SECTION 3 BACKGROUND

- Legal Authority and Scope
- Project Background
- Planning Process
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- Regulatory Overview

(Draft) Section 3

BACKGROUND

LEGAL AUTHORITY AND SCOPE

Chapter 86.26 of the Revised Code of Washington (RCW) requires that counties requesting financial and government participation for flood control assistance provide a flood hazard reduction plan (FHRP), approved by the Department of Ecology (Ecology), in consultation with the Department of Fish and Wildlife. RCW 86.26.105 states that an FHRP must be completed and adopted within three years of the award of a Flood Control Assistance Account Program (FCAAP) flood control maintenance grant. This program is discussed in detail below. Although Grays Harbor County has not received funding for county-wide flood hazard management planning, it has been awarded FCAAP monies to address localized drainage issues and to develop a smaller scale flood hazard reduction plan for the Grayland area. Eventually, with additional funding, a County-wide FHRP will be completed.

As fully detailed in Chapter 173-145 of the Washington Administrative Code (WAC), the FHRP must include several key elements. Broadly, these elements are as follows:

- Determination of the need for flood control work
- Watershed descriptions, including the identification of specific problem areas, historical and potential flood damage, the documentation of applicable regulations, and goals for the planning area
- Alternative flood control work
- Identification of potential impacts of instream flood control measures to instream uses and resources
- Definitions for the coverage area of the comprehensive plan
- Conclusions and proposed solution(s)

The FHRP is also an element of Grays Harbor County's plan to meet the goals of the Growth Management Act (GMA) and comprehensive planning guidelines. The 1990 GMA requires countywide planning to ensure sensitive, economical, and planned development for some counties. Under the GMA, all counties with a population of at least 50,000 people and a population increase of more than 10 percent in the last 10 years must adopt a comprehensive plan. Although the County does not fall into this category, the County has chosen to initiate the process of compliance with the GMA guidelines to achieve the goals of the GMA.

Sponsorship of Local Government

The FHRP was developed in accordance with Ecology's *Comprehensive Planning for Flood Hazard Management (CPFHM)* approach for an FHRP. In that document, the following steps are outlined for successful completion of a plan.

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

12. Notify Ecology that the final plan is adopted.

PROJECT BACKGROUND

A few years ago, Grays Harbor County initiated a process to prepare a comprehensive utilities plan for water supply, sewers and drainage. As part of this process, the County conducted a series of public meetings. The meetings were held not long after the serious floods of late 1990, and discussions of drainage and flooding issues dominated the meetings. In response, the County has placed increased emphasis on planning for solutions for drainage.

The residents of the Grayland area were one of the groups that expressed the need for solutions to drainage problems. This plan is a direct response to that expression of need. The County applied for and received a grant from Ecology to prepare a Flood Hazard Reduction Plan.

The drainage problems that affect the most people in the area, and are potentially the most hazardous, are the numerous areas of ponding along SR 105 and other roads. Other areas of ponding are discussed in more detail in Section 5, Flood Damage History, and shown in Figure 5-1.

Areas of flooding in Grayland fall into two categories: those associated with the main drainage channel and local drainage issues. Flooding associated with the main channel occurs at several locations but in most cases is not a serious concern. The area surrounding the channel is low and residents understand that flooding will occur in the low areas along the channel. Local drainage problems occur throughout the area and many are not related to the main channel. West of SR 105, local drainage historically flowed to the ocean. Over the years, the beaches in this area have accreted and the traