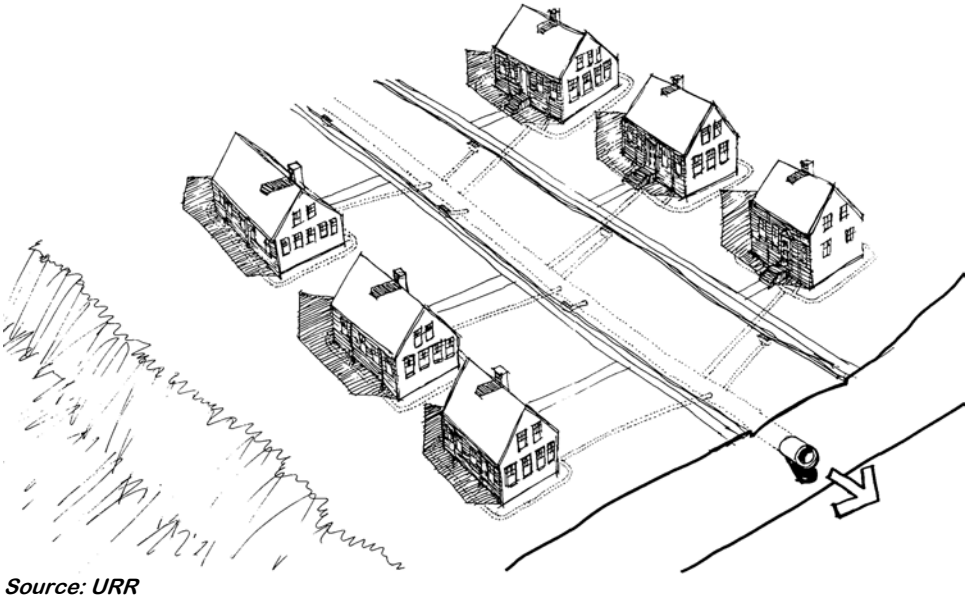
walls, mass grading, and revegetation and evaluate their effectiveness. Compare the real property values of vulnerable sites with the prior public repair and replacement expenditure and potential costs associated with further protection. The Property Protection Scoring System provided in Appendix G could be adapted as a method to assess the effective value of comparative prevention measures.

Subdivisions that do not collect surface runoff water increase the likelihood that severe erosion and slope instability will become a problem over time.



Source: URR

Subdivision plans should include provisions for collecting and safely routing surface runoff water.



Source: URR

c. Wildfire Hazard Areas – Describe the areas subject to wildfires. Coordinate this with existing mapping and designations from the state Department of Natural Resources (DNR) or local resource land mapping, aerial photography (also available from the DNR) and studies and surveys prepared as part of development project applications. Other sources of information include private timber owners' maps and ownership records, County Assessor current use taxation records, and fire department/district information. Overlay this information on land use and building maps to assess the nature and extent of current development which is susceptible to damage. Review reports from prior wildfire events to determine which properties have been affected regularly in recent history. Document existing and planned fire suppression measures and evaluate their relative effectiveness. Compare the real property values of vulnerable sites with the prior public repair and replacement expenditure and potential costs associated with further protection. The Property Protection Scoring System provided in Appendix G could be adapted as a method to assess the effective value of comparative prevention measures.

d. Compilation of Vulnerability/Statement of Risk – Develop an overview of the vulnerability assessments to indicate where there are specific areas affected significantly by two or more hazards. This would involve adding up the exposures which indicate locations that are likely to be the most suitable for aggressive mitigation strategies such as land acquisition. The value of future public use/benefit of the land should be part of the decision making process.

Vulnerability Assessment	
Type of Hazard Experienced	**Past Occurrences**
Facilities exposed to hazards	
Secondary hazard disruption damage	
Number of (residents, employees, livestock) exposed	
Shelter demand generated by hazard	
Environmental impacts	
Value of exposed property	
Evacuation needs and capability	
Hazardous materials danger	
Hazardous facilities danger	
Other landslides	
Source: Kaiser and Goebel, 1996	

3. GOALS AND POLICIES – Establish the framework for directing hazard prevention and protection based on the community's values, prior success in hazard mitigation, and the results of the vulnerability assessment.

a. Goals may be stated in terms of risk reduction or in terms of more concrete, site-specific milestones, or both. For example, a goal could be stated as follows:

Reduce landslide damage in the West Hills by 25 percent over the next 10 years.

This type of goal requires that your database can estimate prior damage in order to set up a baseline for measuring success. Another example is:

Acquire land in the Blue River floodplain for expansion of Blue River Park and flood damage mitigation.

Hazard reduction goals and policies are the first step towards applying resources and bringing potentially disastrous situations under control.

Source: Washington DNR

This type of goal is less theoretical and more specific to problem solutions that can be implemented through policies and projects. This is where the analysis of the existing comprehensive plan described in Chapter 2 comes into play. The new goals in the Natural Hazard Reduction Element should reflect the goals of the other plan elements to the extent possible. In doing this, you will be able to compound the values from various elements to get more "bang for the buck."

b. Policies follow the format of the goals and provide more specific intent language that drives the implementation actions. It is suggested that each goal be addressed by policies for both prevention and protection. Policies or intent statements from the critical areas ordinance and Shoreline Master Program (SMP) should also be adapted or referenced. For instance, it is likely that your SMP has language on protecting public health, safety, and welfare in the shoreline area which provides the basis for regulating land use and development within the shoreline area. Related hazard policies for flood damage mitigation should be framed to provide for additional measures such as shoreline environment designations and regulations that address more specific stream segments which are particularly flood-prone or where damage has been historically high.

☑ *Policies Implement Your Goals*

4. STRATEGIES AND ACTIONS – This is the most urgent part of the element, where the top priority programs and projects can be described and adopted as part of your jurisdiction's action plan.

Once a community has defined its hazard reduction goals, an implementation strategy can be adopted. Make sure there is consistency between broad goals and policies and implementing strategies and regulations. Specific regulations adopted by each community reflect the conditions and priorities of that community. As the summaries of regulations and plans that follow and that are found in Appendix D indicate, there is no one right way to implement your goals. These examples indicate there are significant differences in methodologies and scope (e.g., one river versus many). The underlying objective is to define and implement a strategy to reduce the hazard.

Wildfire hazard vulnerability assessment would have identified the lack of defensible space and may have saved this home.

Source: WA DNR

Flood Hazard Reduction Strategies		
Community	**Primary Goals**	**Strategy**
River Improvement, Pierce County	Provide comprehensive storm drainage systems, flood control, and drinking water supply.	Gather and analyze recent flood data, establishing higher regulatory standards, purchasing properties within the 100-year floodplain, and replacing levees with setback levees to allow river to reclaim more of the meander belt.
Integration of GIS and Hydraulic Modeling for Floodplain Management, City of Sumas	Better define critical zones and limit new development; identify properties for potential acquisition.	Develop a detailed hydraulic model of the Nooksack River overflow and the Sumas River and integrate that model with a GIS.
Channel Migration Studies and Mapping, King County	Integrate an understanding of river meander belts into comprehensive floodplain management and identify homes and development threatened by long-term migration patterns for potential buy-outs.	Study and map the meander belt of all major rivers in King County; identify existing and historic channels and channel migration patterns along river sections.
Rickreal Creek Greenway, Polk County Oregon	Develop a simplified approach to floodplain regulation and planning and reduce impacts of streambank erosion.	Establish a riparian setback as three times the average stream width up to a maximum of 100 feet on either stream bank: setback dedication required per zoning code.

Landslide Hazard Reduction Strategies		
Community	Primary Goals	Strategy
Critical Area Regulations, Bothell, Washington (Draft)	Disclosure of risk and establishment of criteria for mitigation to control loss of life and public and private property damage.	In recognition of the possible mitigation value of site alteration, clear criteria for alternation eligibility (e.g., obtaining geotechnical analysis) are established. A fund for mitigation is established and transfer of development rights from one part of the site to another is allowed.
Colorado Landslide Hazard Mitigation Plan	Reduce statewide actual and potential landslide losses through the coordination of loss-reduction efforts by state and local governments.	Implementation is through a two-pronged approached where the state develops information and enabling policies, while the local communities provide on-the-ground hazard mitigation.
Preliminary Landslide	Revise City policies and practices relating to landslides to improve	Recommendations fall into three categories: private responsibilities in landslide prone areas,

Landslide Hazard Reduction Strategies		
Community	Primary Goals	Strategy
Policies for Seattle (June, 1998)	preparation, response, and recovery throughout the City's organizational structure.	public infrastructure in landslide prone areas, and financing landslide management proposals.
Slope Provisions, Sensitive Areas Overlay District, City of Bellevue	Recognize the existence of natural conditions which affect the use and development of property and impose special regulations in order to protect environmentally sensitive areas and the public health, safety, and welfare.	Development is restricted to a set of allowable uses, an additional structural setback is imposed on adjacent land, and the allowable density and intensity of development on the site (in the protected area portions) is tied to a "development factor" which is based on the extent of the protected areas.

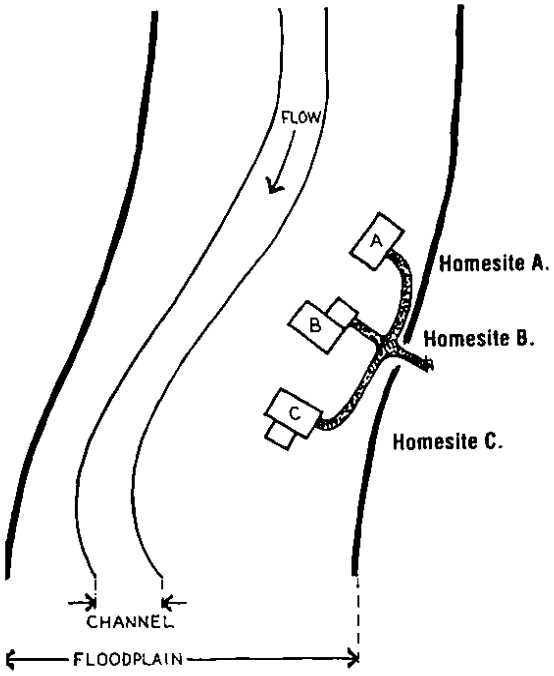
Wildfire Hazard Reduction Strategies		
Community	**Primary Goals**	**Strategy**
Wildfire Hazard Identification and Mitigation System, Boulder County, Colorado	Identify and mitigate the wildfire hazards in the wildland/urban interface areas through development of a GIS-based tool and promotion of excellent interagency and cross-jurisdictional cooperation and community involvement.	The GIS tool (which incorporates hazard assessment, forest management, wildfire behavior, and fire suppression expertise) is used to develop hazard rating maps from parcel-level data; these maps are used in the development review process and county comprehensive planning models.
Wildland Urban Interface Legislation, Clark County	Identify, classify, and map interface problem areas and identify appropriate mitigation techniques for each area.	Identify and map geographic boundaries of the interface area on parcel basis; develop regulation to improve firefighting response and reduce the ignition hazard of buildings in the interface; and develop educational materials for residents in these areas.

a. Hazard area designations – Hazard-prone areas should be mapped (designated) much as critical areas were in the early days of GMA planning and as shoreline environments have been designated in your SMP. In many cases, the hazard areas will be very similar to those

b. Regulations – The element should also provide the intent for amendments to the zoning, subdivision, clearing and grading, environmental review, forest practices, and other codes and standards that are used to regulate development. Rather than include the full body of proposed regulations in the element, it is better to state the need for the regulations and recommend strategies for phasing them in over a time period in conjunction with other planned code updates. Some specific strategies that may be used include slope setbacks and easements; forest clearing buffers; limitations on development density in hazard-prone areas; seasonal limitations on clearing and grading; and public works standards for road cuts on hillsides.

c. Other Mitigation Strategies and Actions – The element should also define initiatives to provide for hazard reduction. These initiatives may already be included in the comprehensive plan or other plans and programs. Open space acquisition is an example where multiple objectives can be accomplished. This section of the element should also include capital improvement projects, such as transportation improvements (roads and bridges), utilities, and specific hazard protection improvements such as dikes, levies, and retaining walls. This portion should be cross-referenced with the Capital Facilities and Utilities elements and with the six-year financing plan. This will eliminate redundancies and make sure that projects are framed to address hazard mitigation objectives in addition to other needs. It should also be correlated with operating budget recommendation.

Configuration of buildings in floodplains should respect the river's flow.



Source: Morris, 1997

5. CONSISTENCY – Since you are developing a new aspect of the comprehensive plan, it is important to determine that the element is consistent with the other plan elements. This consistency review could be incorporated into the prior sections of the element, but a brief stand-alone reference section would be advisable. Further, it is advisable that the internal consistency of the element be addressed. This second tier consistency review permits you to check the outcomes of the process with your initial vision.

Confronting Natural Hazards, Land Use Planning for Sustainable Communities, a 1997 publication of the College of Urban and Public Affairs, University of New Orleans provides a useful questionnaire that can be used to evaluate the hazard element. The following lists the categories of questions.

Clarity of purpose – articulation of a comprehensive overview of the mitigation outcomes which the plan attempts to achieve

Explicit procedural actions – involvement of stakeholders in preparing the plan and key milestones that occurred during the process

Identification of issues – relative seriousness of issues and explanations of why issues are of significance

Forceful direction setting – policies to guide day-to-day decision making and long-range mitigation planning

Quality of fact base – incorporation and explanation of the use of factual data that explain current conditions, trends, and likely future conditions

Integration with other plans and policy instruments – integration of key actions with other plans and policy instruments that are authored both within and outside the community

Linkage of mitigation with community development – mitigation actions tied to other publicly supported community development actions

Use of multiple hazard mitigation – use of goals and policies that are generic and effective for different types of hazards

Organization and presentation – readable, comprehensible and easy to use for both lay and professional people

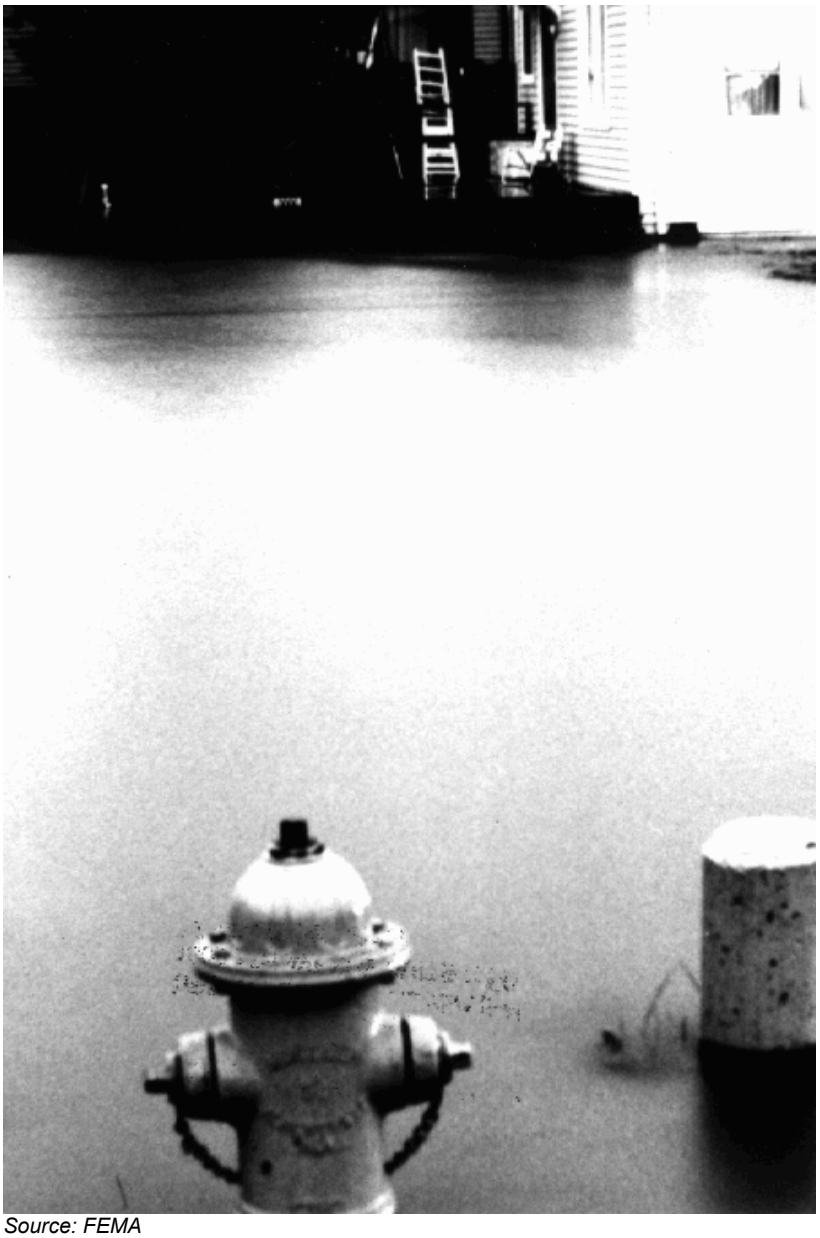
Internal consistency – Issues, goals, objectives, policies, etc. that are consistent and mutually reinforcing

Monitoring – goals and objectives that can be used as indicators for monitoring success of implementation

Implementation – Indication of the commitment to carrying out the plan

Each category contains specific questions that help to determine if the element is responsive to the intent of creating a planning framework for long-term hazard avoidance.

Flooding disrupts access to, and provision of, life safety service.



Source: FEMA

APPENDIX A

EMERGENCY FUNDING SOURCES

EMERGENCY FUNDING SOURCES

Agency	Type of Funds	Who/What is Eligible	Match Required	Time Limitations	Requirements
Federal Highway Administration (FHWA)	FHWA Emergency Relief (E12) – Temporary and Incidental Permanent – within the first 180 days	Cities, counties, tribes, and public agencies – for repairs to roads and bridges for damages eligible for FHWA funds (functional class Major Collector and above for rural, Major Collector and above for urban). State must make application.	NA	First 180 days from start of storm event based on disaster declaration by Governor and President.	Federal Regulation 23 USC 125. Restore roads and bridges damaged by natural disasters. State must declare more than $500,000 in damages statewide on federal aid eligible routes.
FHWA	FHWA Emergency Relief (ER) Temporary and Incidental Permanent – after the first 180 days	Public agencies – for repairs to roads eligible for FHWA funds (functional class Major Collector and above for rural, Major Collector and above for urban).	Typically 13.5%	Until complete – must start within two years.	Federal Regulation 23 USC 125.
FHWA	FHWA Permanent Restoration – FHWA Emergency Relief (ER)	Public agencies – for repairs to roads eligible for FHWA funds (functional class Major Collector and above for rural, Major Collector and above for urban).	Typically 13.5%	Until complete – must start within two years.	Federal Regulation 23 USC 125 and all other federal permit and contract requirements.
FHWA	FHWA Betterment – FHWA Emergency Relief	Public agencies – for repairs to roads, creeks, and rivers eligible for FHWA funds (functional class Major Collector and above for rural, Major Collector and above for urban).	Typically 13.5%	Until complete – must start within two years.	Requires special approval by FHWA based on case-by-case analysis of cost/benefit to ER program.
Department of Community, Trade and Economic Development (CTED)	Emergency Planning – Low-interest Loans at 5%	Public work emergencies – must be for construction and reconstruction of existing facilities for the counties, cities, and special purpose districts. If state or federal disaster funds are received, they must be applied to the loan (maximum 20 years).	NA	Accepted any time of year on a first come, first served basis.	Must have a capital improvement plan (CIP) in place. Cities and counties must be levying option ¼% real estate excise tax. All contracted construction must be let by competitive bid.

Agency	Type of Funds	Who/What is Eligible	Match Required	Time Limitations	Requirements
U.S. Army Corps of Engineers	Channel clearing for flood control	Cities, counties, public utility districts, tribes, and states. To remove accumulated snags and other debris; and for channel clearing and straightening in navigable streams and tributaries for flood control purposes.	Implementation 25% non-federal. Total dollar amount varies.	Ongoing	Flood control
Department of Ecology	Flood Control Assistance Account Program	Cities, towns, counties, ports, and tribes. Prevent or lessen damage from future floods; bank stabilization; bioengineering; urban drainage improvements. Emergency flood control maintenance work.	Grants. Up to 80% of the total eligible costs.	January - February of odd-numbered years.	Develop comprehensive flood control management plans and flood control maintenance projects.

APPENDIX B

GOVERNMENT FUNDING SOURCES FOR INFRASTRUCTURE-RELATED NEEDS

GOVERNMENT FUNDING SOURCES FOR INTRASTRUCTURE-RELATED NEEDS

GRANT PROGRAMS	ELIGIBLE PROJECTS	ELIGIBLE PARTICIPANTS	FUNDS AVAILABLE
CTED **Community Development Block General Purpose Grant** Stephen Buxbaum PO Box 48300, Olympia (360) 586-1243 Fax (360) 586-4162	Grants for water pollution control, drinking water, roads, streets and bridge projects. Must benefit low- and moderate-income persons.	• Cities (non-entitlement) • Counties (non-entitlement) • Special purpose districts (through one of the above) • Tribes (through one of the above)	Approximately $8 million each year. Maximum grants of $750,000. One application for each funding cycle. Applications due November of each year.
CTED **CDBG** **Imminent Threat Fund** Bill Prentice PO Box 48300, Olympia (360) 753-2223 Fax (360) 586-4162	Grants for emergencies posing an immediate threat to the public health and safety of non-entitlement cities or counties. Jurisdiction must have insufficient funds to address the urgent need and are unable to take PWTF emergency loan.	• Cities (non-entitlement) • Counties (non-entitlement) • Special purpose districts (through one of the above) • Tribes (through one of the above)	$400,000 set aside at beginning of funding year. Applications accepted on a fund-available basis and coordinated with PWTF.
CTED **CDBG** **Planning Only** Kaaren Roe PO Box 48300, Olympia (360) 586-6925 Fax (360) 586-4162	Grants for comprehensive plans, infrastructure planning, feasibility studies, and pre-engineering reports. Must benefit low- and moderate-income persons.	• Cities (non-entitlement) • Counties (non-entitlement) • Special purpose districts (through one of the above) • Tribes (through one of the above)	Approximately $300,000 each year. Maximum grants of $24,000 and $40,000 (multiple jurisdictions).

GRANT PROGRAMS	ELIGIBLE PROJECTS	ELIGIBLE PARTICIPANTS	FUNDS AVAILABLE
CTED, Public Works Board **Public Works Trust Fund** **Capital Facilities Planning Program** PO Box 48319, Olympia (360) 586-4172 Fax (360) 664-3029 www.crab.wa.gov	Zero percent loans to help finance capital facilities plans (CFP). Bridges, roads, domestic water, sanitary sewer, and storm sewer systems are eligible. Loans may be used to develop a single system CFP, through comprehensive plans are preferred.	• Cities, counties, and towns planning under GMA whose deadlines for adoption of comprehensive plans and development regulations **are not past due** • Special purpose districts • Counties, cities, and towns not currently subject to the GMA requirements • Newly formed counties, cities, and special purpose districts • Receiverships • Annexations • New system	Loans at zero percent interest; $30,000 maximum per jurisdiction with 25% local share required. Application cycle is ongoing, subject to availability of funds.
CTED, Public Works Board **Public Works Trust Fund** **Construction Loan Program** PO Box 48319, Olympia (360) 586-4172 Fax (360) 664-3029 www.crab.wa.gov	Low-interest revolving loan fund to help local governments finance critical public works needs, including for repair replacement and improvements to bridges, roads, domestic water, sanitary sewer and storm sewers.	• Cities • Counties • Special purpose districts (except ports or school districts)	Loans at 1-3% depending on local match (10% minimum local match). $7-10 million per jurisdiction available per biennium. Applications due in April.

GRANT PROGRAMS	ELIGIBLE PROJECTS	ELIGIBLE PARTICIPANTS	FUNDS AVAILABLE
CTED Public Works Board **Public Works Trust Fund** **Emergency Loan Program** PO Box 48319, Olympia (360) 586-4172 Fax (360) 664-3029 www.crab.wa.gov	Low-interest loans to repair or replace critical public works systems (bridges, roads, domestic water, sanitary sewers, or storm sewers) damaged by natural disaster or other unforeseen or unavoidable circumstances, which poses an immediate or emergent threat to public health and safety and has declaration of emergency.	• Cities • Counties • Special purpose districts (except port or school districts)	Loans up to $500,000 with 5% fixed interest rate. Funds are accessible throughout the year as long as available.
CTED Public Works Board **Public Works Trust Fund** **Pre-Construction Program** PO Box 48319, Olympia (360) 753-3158 Fax (360) 664-3029 www.crab.wa.gov	Low-interest loans for the pre-construction phase of infrastructure projects, including design, engineering, bid-document preparation, environmental studies, and right-of-way-acquisitions.	• Cities • Counties • Special purpose districts (except port or school districts)	Loan terms same as Construction Loan Program. Applications due in September.
DOE **Centennial Clean Water Fund** Kim McKee Water Quality Program PO Box 47600, Olympia (360) 407-6566 Fax (360) 407-6574	Grants and loans to finance the planning, design, acquisition, construction, and improvement of water pollution control facilities and activities.	• Cities • Counties • Special purpose districts (except port or school districts) • Tribes • State agencies • Conservation districts	$11.5 million for FY 2000 for statewide projects. $5 million for small community projects. Amount frequently changes due to legislative directives. Applications accepted January-February.

GRANT PROGRAMS	ELIGIBLE PROJECTS	ELIGIBLE PARTICIPANTS	FUNDS AVAILABLE
DOE **Centennial Clean Water Fund Emergency Management** Water Quality Program PO Box 47600, Olympia (360) 407-6566 Fax (360) 407-6574	Grants and loans for water quality/public health environmental emergencies when immediate corrective action is required (e.g., broken sewer pipes in public area).	• Cities • Counties • Special purpose districts (except port or school districts) • Tribes • State agencies	Applications will be accepted any time, if funds are available. There was $2 million available for FY 2000.
DOE **Federal Clean Water Act (Sec. 319)** Dan Filip PO Box 47600, Olympia (360) 407-6509 Fax (360) 407-6426	Grants to fund comprehensive watershed based nonpoint source pollution prevention and control activities (implementation only).	• Local government • Special purpose districts • Tribes • Non-profits • State and federal agencies	75% grants; $1-2 million available each year. Will accept applications January-February.
DOE **Flood Control Assistance Account Program** PO Box 47600, Olympia (360) 407-6796 Fax (360) 407-6305	Grants for 1) Development of Flood Control Management plans; and 2) Flood control maintenance projects. Funds also available for emergency flood control maintenance work needed to protect life or public property. Declaration of emergency needed.	• Cities • Counties • Special purpose districts • Service agencies • Tribes (through one of the above)	Grants; percentages vary as do the funds available each year and the application period.

GRANT PROGRAMS	ELIGIBLE PROJECTS	ELIGIBLE PARTICIPANTS	FUNDS AVAILABLE
DOE **Referendum 38 Emergency Water Supply** PO Box 47600, Olympia (360) 407-6630 Fax (360) 407-7162	Loans and grants to make permanent repairs of agricultural water supply system breaks during irrigation season. Breaks must create emergency shortage of water threatening property loss or public safety.	• Irrigation districts • Tribes	Loans and grants combination up to 90% (30% grant and/or 60% loan).
DOE **Water Pollution Control State Revolving Fund** Brian Howard PO Box 47600, Olympia (360) 407-6510 Fax (360) 407-6574	Low-interest loans to fund high priority water quality projects, such as wastewater treatment facilities, non-point source pollution projects, and estuary protection and preservation programs for Puget Sound.	• Cities • Counties • Special purpose districts • Tribes • State agencies	Low interest loans up to 100% of total project.
DOH **Public Water System Technical Assistance Program** Holly Weber PO Box 47829, Olympia Main (360) 236-3100 Fax: (360) 664-4500 SW (360) 664-0768 NW (206) 464-7670 East (509) 456-3115	Technical assistance available to help with public drinking water quality and quantity problems. Help utilities solve design, operations, and management problems; waterworks operator certification and training; review and approval of construction documents; project reports and water system plans. For studying formation of regional water entities and other restructuring.	• Public water systems	Technical assistance

GRANT PROGRAMS	ELIGIBLE PROJECTS	ELIGIBLE PARTICIPANTS	FUNDS AVAILABLE
Army Corps of Engineers **Channel Clearing for Flood Control** Lester Soule PO Box C-3755 Seattle, WA 98124-2255 (206) 764-3600 Fax (206) 764-4470	For removing accumulated snags and other debris and for channel clearing and straightening in navigable streams and tributaries for flood control purpose.	• Cities • Counties • Public utilities • Tribes • States	Total dollar varies with cost sharing; 65% federal, 35% non-federal for implementation.
ACOE **Construction of Industrial Water Supply Projects** Lester Soule PO Box C-3755 Seattle, WA 98124-2255 (206) 764-3600 Fax (206) 764-4470	For modification of an existing Corps reservoir or reallocation of existing storage.	• Counties • Tribes • Water utilities • States	Cost shared
ACOE **Flood Control Studies** Lester Soule PO Box C-3755 Seattle, WA 98124-2255 (206) 764-3600 Fax (206) 764-4470	Studies which may lead to the design and construction of flood damage prevention measures, both structural and non-structural, including flood warning systems.	• Cities • Counties • Special purpose districts • Tribes • States	Total dollar amount varies with cost sharing. 100% federal for reconnaissance studies. 50% federal for feasibility studies. 75% federal, 25% non-federal for implementation.

GRANT PROGRAMS	ELIGIBLE PROJECTS	ELIGIBLE PARTICIPANTS	FUNDS AVAILABLE
ACOE **Flood Fighting** Paul Komoroske PO Box C-3755 Seattle, WA 98124-2255 (206) 764-3406 Fax (206) 764-3319	Corps will assist local governments with technical advice, contracting for equipment and materials for flood fighting.	• Cities • Counties • Special purpose districts • Tribes	Cost is 100% federal.
ACOE **Flood Plain Management Services** Joe Weber PO Box C-3755 Seattle, WA 98124-2255 (206) 764-3661 Fax (206) 764-6678	Technical and planning assistance to support effective floodplain management along stream, lake, and coastal areas. Services include evaluation and interpretation of flood event, flood warning; audits and NFIP.	• Cities • Counties • Tribes	Technical assistance. Cost is 100% federal.
ACOE **Levee Rehabilitation** Paul Komoroske PO Box C-3755 Seattle, WA 98124-2255 (206) 764-3406 Fax (206) 764-3319	Rehabilitation and restoration work covers flood control works damaged or destroyed by floods.	• Cities • Counties • Special purpose districts • Tribes	Cost is shared, 80% federal and 20% local. Technical engineering assistance is available. Application period is within 30 days after a disaster.

GRANT PROGRAMS	ELIGIBLE PROJECTS	ELIGIBLE PARTICIPANTS	FUNDS AVAILABLE
ACOE **Shore and Stream Bank Erosion** Lester Soule PO Box C-3755 Seattle, WA 98124-2255 (206) 764-3600 Fax (206) 764-4470	Technical and engineering assistance to public interests in developing structural and non-structural methods to prevent damages from shore and stream bank erosion.	• Cities • Counties • Public utility districts • Ports • Tribes • States	Open funding period. Engineering and environmental technical assistance.
ACOE **Stream Bank and Shoreline Protection Projects** Lester Soule PO Box C-3755 Seattle, WA 98124-2255 (206) 764-3406	Grants to develop and construct emerging stream bank and shoreline protection projects to protect endangered highways, highway bridge approaches, and public works facilities such as water and sewer lines, churches, public and private non-profit schools, and hospitals.	• Cities • Counties • Public utility districts • Ports • Tribes • States	Engineering/environmental technical assistance. Open funding period. Project costs are shared between federal (75%) and local sponsor (25%). Maximum $500,000 per project.
Economic Development and Administration **EDA Grants** Lloyd Kiry 915-2nd Ave #1856 Seattle, WA 98174 (206) 220-7682 Fax (206) 220-7669	Grants for planning economic development strategies, technical assistance, and construction of infrastructure and buildings that facilitate economic expansion and diversification.	• Cities • Counties • Special purpose districts • Ports • Tribes • States (all in economic distress)	Local match required depending on degree of economic distress of area for construction projects.

GRANT PROGRAMS	ELIGIBLE PROJECTS	ELIGIBLE PARTICIPANTS	FUNDS AVAILABLE
Rural Economic and Community Development **Community Facility Loans** PO Box 2427 Wenatchee, WA 98807-2427 (509) 664-0241 Fax (360) 704-7742	Loans to develop essential community facilities for public use in rural areas and towns of not more than 20,000. Use to construct, enlarge, or improve facilities for health care, public safety, and public services.	• Cities • Counties • Special purpose districts • Tribes • Non-Profit	Varies: Maximum loan term – 40 years or useful life. Up to $5 million available per year. On going.
Rural Economic and Community Development **Community Programs Guaranteed Loans** 905-24th Ave SW, Suite B-3 PO Box 2426 Olympia, WA 98507-2426 (360) 753-9881 Fax (360) 753-8082	Guarantees loans by eligible lenders to borrowers in rural areas and in towns of up to 10,000 for developing water and waste disposal facilities or 20,000 for developing other essential community facilities. Use to construct, enlarge, or improve essential facilities	• Counties • Special purpose districts • Tribes • Non-profits • Towns	$35 million is available nationally; usually 80% guaranteed. Extreme situations up to 90%. Year-round.
Rural Economic and Community Development **Rural Utilities Service** Sandra Boughton 301 Yakima St, Room 314 Wenatchee, WA 98801 (509) 664-0200 Fax (509) 664-0202	Grants and loans to construct, repair, improve, expand, or modify water and waste disposal facilities, solid waste and storm drain facilities in rural areas and towns up to 10,000. Also pay fees such as legal and engineering costs connected to development of the facilities. Priority is given to jointly funding projects.	• Cities and towns • Counties • Special purpose districts • Tribes • Non-profit associations	Up to 40-year maximum term. Loans and grants available subject to congressional funding.

APPENDIX C

GLOSSARY

GLOSSARY

(a) Base Flood or 100-year flood. The flood having a one percent chance of being equaled or exceeded in any given year. (WAC and 44 CFR)

(b) Comprehensive Flood Control Management Plan (CFCMP). A document which determines the need for flood control work, considers alternatives to in-stream flood control work, identifies and considers potential impacts of in-stream flood control work on the state's in-stream resources, and identifies the river's meander belt or floodway, as described in WAC 173-145-040. (WAC)

(c) Community Rating System (CRS). A system in the National Flood Insurance Program that recognizes community efforts beyond those minimum standards by reducing flood insurance premiums for the community's property owners. (NFIP/CRS)

(d) Development. Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations, or storage of equipment or materials. (44 CFR)

(e) Flood or Flooding. A general and temporary condition of partial or complete inundation of normally dry land areas from; the overflow of inland or tidal waters, or the unusual and rapid accumulation or runoff of surface waters from any source. (44 CFR)

(f) Flood Insurance Rate Map (FIRM). The official map on which the federal insurance administration has delineated both the areas of special flood hazard and the risk premium zones applicable to the community. (WAC)

(g) Floodway. 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 a designated height. (WAC)

(h) Floodway Fringe. That portion of a floodplain which is inundated by floodwaters but is not within a defined floodway. Floodway fringes serve as temporary storage for floodwaters. (Yakima County Code, Washington)

(i) Flood Compatible Land Uses. Those uses of the land within the river's meander belt or floodway which comply with the minimum state, federal, and local floodplain management regulation requirements. (WAC)

(j) Floodplain. Any land area susceptible to being inundated by water from any source. (44 CFR)

(k) Floodplain Management. The operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works, and floodplain management regulations. (44 CFR)

(l) Floodplain Management Activities. Activities described in WAC 173-145-050 performed by local governments through ordinances or other means to reduce the damaging effects of flooding. (WAC)

(m) Floodplain Management Regulations. Zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances, and other applications of police power. The term describes such state or local regulations, in any combination thereof, which provide standards for the purpose of flood damage prevention and reduction. (44 CFR)

(n) Hazard Mitigation. Any action taken to reduce or eliminate the long-term risk to human life and property from natural hazards. (44 CFR)

(o) Meander Belt. That portion of the floodplain that can be identified by the evidence of present and previous meanders. This shall include the present stream channel. Where there is no identified floodway, that area which is floodprone and has similar topographic characteristics to present and historic stream channels shall be considered as a meander belt. (WAC)

(p) Public Benefit. Benefit to the health, safety, or general welfare of the citizens of the state or community at large which results from a flood control project or plan, or some benefit by which their rights or liabilities are affected such as an effect on public property or facilities owned or maintained by a municipal corporation. (WAC)

(q) Regulatory Floodway. 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 a designated height. (44 CFR)

(r) Riparian. Of, pertaining to, or situated on the edge of the bank of a river or other body of water. (Oregon Planning Goals)

(s) Watershed. The region draining into a river, river system, or body of water. (Webster's II)

(t) Wetlands. Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. [33 CFR 328.3(b) and RCW 36.70A.030(20)]

APPENDIX D

EXAMPLES OF IMPLEMENTATION STRATEGIES

EXAMPLES OF IMPLEMENTATION STRATEGIES

This section describes some of the more innovative and effective flood planning and mitigation programs that are being implemented in the region. These examples are presented as "food for thought" for planners and decision-makers about to undertake similar programs. Each example documents the program's mission, objectives, and implementation techniques and concludes with a discussion of the program's strengths and weaknesses.

Flood Strategies

I. Pierce County River Improvement, Pierce County, Washington

A. Primary Goals:

Pierce County River Improvement (PCRI), a part of the Pierce County Public Works and Utilities Department Water Programs Division, works cooperatively with federal, state, and local agencies to provide flood protection and emergency relief coordination services while promoting responsible uses of the riverine system. Specific goals include:

Comprehensive Storm Drainage Systems: Provide comprehensive storm drainage systems which minimize economic loss and enhance water quality.

Flood Control: Maintain the flood control capacity in the Puyallup, White, and Carbon rivers.

Drinking Water Supply: Coordinate and facilitate planning and construction of the community's drinking water supply consistent with Pierce County's Coordinated Water System and Comprehensive plans.

B. Strategy:

PCRI is funded from two sources: a real estate excise tax (for structural and non-structural improvements to the floodplain management/flood control system) and the Surface Water Management Utility (for existing facilities). The current program objectives are:

1. Implement cost-effective flood control strategies by purchasing $500,000 of developed and undeveloped properties within the 100-year flood plain during 1998.
2. Conduct a gravel removal study, evaluating the long-term effects of gravel removal on salmon and its impact as a flood control measure.
3. Revise mapping areas outside of the 100-year floodplain boundary, upgrade river gauges, and add two new sites to enhance the early flood-warning program.

4. Maintain existing levels of flood protection through routine repair and maintenance of flood control facilities by: 1) placing 10,000 tons of riprap; 2) removing 5,000 cubic yards of gravel; 3) removing 1,500 cords of debris as needed; 4) planting 16,500 willow plants; and 5) clearing or grading three miles of river access.
5. Maintain the county's capability to respond quickly, efficiently, and effectively to flood control emergencies and maintenance needs along the Puyallup, Carbon, and White rivers by: 1) completing annual inventory of 42 miles of river; and 2) producing 50,000 tons of screened gravel and 5,000 tons of riprap at the County Quarry.

The recently completed Puyallup River Basin Comprehensive Flood Control Management Plan included the following recommendations:

1. Coordinate and standardize floodplain regulations for all municipalities throughout the basin.
2. Regulate flood plain development to control inappropriate uses.
3. Develop a flood warning system for the major rivers.
4. Begin a public awareness program promoting responsible uses of the flood plain area.
5. Construct "setback" levees and other structural alternatives further away from the river to allow for a more natural riverine environment.

C. Discussion:

Due to the magnitude of the 1996 flood event, Pierce County was forced to not only repair many of the destroyed flood control facilities, but also to evaluate its river basins and develop a comprehensive flood control management plan. Pierce County has increased its efforts in certain floodplain management activities by gathering and analyzing recent flood data, working towards the establishment of higher regulatory standards, identifying repetitive loss areas, purchasing developed and undeveloped properties within the 100-year floodplain, involving the public in the comprehensive flood control management plan, restoring the levees with "setback" levees to allow the rivers to reclaim more of the meander belt, and upgrading the county's flood warning system.

The results of the Pierce County River Improvement Project will provide at least four significant benefits to the general public of Pierce County:

1. Reduce the impacts of future flood events to public and private properties.
2. Reduce the long-term maintenance costs to publicly owned flood control works.
3. Allow for a more natural riverine environment.
4. Increase the county credits within the Community Rating System, which will result in lower NFIP insurance premiums for the community.

II. Integration of GIS and Hydraulic Modeling for Floodplain Management, Sumas, Washington

A. Primary Goals:

Hydraulic Modeling: Develop a detailed hydraulic model of the Sumas River and the Nooksack River overflow and integrate that model with a GIS.

Flood Hazard Areas: Model and zone critical areas within the city of Sumas subject to flood damage using recent historical flood data to provide an accurate representation of flooding in the city. Provide details of future flooding potential, including the depth of flood water and velocity of flood flows.

B. Strategy:

1. Use the GIS and hydraulic model to better define the critical zones and provide a basis for limiting new development in these zones.
2. Use the GIS and hydraulic model to aid in addressing the international flooding concerns on the Nooksack River.
3. Identify empty plots and undeveloped land within the critical flood hazard zones for potential buy-outs by the city.

C. Discussion:

This strategy of hydraulic modeling is a relatively expensive and time-intensive approach to floodplain management. After the initial investment though, the GIS and hydraulic model combination should be a powerful and diverse tool and will require limited maintenance. This tool will also allow local residents and emergency response personnel to identify the highly critical flood zones during future flood events.

III. Channel Migration Studies and Mapping, King County, Washington

A. Primary Goals:

Floodplain Management: Study and map the meander belt of all major rivers in King County as the basis for land use planning in developing a comprehensive floodplain management plan.

Channel Migration Hazards: Identify existing and historic river channels and, from these, identify channel migration patterns and average annual rates of migration along river sections. Identify homes and development threatened by immediate and long-term migration patterns.

B. Strategy:

1. Use the channel migration maps to better define land use planning zones along the meander belt. Limit development in the at-risk zones.
2. Identify developed and undeveloped plots within the meander belt zones for potential county buy-outs.

C. Discussion:

This approach of studying and mapping the meander belt for purposes of land use planning is relatively expensive. An extensive amount of time and resources are required to study old maps and aerial photographs to establish historical river channels. The need for continuous monitoring and updating of the maps to maintain accuracy means that the long-term cost will remain high. This approach does, however, provide detailed data and a quantitative analysis of channel migration. Flood protection may also be improved as the flood events may result in zones of significant migration leading to flooding in areas outside the zones defined on the flood insurance rate maps.

IV. Rickreal Creek Greenway, Polk County, Oregon

A. Primary Goals:

Comprehensive Planning: Develop a comprehensive plan that confirms with the state of Oregon Statewide Planning Goals relating to floodplain management and natural resources.

Simplified Approach to Regulation: Polk County sought to establish a simplified approach to floodplain management and natural resource preservation ordinances.

B. Strategy:

1. Participate in the National Flood Insurance Program (NFIP). Ensure that development in flood-prone areas is responsive and appropriate for the hazard; such development will require a county building permit and must be flood proof.
2. Establish a riparian setback to limit development along certain natural creeks within Polk County. The riparian setback is defined as three times the average stream width, up to a maximum of 100 feet on either stream bank.

C. Discussion:

The simplified approach to floodplain management and natural resource conservation utilized by Polk County has allowed for low-cost, expedited adoption of planning ordinances. This type of approach allows local communities to take progressive steps toward the mitigation of flood-related damage, while staying within limited budgets and time constraints.

Landslide Strategies

I. Critical Area Regulations Landslide Hazard areas, Bothell, Washington (Draft)

A. Primary Goals:

Disclosure of Risk and Hazard Mitigation: As landslides may constitute a significant threat of loss of life as well as public and private property damage, the primary goals of this ordinance are disclosure of risk and establishment of criteria for mitigation.

B. Strategy:

Geologically hazardous areas include areas susceptible to erosion, sliding, earthquake, or other geological events. A landslide hazardous area is any area that has experienced prior landslides or is particularly susceptible to landslides due to a combination of soil type, topography, and hydrology. It is the intent of the city of Bothell to protect the public's health, safety, and welfare through the regulation of development on or near such hazardous areas, i.e., the property in question as well as the property contiguous to a slide designated area.

The landslide hazard area delineation shall be prepared by a geotechnical professional or professionals qualified in the identification of such areas and shall be mapped.

Landslide hazard area mitigation requirements include:

- Proposed development will not create a hazard to the subject property, surrounding properties, or rights of way and will not produce erosion or sedimentation on off-site properties or in bodies of water.
- Proposal addresses the existing geological constraints of the site, including an assessment of soils and hydrology.
- The proposed method of construction will eliminate or minimize landslide hazard potential.
- Transfer of development rights from one part of the site to another is allowed.

Mitigation approaches in the ordinance include:

- Classification according to degree of landslide hazard.
- Prohibition of development in high landslide hazard areas.
- Requirement for a buffer around high landslide hazard areas.
- Residential density transfer allowed from landslide hazard areas and buffers, with limitations.
- Alterations allowed to landslide hazard areas subject to criteria (CAAP required).

The act creates a critical area mitigation fund administered by the finance director.

C. Discussion:

There are two general approaches to development or other use of potentially hazardous areas, avoidance and alteration. Avoidance does not necessarily reduce the risk of landslide hazards. In some cases alternation of the site (leading to slope stabilization) constitutes mitigation; thus the ordinance establishes clear criteria for alteration eligibility. Where alteration is warranted, the impacts thereof shall be mitigated to ensure that the critical area protection requirements of the GMA are not compromised.

II. Colorado Landslide Hazard Mitigation Plan

A. Primary Goals:

Statewide Coordination: Reduce statewide actual and potential landslide losses through the coordination of loss-reduction efforts by state and local governments. The plan presents six objectives to meet this goal:

1. Identify local government strategies, plans, and programs that can assist in loss reduction.
2. Identify unmet local needs essential to the loss-reduction process.
3. Identify and develop state agency capabilities and initiatives that can deal with unmet local needs.
4. Develop cost-beneficial state mitigation projects that may reasonably be expected to reduce landslide losses.
5. Educate state and local officials and emergency response personnel on the landslide hazard and potential methods for loss reduction.
6. Establish means to provide a long-term, continuous governmental process to reduce losses.

B. Strategy:

This plan proposes a two-prong approach where the primary role in mitigation is assigned to local governments. The state accepts a role for further developing the information and governing infrastructure while the local governments are to put the mitigation "on-the-ground." A wide range of possible strategies and regulatory approaches are suggested for incorporation into local community planning and land use management.

Mitigation options are presented as projects, with implementation cost estimates supplied where possible. These projects are prioritized as Critical Action Projects, Secondary Action Projects, and Follow-up Projects based on the immediacy of the threat and the maturity of the mitigation procedure; local governments are to implement these projects as state and local funding becomes available. When funds are limited, only low-cost projects or those which can be implemented in stages are to be undertaken.

Mitigation actions are further divided into three approaches: modification of community vulnerability, modification of the physical system, and modification of the consequences of landsliding. For example, community vulnerability can be reduced through local land use regulations governing hillside development, particularly through density and soil overlay provisions and grading regulations, even though there is no actual modification of the hazard.

C. Discussion:

As stated in the plan, this is "essentially a support document." The document provides thorough overviews of the nature and history of the Colorado landslide hazard, the concept of mitigation and its role in planning, and the existing mitigation framework (regulations and programs). These, along with a glossary and technical appendices, give local governments a solid foundation for understanding and communicating about the landslide hazard. The Projects chapter provides a "cookbook" for development of a local mitigation program. This is an invaluable resource for local governments with limited technical expertise and staff time.

Acquisition of state and federal support for the identified projects is a major role for the state natural hazards mitigation organization called for by the plan.

III. Preliminary Landslide Policies for Seattle, Washington (June 1998)

A. Primary Goals:

Landslide Policy: The severe winter storms of 1996-1997 caused extensive damage to public and private facilities and raised numerous policy issues for the city:

1. Damage repair costs for city facilities were high and may not be fully reimbursed by FEMA to the level anticipated.
2. Recovery efforts by city agencies, in contrast to the emergency response, were slow and uncoordinated.
3. Blame was placed on the city for some private property damage reportedly caused by inadequate drainage.
4. The city was not insured against loss and some private property owners in seriously impacted areas may not have access to private insurance.
5. Some property owners in steeply sloped areas were unaware of the risks of landsliding and the appropriate best management practices to reduce those risks.
6. The city was (and continues to be) a major landowner of steeply sloping areas.
7. The city may be spending large amounts of money to fix facilities located in landslide prone areas that may be subject to repetitive damages.
8. Some streets in residential areas were informally built and do not meet city standards; upgrading would be very expensive.
9. The Local Improvement District process is not always effective for street and drainage improvements.
10. There is no program to control excess storm water that seeps into the ground and which may contribute to landslides.
11. The city may increase its legal liability if it takes a more active role in protecting the public in landslide prone areas.

At the time of the storm event, the city did not have a comprehensive set of landslide policies. The city's role in these regards had been restricted to response and recovery efforts and regulation of new development in landslide prone areas. In order to address the above issues and better prepare for future events, the city undertook to evaluate and revise current city policies and practices.

B. Strategy:

To initiate this process, the Council considered the city's role as landowner, protector of public safety, regulator of land use, and provider of street and utility services. It analyzed how all of these roles could best be balanced in preparing for and responding to landslide events. A series of public workshops and deliberations were held. The Landslide Policy Group was formed and responded to the request of the Landslide Ad Hoc Committee to propose policy language and programs. The Landslide Policy Group took several actions to improve the emergency response and recovery efforts and presented recommendations in the following three areas:

1. Private responsibilities in landslide prone areas
2. Public infrastructure in landslide prone areas
3. Financing landslide management proposals

Specific recommendations were:

4. Map landslide prone areas (LPAs).
5. Inform citizens of risks and responsibilities in LPAs.
6. Educate citizens about hazards and best management practices in LPAs.
7. Enforce codes and policies in support of best management practices in LPAs.
8. Develop policies for hillsides.
9. Invest in a preventative program to protect public facilities in LPAs.
10. Develop tailored street and drainage standards for residential streets.
11. Address drainage problems.
12. Improve coordination of emergency response and recovery services.
13. Increase the drainage fee to better control storm water runoff.
14. Capitalize a hazard mitigation fund to protect public facilities.
15. Contribute to a risk pool to protect public and private facilities.
16. Use financing mechanisms to help residents and businesses.

Following adoption of the policies by the city in June 1998, they are to implemented throughout the city's organization. Implementation will occur through both stand-alone programs and redirection of current programs and budgets.

C. Discussion:

The Seattle Landslide Policies present an interesting approach to addressing a large-scale situation. City departments with responsibilities for activities and programs concerning landslide areas are directed to fulfill the policy recommendations within their existing organizations. Although the ultimate efficacy of this strategy will not be apparent for some time, it has already served to bring the issues and the general problem of landsliding to the attention of the entire city.

IV. Slope Provisions, Sensitive Area Overlay District, Bellevue, Washington

A. Primary Goals:

Sensitive Area Overlays: The Sensitive Areas Overlay District is a mechanism by which the city recognizes the existence of natural conditions which affect the use and development of property and imposes special regulations on the use and development of that property in order to protect environmentally sensitive areas and the public health, safety, and welfare. Sites characterized by these conditions are referred to as protected areas.

Slope protected areas are those which contain:

1. Areas of colluvial or landslide deposit on slopes of 15 percent or more, together with a primary setback of 75 feet from the toe-of-slope; and/or

2. Slopes of 40 percent or more together with a primary setback of 50 feet from the top-of-slope.

B. Strategy:

1. Development of protected areas is restricted to a set of allowable uses which are generally open space in nature (e.g., tree farm, agriculture, and pedestrian facilities).

2. Structures built adjacent to slope protected areas must be setback 15 feet from the primary setback (*buffer*). Provisions exist for modification of other setbacks when they, in combination with the protected area and primary and structural setbacks, exceed 50 percent of the property dimension.

3. Allowable density (dwelling units per acre) and intensity (floor area ratio for office space) of development are linked to a development factor which is derived from the percentage of the site which is designated as protected area.

4. Performance standards control the extent to which the site may be disturbed and the location, design, and construction types of commercial and office, subdivision and short subdivision, and single-family dwellings.

Calculation of Disturbance Limitations

Disturbance Equation
(square feet of site with 0-15% slope) x 100% + (square feet of site with 15-25% slope) x 60% (square feet of site with 25-40% slope) x 45% (square feet of site with 40% or greater slope) x 30%
Amount of disturbance on-site allowed (square feet)

Source: City of Bellevue Land Use Code, 20.25H.110

C. Discussion:

The use of Special Overlay Districts to control development in "protected areas" allows these provisions to fit seamlessly within the overall Land Use Code. The format and language is similar to other districts (such as the Downtown) which contributes to user-

friendliness. In this context, the protected area restrictions are just another element of the project design and approval process.

The inclusion of the "primary setback" into the protected area definition overcomes the delineation confusion common to this type of ordinance. Such an inclusive delineation, especially in combination with the structural setbacks, ensures that the sensitive sites will be buffered, even when the marked boundaries are inadvertently crossed. The structural setback is adequate to permit construction activities and equipment necessary for development without placing the true buffer at risk. Further, explicit provisions for modification of other, urban design-based setbacks contribute to the enforceability of the protected area setbacks.

Correlation of density and intensity of development with the extent to which the property is assigned as a protected area provides some relief from loss of use resulting from the environmental constraints. In no case is the "percent credit" granted greater than 10 percent of the entire property. The disturbance limits of the performance standards are also intended to balance protection with use of property. The qualitative controls of the performance standards direct development and consequent disturbance to low slope areas, specify that natural topography and vegetation be retained when possible, and that building design be consistent with the constraints of the site.

As a component of the Land Use Code, these provisions guide the implementation of the development goals required by the comprehensive plan. Consideration of the restraints imposed by the variable disturbance limits included in the slope provisions will ensure that growth area allocations are not unexpectedly reduced by the environmental and regulatory constraints. Inventory work conducted in conjunction with the comprehensive planning efforts for environmental factors such as steep slopes will have application (and cost return) during the implementation/regulation phase when provisions such as these exist.

Wildfire Strategies

I. Wildfire Hazard Identification and Mitigation System (WHIMS), Boulder County, Colorado

A. Primary Goals:

Minimize Wildfire Loss: Identify and mitigate the wildfire hazards in the wildland/urban interface areas in hopes of minimizing the potential loss of lives and property from such hazards. This is to be accomplished by:

1. Combining expertise in hazard assessment, forest management, wildfire behavior, and fire suppression; with GIS technology and fire district and community

involvement. WHIMS is designed to used for wildfire hazard identification, homeowner education and motivation, pre-attack planning, emergency response, land use planning, land management, risk assessment, and disaster assessment.
2. Promoting excellent interagency and cross-jurisdictional cooperation and community involvement.

B. Strategy

1. Prepare GIS data for each parcel within the county. This data includes slope, aspect, fuel model type, roadway accesses, and water sources within each fire district.
2. Analyze the GIS data to produce hazard rating maps.
3. Use the hazard rating maps in the development review process and the county comprehensive planning models to ensure high-risk zones are identified prior to development.
4. Maintain the system by periodically updating and adding new information to keep the system dynamic.

C. Discussion:

The WHIMS system represents a creative approach to wildfire analysis for planning purposes by being:

- Comprehensive;
- Preventative rather than reactive;
- Driven at a local level with the desire to get a program in place;
- Dependent on strong interagency cooperation;
- Supported by a high level of volunteer participation; and
- Based upon incentives and education.

It further allows planning and building departments to take a stronger role in the overall mitigation efforts.

II. Wildland Urban Interface Legislation, Clark County, Washington

A. Primary Goals:

Comprehensive Wildland Urban Interface Fire Protection: Develop and establish comprehensive wildland urban interface fire protection through legislation. Quantify and locate interface problems based on nationally recognized standards. Once interface areas are identified, appropriate mitigating measures for each will be

identified by comparing the existing conditions of each area with those present at sites where the mitigating measures had proven effective. The interface areas will also be identified, classified, and mapped for land use planning purposes.

B. Strategy

1. Identify and map geographic boundaries of the interface areas with parcel by parcel identification.
2. Formally recognize the problem and mandate the accommodation of approved and accepted fire resistive designs in future development reviews and approvals.
3. Increase access and signage requirements for roads and driveways.
4. Increase water supply requirements for fire fighting and provide options for delivery systems and mitigation of requirements.
5. Increase fire resistive construction requirements including the prohibition of roof coverings with ratings less than Class C.
6. Establish defensible space requirements for all buildings.
7. Develop provisions for educational material for those considering living in the urban interface areas.
8. Define legal penalties to be imposed where buildings are not constructed or maintained in accordance with the ordinance.

C. Discussion:

The wildland urban interface legislation is a comprehensive approach that identifies and zones critical interface areas. This legislation utilizes nationally recognized mitigation measures and is inclusive of all parcels within the county.

APPENDIX E

MODEL FLOOD DAMAGE PREVENTION ORDINANCE

MODEL FLOOD DAMAGE PREVENTION ORDINANCE

Adoption of this ordinance will comply with the standards for participation in the National Flood Insurance Program (NFIP). The model includes standards and provisions that encourage sound floodplain management and if implemented allows property owners to obtain flood insurance at a more affordable rate.

This model recommends that all residential construction and manufactured homes have their lowest floor elevated one foot above the base flood elevation (100-year flood), and that non-residential construction have the lowest floor elevated one foot above the base flood elevation; or that the area below one foot above the base flood elevation be floodproofed.

The minimum requirement for participation in the NFIP for residential construction and manufactured homes is that the lowest floor be elevated to or above the base flood elevation. Non-residential construction requires that the lowest floor be elevated to or above the base flood elevation or that the area below the base flood elevation be floodproofed.

Even though the minimum standards only require elevation to the base flood elevation, it is recommended that communities adopt the standard in the model ordinance because elevation one foot above the base flood elevation will allow your citizens to receive a substantial reduction in the cost of their flood insurance. Also, as increased development happens, flood elevations can increase, and the one foot above standard allows for an additional margin of safety.

Also, because of the substantial number of manufactured homes that have experienced foundation failure, this model recommends that dry stacked blocks not be used to support manufactured homes in areas of high velocity and/or high water depths.

The model ordinance also includes sections for development in Shallow Flooding Areas (AO Zones), Section 5.5 and Coastal High Hazard Areas (V1-V30, VE and/or V, Section 5.6). If your community does not have either of these zones designated on your Flood Insurance Rate Map, it is not necessary to adopt these sections of the model ordinance.

If you have any questions concerning adoption of this model or participation in the NFIP please contact our Regional Office at (425) 487-4679.

SECTION 1.0
STATUTORY AUTHORIZATION, FINDINGS OF FACT, PURPOSE, AND OBJECTIVES

1.1 STATUTORY AUTHORIZATION

The Legislature of the State of Washington has delegated the responsibility to local governmental units to adopt regulations designed to promote the public health, safety, and general welfare of its citizenry. Therefore, the_____ of _____, does ordain as follows:

1.2 FINDINGS OF FACT

(1) The flood hazard areas of _____ are subject to periodic inundation which results in loss of life and property, health, and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures for flood protection and relief, and impairment of the tax base, all of which adversely affect the public health, safety, and general welfare.
(2) These flood losses are caused by the cumulative effect of obstructions in areas of special flood hazards which increase flood heights and velocities, and when inadequately anchored, damage uses in other areas. Uses that are inadequately floodproofed, elevated, or otherwise protected from flood damage also contribute to the flood loss.

1.3 STATEMENT OF PURPOSE

It is the purpose of this ordinance to promote the public health, safety, and general welfare, and to minimize public and private losses due to flood conditions in specific areas by provisions designed:

(1) To protect human life and health;
(2) To minimize expenditure of public money and costly flood control projects;
(3) To minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
(4) To minimize prolonged business interruptions;
(5) To minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets, and bridges located in areas of special flood hazard;
(6) To help maintain a stable tax base by providing for the sound use and development of areas of special flood hazard so as to minimize future flood blight areas;

(7) To ensure that potential buyers are notified that property is in an area of special flood hazard; and,
(8) To ensure that those who occupy the areas of special flood hazard assume responsibility for their actions.

1.4 METHODS OF REDUCING FLOOD LOSSES

In order to accomplish its purposes, this ordinance includes methods and provisions for:

(1) Restricting or prohibiting uses which are dangerous to health, safety, and property due to water or erosion hazards, or which result in damaging increases in erosion or in flood heights or velocities;
(2) Requiring that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;
(3) Controlling the alteration of natural floodplains, stream channels, and natural protective barriers, which help accommodate or channel flood waters;
(4) Controlling filling, grading, dredging, and other development which may increase flood damage; and
(5) Preventing or regulating the construction of flood barriers which will unnaturally divert flood waters or may increase flood hazards in other areas.

SECTION 2.0
DEFINITIONS

Unless specifically defined below, words or phrases used in this ordinance shall be interpreted so as to give them the meaning they have in common usage and to give this ordinance its most reasonable application.

"APPEAL" means a request for a review of the interpretation of any provision of this ordinance or a request for a variance.

"AREA OF SHALLOW FLOODING" means a designated AO, or AH Zone on the Flood Insurance Rate Map (FIRM). The base flood depths range from one to three feet; a clearly defined channel does not exist; the path of flooding is unpredictable and indeterminate; and, velocity flow may be evident. AO is characterized as sheet flow and AH indicates ponding.

"AREA OF SPECIAL FLOOD HAZARD" means the land in the floodplain within a community subject to a one percent or greater chance of flooding in any given year. Designation on maps always includes the letters A or V.

"BASE FLOOD" means the flood having a one percent chance of being equaled or exceeded in any given year. Also referred to as the "100-year flood." Designation on maps always includes the letters A or V.

"BASEMENT" means any area of the building having its floor subgrade (below ground level) on all sides.

"BREAKAWAY WALL" means a wall that is not part of the structural support of the building and is intended through its design and construction to collapse under specific lateral loading forces, without causing damage to the elevated portion of the building or supporting foundation system.

"COASTAL HIGH HAZARD AREA" means an area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources. The area is designated on the FIRM as Zone V1-V30, VE or V.

"CRITICAL FACILITY" means a facility for which even a slight chance of flooding might be too great. Critical facilities include, but are not limited to schools, nursing homes, hospitals, police, fire and emergency response installations, installations which produce, use or store hazardous materials or hazardous waste.

"DEVELOPMENT" means any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation, or drilling operations or storage of equipment or materials located within the area of special flood hazard.

"ELEVATED BUILDING" means for insurance purposes, a nonbasement building which has its lowest elevated floor raised above ground level by foundation walls, shear walls, post, piers, pilings, or columns.

"EXISTING MANUFACTURED HOME PARK OR SUBDIVISION" means a manufactured home park subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed before the effective date of the adopted flood plain management regulations.

"EXPANSION TO AN EXISTING MANUFACTURED HOME PARK OR SUBDIVISION" means the preparation of additional sites by the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads).

"FLOOD" OR "FLOODING" means a general and temporary condition of partial or complete inundation of normally dry land areas from:

(1) The overflow of inland or tidal waters and/or
(2) The unusual and rapid accumulation of runoff of surface waters from any source.

"FLOOD INSURANCE RATE MAP (FIRM)" means the official map on which the Federal Insurance Administration has delineated both the areas of special flood hazards and the risk premium zones applicable to the community.

"FLOOD INSURANCE STUDY" means the official report provided by the Federal Insurance Administration that includes flood profiles, the Flood Boundary-Floodway Map, and the water surface elevation of the base flood.

"FLOODWAY" means 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.

"LOWEST FLOOR" means the lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access, or storage, in an area other than a basement area, is not considered a building's lowest floor, provided that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirements of this ordinance found at Section 5.2-1(2).

"MANUFACTURED HOME" means a structure, transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when attached to the required utilities. The term "manufactured home" does not include a "recreational vehicle."

"MANUFACTURED HOME PARK OR SUBDIVISION" means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

"NEW CONSTRUCTION" means structures for which the "start of construction" commenced on or after the effective date of this ordinance.

"NEW MANUFACTURED HOME PARK OR SUBDIVISION" means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after the effective date of adopted flood plain management regulations.

"RECREATIONAL VEHICLE" means a vehicle which is:

(a) Built on a single chassis;
(b) 400 square feet or less when measured at the largest horizontal projection;
(c) Designed to be self-propelled or permanently towable by a light duty truck; and
(d) Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use.

"START OF CONSTRUCTION" includes substantial improvement, and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, placement or other improvement was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for a basement, footings, piers, or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

"STRUCTURE" means a walled and roofed building including a gas or liquid storage tank that is principally above ground.

"SUBSTANTIAL DAMAGE" means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

"SUBSTANTIAL IMPROVEMENT" means any repair, reconstruction, or improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure either:

(1) Before the improvement or repair is started; or
(2) If the structure has been damaged and is being restored, before the damage occurred. For the purposes of this definition "substantial improvement" is considered to occur when the first alteration of any wall, ceiling, floor, or other structural part of the

building commences, whether or not that alteration affects the external dimensions of the structure.

The term does not, however, include either:

(1) Any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary to assure safe living conditions, or
(2) Any alteration of a "historic structure," provided that the alteration will not preclude the structure's continued designation as a "historic structure."

"VARIANCE" means a grant of relief from the requirements of this ordinance which permits construction in a manner that would otherwise be prohibited by this ordinance.

"WATER DEPENDENT" means a structure for commerce or industry which cannot exist in any other location and is dependent on the water by reason of the intrinsic nature of its operations.

SECTION 3.0
GENERAL PROVISIONS

3.1 LANDS TO WHICH THIS ORDINANCE APPLIES

This ordinance shall apply to all areas of special flood hazards within the jurisdiction of _____ .

3.2 BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD

The areas of special flood hazard identified by the Federal Insurance Administration in a scientific and engineering report entitled "The Flood Insurance Study for the _____," dated _____, 19__, as amended, with an accompanying Flood Insurance Rate Map (FIRM), as amended, are hereby adopted by reference and declared to be a part of this ordinance. The Flood Insurance Study is on file at _____. The best available information for flood hazard area identification as outlined in Section 4.3-2 shall be the basis for regulation until a new FIRM is issued which incorporates the data utilized under Section 4.3-2.

3.3 PENALTIES FOR NONCOMPLIANCE

No structure or land shall hereafter be constructed, located, extended, converted, or altered without full compliance with the terms of this ordinance and other applicable regulations. Violations of the provisions of this ordinance by failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with conditions), shall constitute a misdemeanor. Any person who violates this ordinance or fails to comply with any of its requirements shall upon conviction thereof be fined not more than _____ or imprisoned for not more than ____ days, or both, for each violation, and in addition shall pay all costs and expenses involved in the case. Nothing herein contained shall prevent the _____ from taking such other lawful action as is necessary to prevent or remedy any violation.

3.4 ABROGATION AND GREATER RESTRICTIONS

This ordinance is not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this ordinance and another ordinance, easement, covenant, or deed restriction conflict or overlap, whichever imposes the more stringent restrictions shall prevail.

3.5 INTERPRETATION

In the interpretation and application of this ordinance, all provisions shall be:

(1) Considered as minimum requirements;
(2) Liberally construed in favor of the governing body; and,
(3) Deemed neither to limit nor repeal any other powers granted under State statutes.

3.6 WARNING AND DISCLAIMER OF LIABILITY

The degree of flood protection required by this ordinance is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Larger floods can and will occur on rare occasions. Flood heights may be increased by man-made or natural causes. This ordinance does not imply that land outside the areas of special flood hazards or uses permitted within such areas will be free from flooding or flood damages. This ordinance shall not create liability on the part of_____,
any officer or employee thereof, or the Federal Insurance Administration, for any flood damages that result from reliance on this ordinance or any administrative decision lawfully made hereunder.

SECTION 4.0
ADMINISTRATION

4.1 ESTABLISHMENT OF DEVELOPMENT PERMIT

4.1-1 Development Permit Required

A development permit shall be obtained before construction or development begins within any area of special flood hazard established in Section 3.2. The permit shall be for all structures including manufactured homes, as set forth in the "DEFINITIONS," and for all development including fill and other activities, also as set forth in the "DEFINITIONS."

4.1-2 Application for Development Permit

Application for a development permit shall be made on forms furnished by the_____ and may include, but not be limited to, plans in duplicate drawn to scale showing the nature, location, dimensions, and elevations of the area in question; existing or proposed structures, fill, storage of materials, drainage facilities, and the location of the foregoing. Specifically, the following information is required:

(1) Elevation in relation to mean sea level, of the lowest floor (including basement) of all structures;
(2) Elevation in relation to mean sea level to which any structure has been floodproofed;
(3) Certification by a registered professional engineer or architect that the floodproofing methods for any nonresidential structure meet the floodproofing criteria in Section 5.2-2; and
(4) Description of the extent to which a watercourse will be altered or relocated as a result of proposed development.

4.2 DESIGNATION OF THE LOCAL ADMINISTRATOR

The (local administrator) is hereby appointed to administer and implement this ordinance by granting or denying development permit applications in accordance with its provisions.

4.3 DUTIES AND RESPONSIBILITIES OF THE LOCAL ADMINISTRATOR

Duties of the (local administrator) shall include, but not be limited to:

4.3-1 Permit Review

(1) Review all development permits to determine that the permit requirements of this ordinance have been satisfied.
(2) Review all development permits to determine that all necessary permits have been obtained from those Federal, State, or local governmental agencies from which prior approval is required.
(3) Review all development permits to determine if the proposed development is located in the floodway. If located in the floodway, assure that the encroachment provisions of Section 5.3(1) are met.

4.3-2 Use of Other Base Flood Data

When base flood elevation data has not been provided in accordance with Section 3.2, BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD, the (local administrator) shall obtain, review, and reasonably utilize any base flood elevation and floodway data available from a Federal, State or other source, in order to administer Sections 5.2, SPECIFIC STANDARDS, and 5.3 FLOODWAYS.

4.3-3 Information to be Obtained and Maintained

(1) Where base flood elevation data is provided through the Flood Insurance Study or required as in Section 4.3-2, obtain and record the actual elevation (in relation to mean sea level) of the lowest floor (including basement) of all new or substantially improved structures, and whether or not the structure contains a basement.

(2) For all new or substantially improved floodproofed structures:

(i) Verify and record the actual elevation (in relation to mean seal level), and
(ii) Maintain the floodproofing certifications required in Section 4.1-2(3).

(3) Maintain for public inspection all records pertaining to the provisions of this ordinance.

4.3-4 Alteration of Watercourses

(1) Notify adjacent communities and the Department of Ecology prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the Federal Insurance Administration.
(2) Require that maintenance is provided within the altered or relocated portion of said watercourse so that the flood carrying capacity is not diminished.

4.3-5 Interpretation of FIRM Boundaries

Make interpretations where needed, as to exact location of the boundaries of the areas of special flood hazards (for example, where there appears to be a conflict between a mapped boundary and actual field conditions). The person contesting the location of the boundary shall be given a reasonable opportunity to appeal the interpretation as provided in Section 4.4.

NOTE - If you do not include Section 4.4 (Variance Procedure), end the above sentence after the word "interpretation," and add the following sentence: "such appeals shall be granted consistent with the standards of Section 60.6 of the Rules and Regulations of the National Flood Insurance Program (44 CFR 59-76).

4.4 VARIANCE PROCEDURE

4.4-1 Appeal Board

(1) The _____ as established by _____ shall hear and decide appeals and requests for variances from the requirements of this ordinance.
(2) The _____ shall hear and decide appeals when it is alleged there is an error in any requirement, decision, or determination made by the _____ in the enforcement or administration of this ordinance.
(3) Those aggrieved by the decision of the _____, or any taxpayer, may appeal such decision to the _____ , as provided in _____ .
(4) In passing upon such applications, the _____ shall consider all technical evaluations, all relevant factors, standards specified in other sections of this ordinance, and:

(i) The danger that materials may be swept onto other lands to the injury of others;
(ii) The danger to life and property due to flooding or erosion damage;
(iii) The susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner;
(iv) The importance of the services provided by the proposed facility to the community;
(v) The necessity to the facility of a waterfront location, where applicable;

(vi) The availability of alternative locations for the proposed use which are not subject to flooding or erosion damage;
(vii) The compatibility of the proposed use with existing and anticipated development;
(viii) The relationship of the proposed use to the comprehensive plan and flood plain management program for that area;
(ix) The safety of access to the property in times of flood for ordinary and emergency vehicles;
(x) The expected heights, velocity, duration, rate of rise, and sediment transport of the flood waters and the effects of wave action, if applicable, expected at the site; and,
(xi) The costs of providing governmental services during and after flood conditions, including maintenance and repair of public utilities and facilities such as sewer, gas, electrical, and water systems, and streets and bridges.

(5) Upon consideration of the factors of Section 4.4-1(4) and the purposes of this ordinance, the _____ may attach such conditions to the granting of variances as it deems necessary to further the purposes of this ordinance.
(6) The _____ shall maintain the records of all appeal actions and report any variances to the Federal Insurance Administration upon request.

4.4-2 Conditions for Variances

(1) Generally, the only condition under which a variance from the elevation standard may be issued is for new construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, providing items (i-xi) in Section 4.4-1(4) have been fully considered. As the lot size increases the technical justification required for issuing the variance increases.
(2) Variances may be issued for the reconstruction, rehabilitation, or restoration of structures listed on the National Register of Historic Places or the State Inventory of Historic Places, without regard to the procedures set forth in this section.
(3) Variances shall not be issued within a designated floodway if any increase in flood levels during the base flood discharge would result.
(4) Variances shall only be issued upon a determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.
(5) Variances shall only be issued upon:

(i) A showing of good and sufficient cause;
(ii) A determination that failure to grant the variance would result in exceptional hardship to the applicant;

(iii) A determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws or ordinances.

(6) Variances as interpreted in the National Flood Insurance Program are based on the general zoning law principle that they pertain to a physical piece of property; they are not personal in nature and do not pertain to the structure, its inhabitants, economic or financial circumstances. They primarily address small lots in densely populated residential neighborhoods. As such, variances from the flood elevations should be quite rare.

(7) Variances may be issued for nonresidential buildings in very limited circumstances to allow a lesser degree of floodproofing than watertight or dry-floodproofing, where it can be determined that such action will have low damage potential, complies with all other variance criteria except 4.4-2(1), and otherwise complies with Sections 5.1-1 and 5.1-2 of the GENERAL STANDARDS.

(8) Any applicant to whom a variance is granted shall be given written notice that the structure will be permitted to be built with a lowest floor elevation below the base flood elevation and that the cost of flood insurance will be commensurate with the increased risk resulting from the reduced lowest floor elevation.

SECTION 5.0
PROVISIONS FOR FLOOD HAZARD REDUCTION

5.1 GENERAL STANDARDS

In all areas of special flood hazards, the following standards are required:

5.1-1 Anchoring

(1) All new construction and substantial improvements shall be anchored to prevent flotation, collapse, or lateral movement of the structure.

(2) All manufactured homes must likewise be anchored to prevent flotation, collapse, or lateral movement, and shall be installed using methods and practices that minimize flood damage. Anchoring methods may include, but are not limited to, use of over-the-top or frame ties to ground anchors (Reference FEMA's "Manufactured Home Installation in Flood Hazard Areas" guidebook for additional techniques).

5.1-2 Construction Materials and Methods

(1) All new construction and substantial improvements shall be constructed with materials and utility equipment resistant to flood damage.
(2) All new construction and substantial improvements shall be constructed using methods and practices that minimize flood damage.
(3) Electrical, heating, ventilation, plumbing, and air-conditioning equipment and other service facilities shall be designed and/or otherwise elevated or located so as to prevent water from entering or accumulating within the components during conditions of flooding.

5.1-3 Utilities

(1) All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system;
(2) The proposed water well shall be located on high ground that is not in the floodway (WAC 173-160-171);
(3) New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharge from the systems into flood waters; and,
(4) On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

5.1-4 Subdivision Proposals

(1) All subdivision proposals shall be consistent with the need to minimize flood damage;
(2) All subdivision proposals shall have public utilities and facilities such as sewer, gas, electrical, and water systems located and constructed to minimize flood damage;
(3) All subdivision proposals shall have adequate drainage provided to reduce exposure to flood damage; and,
(4) Where base flood elevation data has not been provided or is not available from another authoritative source, it shall be generated for subdivision proposals and other proposed developments which contain at least 50 lots or five acres (whichever is less).

5.1-5 Review of Building Permits

Where elevation data is not available either through the Flood Insurance Study or from another authoritative source (Section 4.3-2), applications for building permits shall be reviewed to assure that proposed construction will be reasonably safe from flooding. The test of reasonableness is a local judgment and includes use of historical data, high water

marks, photographs of past flooding, etc., where available. Failure to elevate at least two feet above grade in these zones may result in higher insurance rates.

5.2 SPECIFIC STANDARDS

In all areas of special flood hazards where base flood elevation data has been provided as set forth in Section 3.2, BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD or Section 4.3-2, Use of Other Base Flood Data, the following provisions are required:

5.2-1 Residential Construction

(1) New construction and substantial improvement of any residential structure shall have the lowest floor, including basement, elevated one foot above the base flood elevation.
(2) Fully enclosed areas below the lowest floor that are subject to flooding are prohibited, or shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or must meet or exceed the following minimum criteria:

(i) A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided.
(ii) The bottom of all openings shall be no higher than one foot above grade.
(iii) Openings may be equipped with screens, louvers, or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.

5.2-2 Nonresidential Construction

New construction and substantial improvement of any commercial, industrial, or other nonresidential structure shall either have the lowest floor, including basement, elevated one foot above the base flood elevation; or, together with attendant utility and sanitary facilities, shall:

(1) Be floodproofed so that below one foot above the base flood level the structure is watertight with walls substantially impermeable to the passage of water;
(2) Have structural components capable of resisting hydrostatic and hydrodynamic loads and effects of buoyancy;
(3) Be certified by a registered professional engineer or architect that the design and methods of construction are in accordance with accepted standards of practice for

meeting provisions of this subsection based on their development and/or review of the structural design, specifications, and plans. Such certifications shall be provided to the official as set forth in Section 4.3-3(2);

(4) Nonresidential structures that are elevated, not floodproofed, must meet the same standards for space below the lowest floor as described in 5.2-1(2);

(5) Applicants floodproofing nonresidential buildings shall be notified that flood insurance premiums will be based on rates that are one foot below the floodproofed level (e.g. a building floodproofed to the base flood level will be rated as one foot below).

5.2-3 Manufactured Homes

(1) All manufactured homes to be placed or substantially improved within Zones A1-A30, AH, and AE on the community's FIRM on sites:

(i) Outside of a manufactured home park or subdivision,
(ii) In a new manufactured home park or subdivision,
(iii) In an expansion to an existing manufactured home park or subdivision, or
(iv) In an existing manufactured home park or subdivision on which a manufactured home has incurred "substantial damage" as the result of a flood;

shall be elevated on a permanent foundation such that the lowest floor of the manufactured home is elevated one foot above the base flood elevation and be securely anchored to an adequately designed foundation system to resist flotation, collapse, and lateral movement.

(2) Manufactured homes to be placed or substantially improved on sites in an existing manufactured home park or subdivision within Zones A1-30, AH, and AE on the community's FIRM that are not subject to the above manufactured home provisions be elevated so that either:

(i) The lowest floor of the manufactured home is elevated one foot above the base flood elevation, or
(ii) The manufactured home chassis is supported by reinforced piers or other foundation elements of at least equivalent strength that are no less than 36 inches in height above grade and be securely anchored to an adequately designed foundation system to resist flotation, collapse, and lateral movement.

5.2-4 Recreational Vehicles

Recreational vehicles placed on sites within Zones A1-30, AH, and AE on the community's

FIRM either:

(i) Be on the site for fewer than 180 consecutive days,
(ii) Be fully licensed and ready for highway use, on its wheels or jacking system, is attached to the site only by quick disconnect type utilities and security devices, and has no permanently attached additions; or
(iii) Meet the requirements of 5.2-3 above and the elevation and anchoring requirements for manufactured homes.

5.3 FLOODWAYS

Located within areas of special flood hazard established in Section 3.2 are areas designated as floodways. Since the floodway is an extremely hazardous area due to the velocity of flood waters which carry debris, potential projectiles, and erosion potential, the following provisions apply:

(1) Prohibit encroachments, including fill, new construction, substantial improvements, and other development unless certification by a registered professional engineer is provided demonstrating that encroachments shall not result in any increase in flood levels during the occurrence of the base flood discharge.
(2) Construction or reconstruction of residential structures is prohibited within designated floodways, except for (i) repairs, reconstruction, or improvements to a structure which do not increase the ground floor area; and (ii) repairs, reconstruction or improvements to a structure, the cost of which does not exceed 50 percent of the market value of the structure either, (A) before the repair, or reconstruction is started, or (B) if the structure has been damaged, and is being restored, before the damage occurred. Any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary to assure safe living conditions or to structures identified as historic places shall not be included in the 50 percent.
(3) If Section 5.3(1) is satisfied, all new construction and substantial improvements shall comply with all applicable flood hazard reduction provisions of Section 5.0, PROVISIONS FOR FLOOD HAZARD REDUCTION.

5.4 ENCROACHMENTS

The cumulative effect of any proposed development, where combined with all other existing and anticipated development, shall not increase the water surface elevation of the base flood more than one foot at any point.

5.5 STANDARDS FOR SHALLOW FLOODING AREAS (AO ZONES)

Shallow flooding areas appear on FIRMs as AO zones with depth designations. The base flood depths in these zones range from one to three feet above ground where a clearly defined channel does not exist, or where the path of flooding is unpredictable and where velocity flow may be evident. Such flooding is usually characterized as sheet flow. In these areas, the following provisions apply:

(1) New construction and substantial improvements of residential structures and manufactured homes within AO zones shall have the lowest floor (including basement) elevated above the highest grade adjacent to the building, one foot or more above the depth number specified in feet on the FIRM (at least two feet if no depth number is specified).

(2) New construction and substantial improvements of nonresidential structures within AO zones shall either:

(i) Have the lowest floor (including basement) elevated above the highest adjacent grade of the building site, one foot or more above the depth number specified on the FIRM (at least two feet if no depth number is specified); or

(ii) Together with attendant utility and sanitary facilities, be completely flood proofed to or above that level so that any space below that level is watertight with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy. If this method is used, compliance shall be certified by a registered professional engineer or architect as in section 5.2-2(3).

(3) Require adequate drainage paths around structures on slopes to guide floodwaters around and away from proposed structures.

(4) Recreational vehicles placed on sites within AO Zones on the community's FIRM either:

(i) Be on the site for fewer than 180 consecutive days,

(ii) Be fully licensed and ready for highway use, on its wheels or jacking system, is attached to the site only by quick disconnect type utilities and security devices,

and has no permanently attached additions; or

(iii) Meet the requirements of 5.5 above and the elevation and anchoring requirements for manufactured homes.

5.6 COASTAL HIGH HAZARD AREAS

Located within areas of special flood hazard established in Section 3.2 are Coastal High Hazard Areas, designated as Zones V1-V30, VE and/or V. These areas have special flood hazards associated with high velocity waters from surges and, therefore, in addition to meeting all provisions in this ordinance, the following provisions shall also apply:

(1) All new construction and substantial improvements in Zones V-V30 and VE (V if base flood elevation data is available) shall be elevated on pilings and columns so that:

(i) The bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated one foot or more above the base flood level; and

(ii) The pile or column foundation and structure attached thereto is anchored to resist flotation, collapse, and lateral movement due to the effects of wind and water loads acting simultaneously on all building components. Wind and water loading values shall each have a one percent chance of being equaled or exceeded in and given year (100-year mean recurrence interval);

(2) A registered professional engineer or architect shall develop or review the structural design, specifications and plans for the construction, and shall certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of Section 5.6(1)(i) and (ii).

(3) Obtain the elevation (in relation to mean sea level) of the bottom of the lowest structural member of the lowest floor (excluding pilings and columns) of all new and substantially improved structures in Zones V1-30 and VE, and whether or not such structures contain a basement. The local administrator shall maintain a record of all such information.

(4) All new construction shall be located landward of the reach of mean high tide.

(5) Provide that all new construction and substantial improvements have the space below the lowest floor either free of obstruction or constructed with non-supporting breakaway walls, open wood lattice-work, or insect screening intended to collapse under wind and water loads without causing collapse, displacement, or other structural damage to the elevated portion of the building or supporting foundation system. For the purposes of this section, a breakaway wall shall have a design safe loading resistance of not less than 10 and no more than 20 pounds per square foot. Use of breakaway

walls which exceed a design safe loading resistance of 20 pounds per square foot (either by design or when so required by local or state codes) may be permitted only if a registered professional engineer or architect certifies that the designs proposed meet the following conditions:

(i) Breakaway wall collapse shall result from water load less than that which would occur during the base flood; and
(ii) The elevated portion of the building and supporting foundation system shall not be subject to collapse, displacement, or other structural damage due to the effects of wind and water loads acting simultaneously on all building components (structural and non-structural). Maximum wind and water loading values to be used in this determination shall each have a one percent chance of being equaled or exceeded in any given year (100-year mean recurrence interval).

(6) If breakaway walls are utilized, such enclosed space shall be useable solely for parking of vehicles, building access, or storage. Such space shall not be used for human habitation.
(7) Prohibit the use of fill for structural support of buildings.
(8) Prohibit man-made alteration of sand dunes which would increase potential flood damage.
(9) All manufactured homes to be placed or substantially improved within Zones V1-V30, V, and VE on the community's FIRM on sites:

(i) Outside of a manufactured home park or subdivision,
(ii) In a new manufactured home park or subdivision,
(iii) In an expansion to an existing manufactured home park or subdivision, or
(iv) In an existing manufactured home park or subdivision on which a manufactured home has incurred "substantial damage" as the result of a flood;

Shall meet the standards of paragraphs 5.6(1) through (8) of this section and that manufactured homes placed or substantially improved on other sites in an existing manufactured home park or subdivision within Zones V1-30, V, and VE on the FIRM meet the requirements of Section 5.2-3.
(10) Recreational vehicles placed on sites within Zones V1-30, V, and VE on the community's FIRM either:

(i) Be on the site for fewer than 180 consecutive days,
(ii) Be fully licensed and ready for highway use, on its wheels or jacking system, is attached to the site only by quick disconnect type utilities and security devices, and has no permanently attached additions; or
(iii) Meet the requirements of Section 4.1-1(Permitting requirements) and paragraphs 5.6(1) through (8) of this section.

5.7 CRITICAL FACILITY

Construction of new critical facilities shall be, to the extent possible, located outside the limits of the special flood hazard area (SFHA) (100-year flood plain). Construction of new critical facilities shall be permissible within the SFHA if no feasible alternative site is available. Critical facilities constructed within the SFHA shall have the lowest floor elevated three feet or more above the level of the base flood elevation (100-year) at the site. Floodproofing and sealing measures must be taken to ensure that toxic substances will not be displaced by or released into flood waters. Access routes elevated to or above the level of the base flood elevation shall be provided to all critical facilities to the extent possible.

APPENDIX F

MODEL NATURAL HAZARD REDUCTION ELEMENT

The following information is an outline of a Natural Hazard Reduction Element for the small town of Chum, Washington. No relationships to actual locations or circumstances are implied. For examples of other goals, policies, and implementation strategies, see Appendix D.

INTRODUCTION AND SUMMARY

Numbers shown below in the margin indicate chapters of the Guidebook where information is provided to help with this section of the plan

This comprehensive plan element is intended to provide the citizens of Chum with assurance that the community has addressed issues associated with natural hazards and related disasters. Chum has been subjected to property losses due to flooding, landslides, and wildfires in the past. Past disasters have resulted in reliance on state and federal agencies for reconstruction and mitigation in the form of disaster relief activities and emergency reconstruction payments as well as local bond issues to pay for local matching requirements for federal grants. Funds have been expended for:

- Clean up and repair of damages to city property;
- Payments to private property owners;
- Utility system repairs;
- Debris clean up; and
- Slope regrading and stabilization.

2

The Chum City Council believes that the city should do everything in its power to avoid future disaster events and the related reliance on federal and state mitigation assistance. The Council is also aware that more and more federal agencies are requiring that repairs comply with an adopted mitigation plan. The Council therefore believes that linking hazard avoidance to the comprehensive plan and development code can reduce vulnerability to these events. This approach also has the advantage of reducing the federal mitigation costs (and the local match), and it prepares the city to respond more effectively to disasters that are unavoidable. City funds otherwise used to rebuild after disasters can then be used for other, more productive purposes.

Process

2

This element was produced by city staff with the assistance of the Community Advisory Committee and representatives of the state Emergency Management Division; Community, Trade and Economic Development (CTED); and the Federal Emergency Management Agency (FEMA).

The process included:

- List of meetings
- Community workshops
- Background reports and analysis of prior hazard incidents and mitigation programs and costs
- Interviews of town historians
- Research into newspaper and historical records
- Technical consultations with local consultants and agency staff
- Compilation of source materials from development proposals
- Draft reviews discussions with the Planning Commission and Advisory Committee

Community Background

In recent history, Chum has suffered several events as shown below:

2

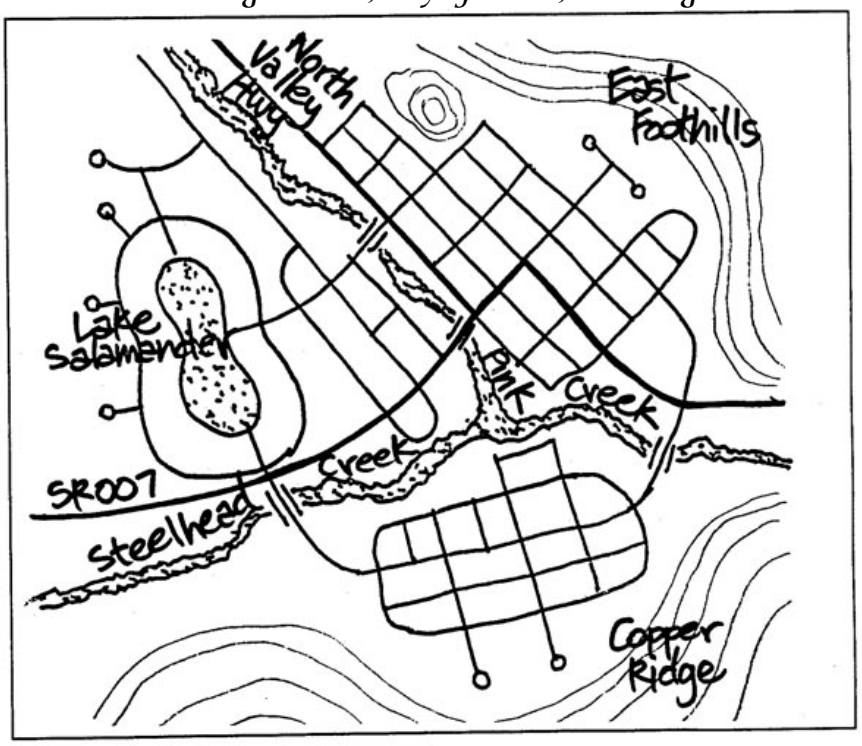
Event	Duration	Location	Cost*
Landslide	Nov-Dec 94	East Foothills	$400,000
Landslide	Jan 95	East Foothills	$2,750,000
Wildfire	Aug 95	North Valley	$35,000
Flood	Apr 96	North Valley	$235,000
Flood/Slide	Jun 98	East Foothills	$1,175,000

***Funds from federal and state assistance grants and loans. Additional city expenses and local administration costs not included.**

This recent history, plus other documented events discovered during the preparation of the element, begin to point out geographic areas and development types that are susceptible to hazard events. The element is intended to address these hazards.

The city is constrained on two sides by steep hillsides subject to landslides. Steelhead and Pink creeks and Salamander Lake are subject to seasonal flooding. The abundant vegetation surrounding the city creates vulnerability to wildfires.

Figure H-1, City of Chum, Washington



Definitions

3

The following terms are used in the element and are important since they relate to state and federal program guidance and regulations.

- Landslides – Earth movement on hillsides triggered by over-saturated soils, poor drainage, or slope failures.
- Flooding – A general and temporary condition of partial or complete inundation of normally dry land areas from the overflow of inland or tidal waters, or the unusual and rapid accumulation or runoff of surface waters from any source.
- Wildfires – Fires initially started in burning vegetation in undeveloped areas triggered by natural events such as lightning or by human activities such as trash burning which can spread into urban areas.

Vision Statement

The City of Chum should be a safe, secure place for its citizens. Safety from natural hazard events such as floods, landslides, and wildfires cannot be completely assured, but the comprehensive plan and development code do provide measures for avoiding many types of events which have occurred in the past.

Goals, Policies, and Strategies

The following goals, policies, and action strategies were developed during the process and reflect the conclusions and agreement of the Advisory Committee, Chum Planning Commission, and Chum City Council for effective measures that can be implemented by the city.

4

Primary Goal: Reduce city exposure to floods, landslides, and wildfires to minimize reliance on federal and state programs for disaster mitigation; protect public and private property; save lives; and use community resources wisely.

Policies

Policy H-1: Utilize natural features such as floodplain boundaries and steep slopes to control development that could result in increasing hazard susceptibility.

Policy H-2: Integrate regulatory standards such as buffers and setbacks with hazard avoidance measures.

Policy H-3: Coordinate hazard vulnerability assessments with programs for purchase or preservation of open space.

Policy H-4: Update hazard mitigation and disaster plans annually.

Policy H-5: Coordinate related activities of city departments with the county and state and federal agencies.

Strategies

Strategy H-1: Complete hazard mapping and designation of key protection areas.

Strategy H-2: Revise the development code to increase setbacks from steep slopes.

Strategy H-3: Program incremental purchase of North Valley floodway into the Capital Facilities Plan and the Six-Year Financing Plan.

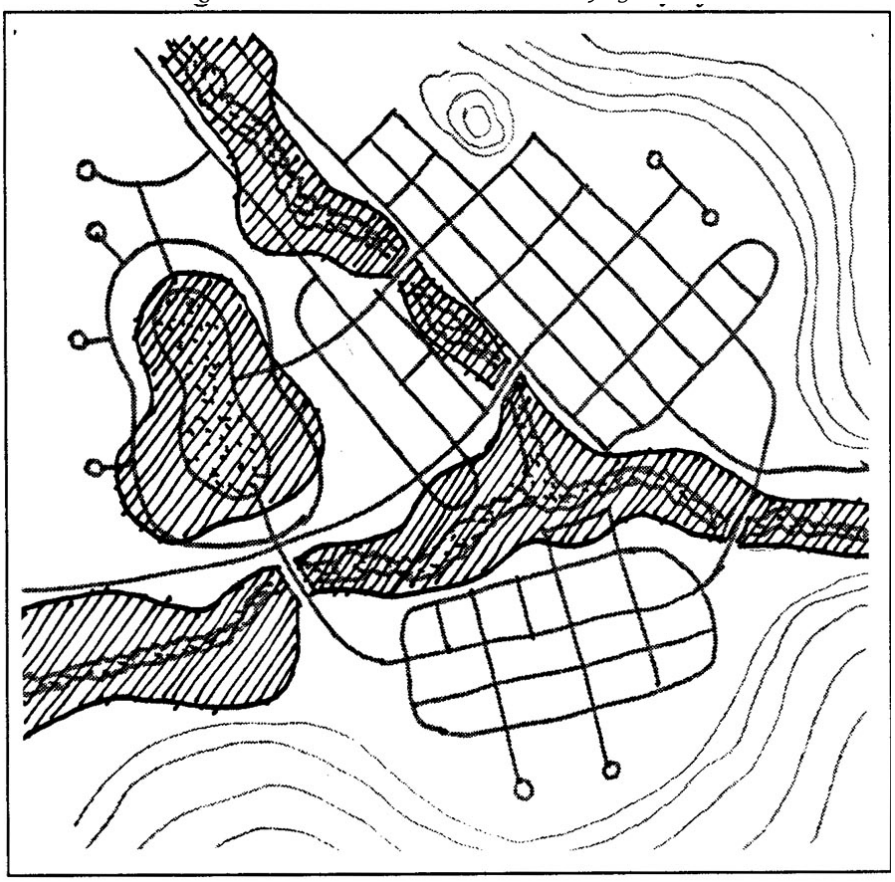
RISK AND VULNERABILITY ASSESSMENT

3

Flood Hazard Areas

Figure H-2 depicts the areas most vulnerable to flooding within the Chum planning area. This includes the floodplains and floodways of the Steelhead and Pink watersheds, the lowlands around Lake Salamander, and some low-lying areas that have had historical flooding. The mapping is based on the FEMA data with some additional information provided by local residents. In addition, the areas have been adapted from the critical areas ordinance designation of frequently flooded areas and the Shoreline Master Program (SMP).

Figure H-2 Flood Hazard Areas, City of Chum



Vulnerability Assessment

4

Each of the flood hazard areas is characterized in the following chart in terms of its respective vulnerability.

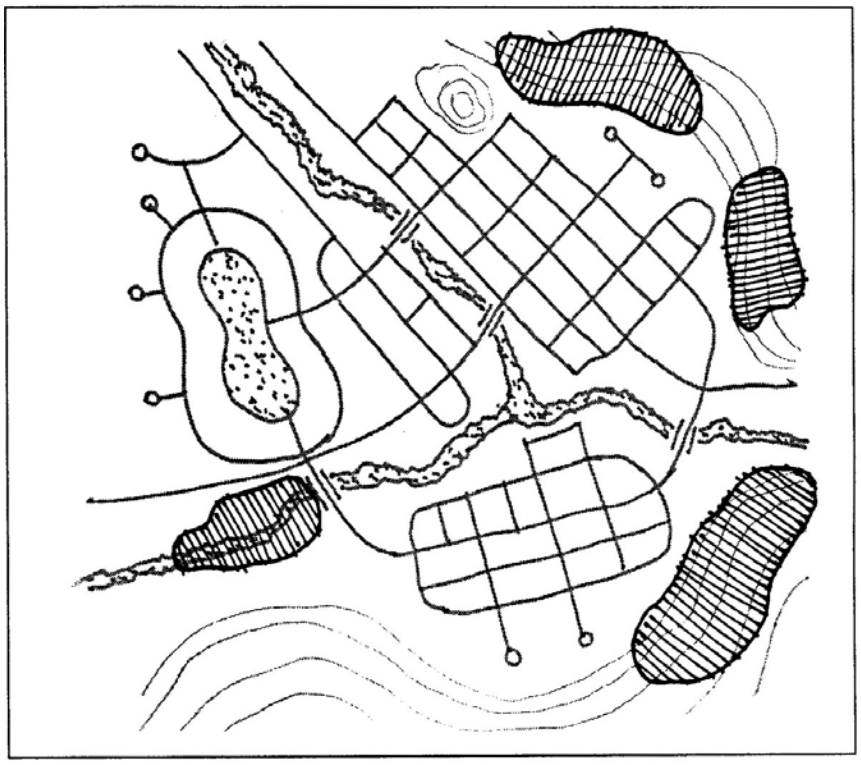
Flood Hazard Area	Vulnerability	Number of Properties Affected	Land Use
Steelhead Creek Watershed	Medium - High	10-15	Low-density residential, mobile home park
Pink Creek Watershed	Low-Medium	4-6	Industrial park
Salamander Lake	Low-Medium	100-125	Single-family houses, condominiums
Low-lying areas	Low		

3

Landslide Hazard Areas

Figure H-3 depicts areas deemed to be vulnerable to landslides. These are generally located along steep slopes forming the East Foothills. The mapping is based on U.S. Geological Survey topographical maps, more detailed survey information compiled from city records, geotechnical reports on recent development proposals, and the critical areas ordinance designation of geologically hazardous areas updated with locational information from actual landslide events.

Figure H-3, Landslide Hazard Areas



Vulnerability Assessment

4

Same level of discussion as under Flood Areas.

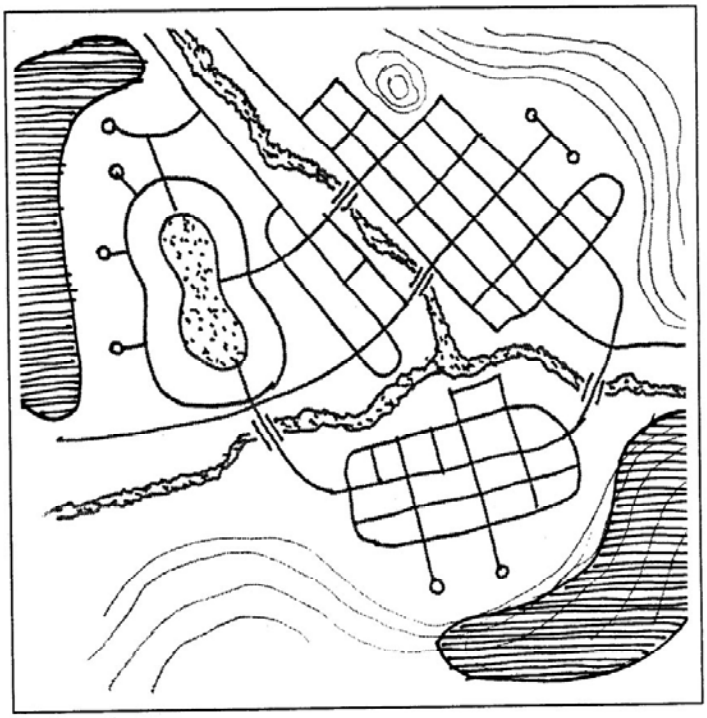
Landslide Hazard Area	Vulnerability	Number of Properties Affected	Land Use
East Foothills	Medium - High	25-40	Low-density residential
Copper Ridge	Low-Medium	10-15	Medium-density residential
Steelhead Creek @ SR 007 Bridge	Medium	1	City park

3

Wildfire Hazard Areas

Figure H-4 depicts the areas in the Chum planning area which are vulnerable to wildfires. This mapping is based on recent records of the state Department of Natural Resources (DNR), the Chum Fire Department records, and property owners and residents' recollections of past incidents. Another basis for this mapping is the type and location of vegetation within the area that supports wildfires.

Figure H-4, Wildfire Hazard Areas



Vulnerability Assessment

4

The following table summarizes recent wildfire characteristics.

Wildfire Hazard Area	Vulnerability	Number of Properties Affected	Land Use
North Valley Ridge (east of Lake Salamander)	Low-Medium	10-15	Low-density residential
East Foothills (south of Pink Creek)	Low	10-25	Low-density residential, orchards

Compound Vulnerability

3

(This would be where areas that are vulnerable to more than one type of hazard would be highlighted. Multiple vulnerability should be a prime indicator that regulatory intervention is needed.)

GOALS AND POLICIES

(An elaboration of the goals and policies summarized at the beginning with particular attention to the correlation of the hazard goals and policies with those of the other plan elements).

4

The City of Chum should be a safe, secure place for its citizens. Safety from natural hazard events such as floods, landslides, and wildfires cannot be completely assured, but the comprehensive plan and development code do provide measures for avoiding many types of events which have occurred in the past.

Goal

Reduce city exposure to floods, landslides, and wildfires to minimize reliance of federal and state programs for disaster mitigation; protect public and private property; save lives; and use community resources wisely.

Policies

Policy H-1: Utilize natural features such as floodplain boundaries and steep slopes to control development that could result in increasing hazard susceptibility.

Policy H-2: Integrate regulatory standards such as buffers and setbacks with hazard avoidance measures.

Policy H-3: Coordinate hazard vulnerability assessments with programs for purchase or preservation of open space.

Policy H-4: Update hazard mitigation and disaster plans annually.

Policy H-5: Coordinate related activities of city departments with the county and state and federal agencies.

STRATEGIES AND ACTIONS

5

- Mapping Designations – Continue to revise and compile mapping of vulnerable areas using city, county, state and federal databases. As additional surveying and other data collection are produced for infrastructure improvements, integrate this information into the mapping system. Require digital mapping files for all subdivision projects and integrate this information. Update mapped hazard designations based on "real world" information as it becomes available.

- Development Regulations – Revise the zoning, subdivision, critical areas ordinances, and the regulations portion of the SMP to incorporate hazard avoidance provisions and assure consistency of definitions and mapping.

- Outright Purchase and Transfer of Development Rights Programs – Develop methods for determining the most effective use of public funds and incentives in protecting vulnerable areas from future damage resulting from floods, landslides and wildfires. Develop an acquisition plan which proposes uses for the property to be acquired consistent with other plan elements. The transfer of development rights concept should also be evaluated by an economic analysis taking into account market trends, land values, and development potentials.

- Capital Projects and Acquisitions – Develop criteria for the evaluation of future capital facilities with respect to location and hazard vulnerability. Define future land acquisitions which support public open space needs and also remove vulnerable areas from potential development actions.

- Operating Budget – Review budget line items to ensure that hazard reduction tasks (maintenance of newly acquired lands, debris clearance, vegetation management, etc.) can be executed on a regular basis.

APPENDIX G

PROPERTY PROTECTION SCORING SYSTEM

PROPERTY PROTECTION SCORING SYSTEM

This appendix reviews the types of information to collect and how to process the data to identify the most appropriate nonstructural measures to protect a building from surface flooding.

This scoring system is based on the premise that the best protection measure is to acquire the property and demolish the building or move it out of the floodplain. Only sound buildings in low hazard areas are recommended for elevation or floodproofing.

Points are given for various criteria that represent flood damage potential, cost effectiveness, and other factors that determine whether a property should be acquired. When there are not enough funds to buy all properties that qualify, the points can be used as a ranking system to prioritize properties for acquisition. The user may want to revise the point system to better match local goals, objectives, and priorities.

The point scoring and calculations can be done by hand, a job that is made easier by worksheets that list the data for each property and the accompanying scores. An example of such a worksheet is in Figure C-2.

Where there are large numbers of buildings, a database management program should be developed to store and process the information. The software should be compatible with or, preferably, have access to other property databases in the community, such as tax assessment files.

Step 1. Collect data on each property.

The data needed are either in existing databases or can be obtained by conducting a windshield survey. Except where noted, the information collected is for the primary building on the property. A property location base map is a very helpful tool in this process. An example is in Figure C-1.

1.1 Building foundation. Identify whether the foundation is a crawlspace, slab, or basement. Source: windshield survey. A basement is considered any floor that is below grade, including split level and bi-level homes and garden apartments.

1.2 Building walls. If the building is on a slab foundation, note whether it has masonry walls on all four sides. This includes brick facing on a wood frame wall. Source: windshield survey.

1.3 Building condition. Determine whether the building is well maintained or dilapidated. Source: windshield survey.

1.4 Soil stability. Check the soil survey published by the Natural Resources Conservation Service to identify areas where the windshield survey should concentrate on looking for signs of unsuitable soils. The windshield survey should see if there is evidence of cracked walls, settling, unstable soil, or other sign of stress.

1.5 Lowest floor elevation. For buildings with basements, the lowest floor elevation is the basement floor level. Source: high water marks or first floor elevation surveys that may have been prepared as part of a flood control project. Rough elevations can be extrapolated from orthophoto maps, although they will only be good to within 1-2 feet. In some cases, the planner may want to survey in accurate elevations.

1.6 Personal data. Collect pertinent information about the occupants if known (e.g., handicaps, disabilities, willingness to sell, etc.). Source: personal contacts with the owners. The relatively small weight given to this factor will probably not warrant the expense to collect the data on every property under consideration. However the planner may want to mail a survey to residents to obtain data such as their personal concerns, support for other community objectives, and income levels (to determine qualifications for financial assistance programs).

Step 2. Obtain flood hazard data.

All of the data are available in the community's flood insurance study for those areas studied in detail (AE and A numbered zones). The Office of Water Resources, the State Water Survey, FEMA, or the Corps of Engineers can provide guidance on estimating the data in areas not studied in detail.

2.1 Base flood elevation. Source: flood insurance study or Flood insurance Rate Map.

2.2 10-year flood elevation. Source: flood insurance study.

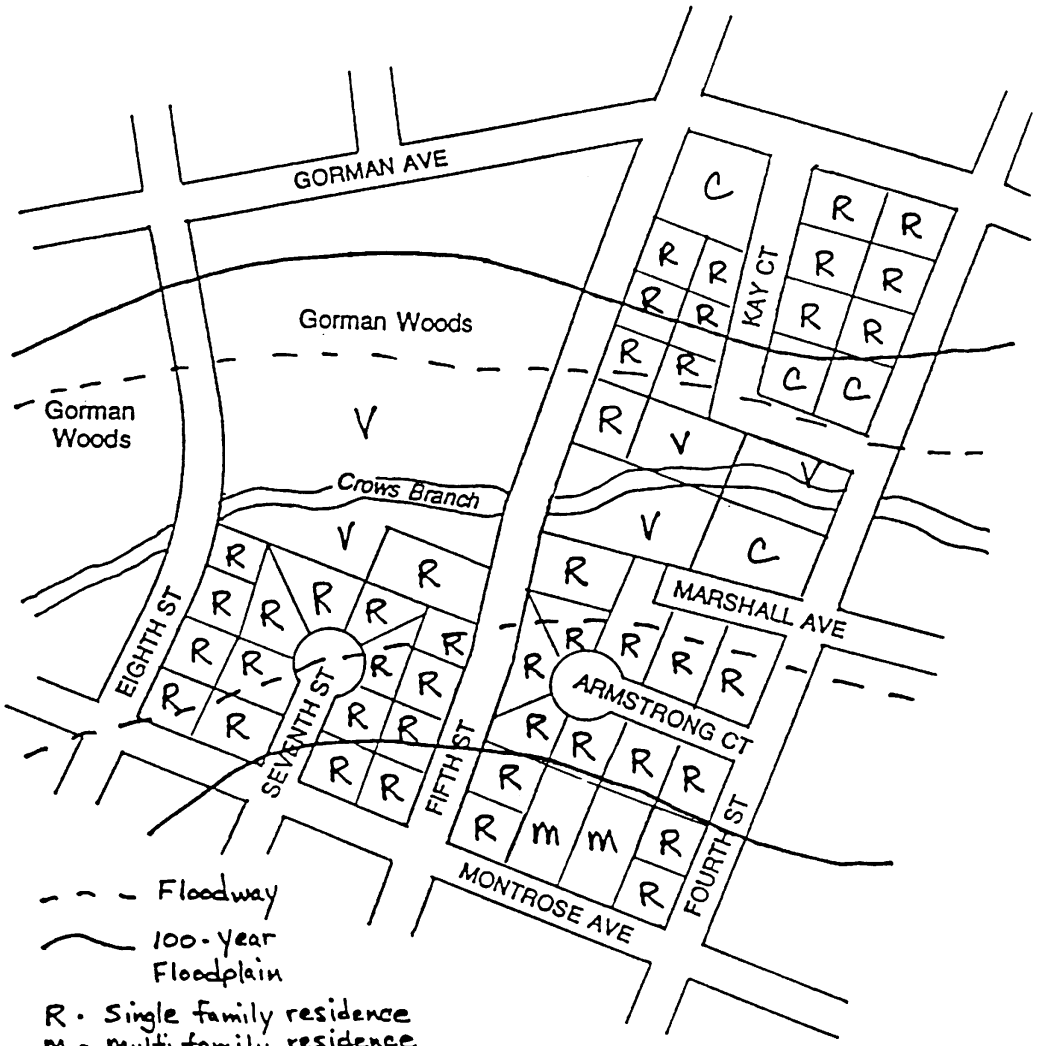
2.3 Building in floodway. Source: floodway map.

2.4 Average floodway velocity. This is in feet per second. Source: floodway data table in the flood insurance study. In areas not studied by FEMA, the average floodway velocity can be extrapolated from streams with similar slopes and topography.

2.5 Base flood depth. Subtract the lowest floor elevation from the base flood elevation. The resulting figure is the base flood depth. If the lowest floor is higher than the base flood elevation, this will be a negative number.

2.6 10-year flood depth. Subtract the lowest floor elevation from the 10-year flood elevation. The resulting figure is the 10-year flood depth. It will also be a negative number where the lowest floor is higher than the 10-year flood elevation.

Figure C-1 Example Property Location Base Map



The base map can be any map that shows parcels or property lines. It should show the floodway and floodplain boundaries and current land uses. This example shows a four block section of the Crows Branch floodplain in the Village of McLake *(see Figure 3-3)*.

Step 3. Obtain other data on the area.

Factors other than building condition and water hazard should be considered. This section identifies these other factors.

3.1 Sources of toxics. Determine whether the site is near or less than a mile downstream of a source of pollution by toxic or hazardous materials. Also note if the site itself contains such materials that could be carried away by floodwaters. Source: local emergency manager and windshield survey.

3.2 Planned flood control. Determine whether the property is scheduled to be protected by a flood control project. If so, identify when and to what flood protection level. Source: local planning or engineering office.

3.3 Site needed for or adjacent to a community facility. Note yes or no. Source: flood control project plans, park development plans, and similar community plans.

Step 4. Obtain data on financing.

One of the most important determinants of flood hazard mitigation is affordability. This step checks for the amount of funds available and the acquisition costs.

4.1 Outside financial assistance. The local cost share helps determine which measure is most affordable from the owner's or the community's perspective. This figure will range from 0 to 1.0 (i.e., from no local cost share to 100% of the cost paid by the community). Source: Federal programs and data on whether buildings or owners qualify.

4.2 Market value. The dollar value of the property (buildings and land) is needed. Source: tax assessor's files. The assessor can advise how to adjust the figure to coincide with current market value.

Step 5. Calculate the protection feasibility score.

This step determines whether it is feasible for the building to be protected by a method other than acquisition.

5.1 Flood control project. Determine the appropriate number of points for the property based on the information in step 3.2:

a. Site to be protected by a project that is funded and underway: 0 points.
Site to be protected by a project planned for the next five years: 1 point.
Site to be protected by a project planned for the next 10 years: 2 points.

b. Double the score if the site will be protected to less than the base or 100-year flood.

c. If there is no project planned or a project is more than 10 years away: 5 points.

5.2 Floodproofing. Determine the feasibility score for elevation or floodproofing based on the type of building (maximum possible points: 10):

a. Building dilapidated, abandoned or otherwise in bad condition (step 1.3): 10 points. Generally, the building is not worth protecting and should be acquired.

b. Building with basement (step 1.1)

Subject to surface flooding, base flood depth > 3 feet (step 2.5): 10 points.

Subject to surface flooding, base flood depth ≤ 3 feet (step 2.5): 5 points. Consider barriers as the most appropriate property protection measure short of acquisition.

Subject to surface flooding, base flood depth < first floor (step 2.5): 3 points. Consider barriers and wet floodproofing as the most appropriate property protection measure short of acquisition.

Subject to sewer backup flooding: 0 points. Consider sewer backup protection measures.

Subject to subsurface seepage: 0 points. Consider dry floodproofing measures.

c. Building on crawlspace (step 1.1)

Base flood depth > 6 feet (step 2.5): 10 points.

Base flood depth 3 - 6 feet (step 2.5): 5 points. Consider elevation as the most appropriate property protection measure short of acquisition.

Base flood depth < 3 feet (step 2.5): 3 points. Consider elevation and barriers as the most appropriate property protection measures short of acquisition.

d. Building on slab (step 1.1)

Base flood depth > 3 feet (step 2.5): 10 points.

Base flood depth ≤ 3 feet (step 2.5), masonry walls (step 1.2): 3 points. Consider a barrier and dry floodproofing as the most appropriate property protection measures short of acquisition.

Base flood depth ≤ 3 feet (step 2.5), non-masonry walls (step 1.2): 3 points. Consider a barrier as the most appropriate property protection measure short of acquisition.

5.3 Subtotal. Add the points from step 5.1 to the points from step 5.2. The result measures the feasibility of an alternative to acquisition. The range is 1 to 15. The higher the score, the more appropriate it is to acquire the property because the other methods of flood protection are not feasible or won't be available for a long time. The community may want to use this step to eliminate properties from further consideration for acquisition, e.g., all properties that receive a score less than 3.

Step 6. Calculate the damage potential score.

This step measures the damage potential of each building. It is the sum of the following factors:

6.1 Base flood depth. One point is given for each foot of base flood depth (step 2.5). Maximum possible points: 10.

6.2 Flood velocity. Subtract 5 from the average floodway velocity (step 2.4). If the site is in the floodway (step 2.3), use the result. If the site is not in the floodway, divide the result by 2. The minimum value is 0 and the maximum possible is 5.

6.3 Soil stability. If there is evidence of settling or unstable soil (step 1.4): 1 point.

6.4 Toxics. If the site is near or less than a mile downstream of a source of pollution by toxic or hazardous materials (step 3.1): 3 points. If the site itself contains such materials that could be carried away by floodwaters: 6 points. Both of these situations may apply to a site, so the scores are added together. Maximum possible points: 9.

6.5 Subtotal. Add the points from 6.1 through 6.4. The result measures the hazard the building is exposed to. The score can range from a negative (where the flood depth is a negative number) to 25. The higher the score, the more damage the property is likely to incur.

Step 7. Calculate the economics score.

This step incorporates economic data into the ranking system. It is the sum of the following factors:

7.1 Economic feasibility. If the building has a basement (step 1.1) and the 10-year flood depth is greater than four feet (step 2.6): 4 points. If the building does <u>not</u> have a

basement and the 10-year flood depth is greater than zero: 4 points. These situations are mutually exclusive. Maximum possible points: 4.

7.2 Relative local cost. Multiply the local cost share (step 4.1) times the market value (step 4.2). The result is the relative cost to the community. The following points score the relative cost to the community:

Example: A property is eligible for a grant which covers 75% of the cost of acquisition. The local cost share is 0.25. The property is valued at $80,000. 0.25 x $80,000 = $20,000. The property receives 4 points.

0 - $10,000	5 points
$10,001- $25,000	4 points
$25,001- $50,000	3 points
$50,001- $75,000	2 points
$75,001- $100,000	1points
$100,000+	0 points

7.3 Reuse. If the site is needed for right of way for a planned flood control project, a park or other public open space (step 3.3): 6 points. If the site is adjacent to existing open space or a site that will be acquired in the near future: 3 points.

7.4 Subtotal. Add the points from 7.1 through 7.3. The result measures the cost-effectiveness of acquiring the property based on the relative cost to the community. The range is from 0 to 15.

Step 8. Incorporate personal factors.

This step incorporates personal factors not directly related to flood damage to the property. The information was collected in step 1.6.

8.1 Handicap. If the property is an owner-occupied permanent residence (not a commercial, seasonal or rental property), one point for each of the building's occupants who is handicapped or of limited mobility. Maximum possible points: 3.

8.2 Willing seller. If the owner has voiced an interest in selling: 1 point.

8.3 Repetitive flooding. If the building has been flooded more than once in recent years: 1 point.

8.4 Neighborhood attitude. If there is strong neighborhood support for acquisition: 1 point.

8.5 Subtotal. Add the points from 8.1 through 8.4. The result incorporates factors not directly related to flood damage. The user may want to omit step 8, especially if the data are hard to obtain. The range is 0 to 6.

Step 9. Calculate the property acquisition score.

This last step totals the points for each property. The weights given to each of the four major factors are shown below. A community may want to revise the weights and scores to better reflect local conditions, needs, goals, and objectives.

Factor	Score	Weight
Step 5. Feasibility of protection by other methods	10	18%
Step 6. Flood damage potential	25	45%
Step 7. Economics Step	15	27%
Step 8. Personal factors	6	10%
	56	100%

For example, a community may feel that the only factor that counts is damage potential. It can eliminate economics and personal factors from the ranking system. The points can be adjusted accordingly to make steps 5 and 6 each worth 50 percent of the total possible score.

An example worksheet with completed calculations appears in Figure C-2.

Figure C-2 Property Protection Worksheet

Address: 401 Armstrong Ct. ID #: BlK 115, lot 2-008
Owner: John Jones
Type: (single family) multi family, commercial, industrial, public, vacant (circle one)

1.1 Building foundation: (crawlspace) slab, or basement (circle one)
1.2 Building walls: masonry walls on all four sides? yes or (no)
1.3 Building condition: (well maintained) or dilapidated?
1.4 Soil stability: evidence of unstable soil? yes or (no)
1.5 Lowest floor elevation: 609
1.6 Personal data: Flooded in '86, '93, likes neighborhood

2.1 Base (100-year) flood elevation: 612
2.2 10-year flood elevation: 610
2.3 Building in floodway: yes or (no)
2.4 Average floodway velocity: 1.6 feet per second
2.5 Base flood depth: 3'
2.6 Ten-year flood depth: 1'

3.1 Sources of toxics: Across stream from paint + lacquer storage
3.2 Planned flood control: None
3.3 Site needed for or adjacent to: N/A

4.1 Outside financial assistance/local cost share: 0.5
4.2 Market value: $ 125,000

5.1	Flood control project score:	5	
5.2	Feasible protection measure: Elevation Acquisition appropriateness score:	5	
5.3	Add the points from 5.1 and 5.2. Feasibility of protection score:		10
6.1	Base flood depth score:	2	
6.2	Flood velocity score:	0	
6.3	Soil stability score:	0	
6.4	Toxics score:	3	
6.5	Add the points from 6.1 through 6.4. Flood damage potential score:		5
7.1	Economic feasibility score:	0	
7.2	Relative cost to the community score:	2	
7.3	Reuse score:	0	
7.4	Add the points from 7.1 through 7.3. Economics score:		2
8.1	Limited mobility score:	0	
8.2	Interest in selling score:	0	
8.3	Recent flooding score:	1	
8.4	Neighborhood concern score:	0	
8.5	Add the points from 8.1 through 8.4. Personal factors score:		1
9.	Add the points from 5.3, 6.5, 7.4 and 8.5. Property acquisition score:		18

Step 10. Plot the results.

The results for each property should be plotted on the property location base map. The results would be both the property protection measure shown in item 5.2 and the total score for each property.

Plotting these will show where neighboring buildings have viable elevation or floodproofing recommendations. Where elevation and floodproofing are not viable, the higher scores should delineate areas that should be acquired.

Example

An example of a property protection recommendation map is shown in Figure C-3.

The properties with buildings in the floodway on Seventh and Eighth streets are subject to deep flooding. Step 5 found that due to their foundations and flood hazard, acquisition is the best flood protection measure for these buildings. They are also adjacent to Gorman Woods, a public preserve. The lots and their utilities can be used for parking and facilities to support Gorman Woods.

Armstrong Court is a newer subdivision built on higher ground, most of it out of the floodway. The buildings are on crawlspaces. As with John Jones' house (see Figure C-2) the property protection scoring system concluded that these buildings can be elevated. Because there are not sufficient funds to buy all of the properties in the floodplain and Armstrong Court residents don't want to leave, these properties are recommended for elevation.

The buildings between Marshall Avenue and Kay Court are the oldest in this area. They have been allowed to run down and would be relatively inexpensive to purchase. The commercial property on the northwest corner of Marshall and Fourth was found to store toxic materials. It rated highest on the scoring system and the Village intends to purchase and clear it as soon as possible.

Properties on higher ground are subject to less of a flood hazard. The more expensive ones that are in sound condition are recommended for elevation, dry floodproofing, or correction of basement seepage or sewer backup problems.

Figure C-4 is a floodplain reuse map. It shows how these four blocks could look in the future. Such a map provides the planners with a vision for a multi-objective plan: one that provides flood loss reduction, increased safety, clearance of blighted properties, and improved recreation facilities.

A multi-objective plan will generate support from more people. It is therefore more likely to succeed than a single-objective plan that addresses only flooding.

Figure C-3 Property Protection Recommendation Map

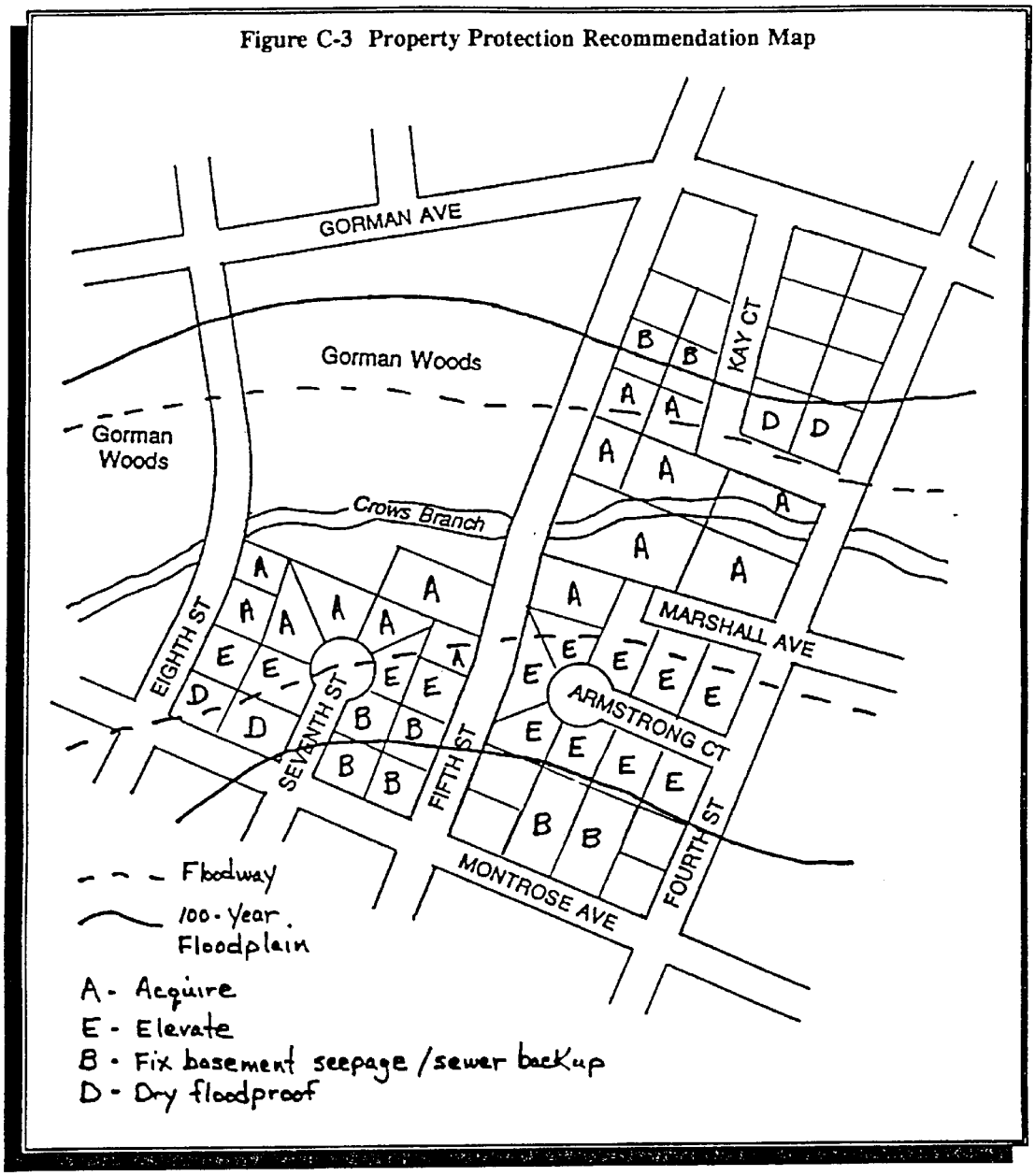
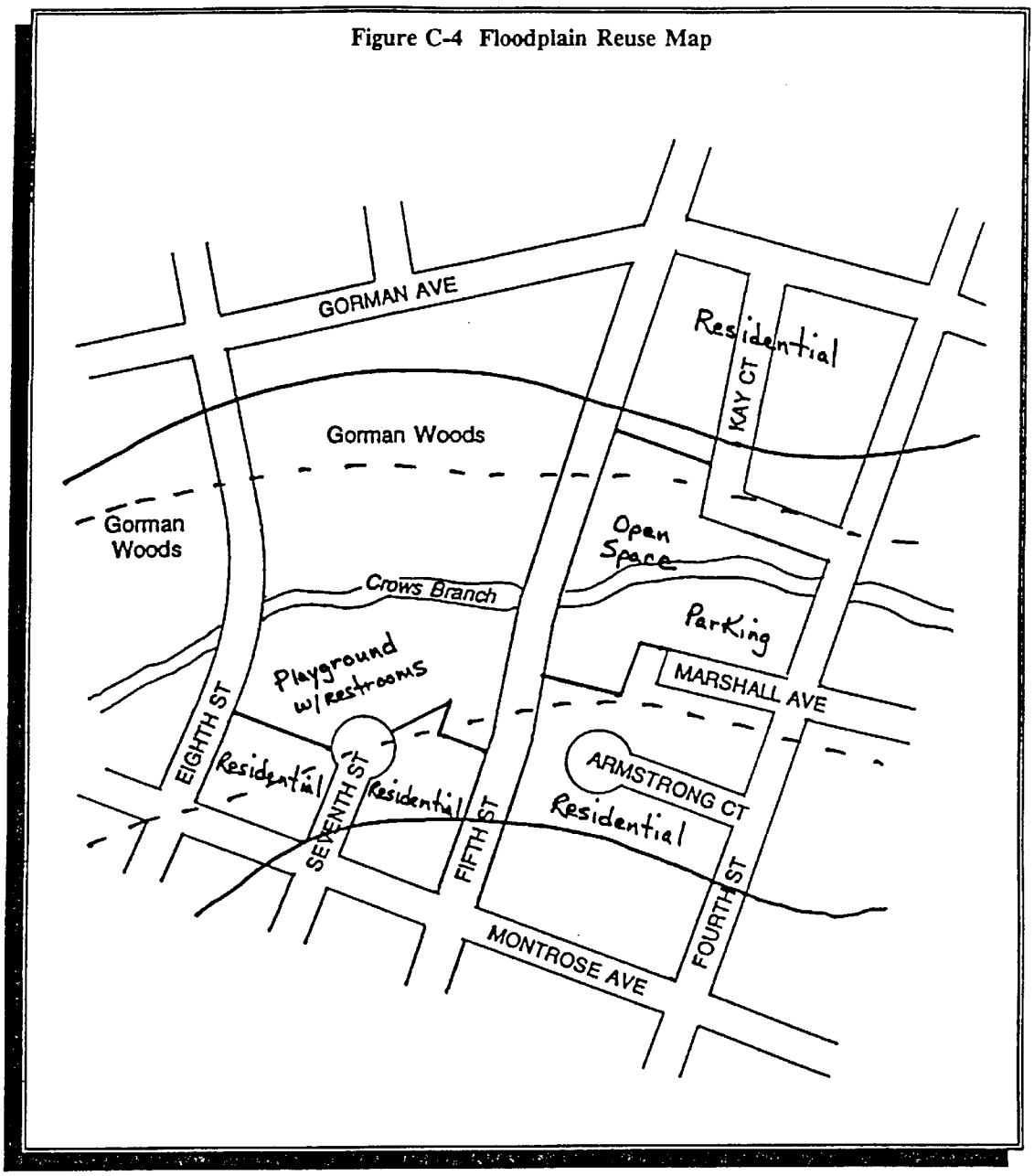


Figure C-4 Floodplain Reuse Map



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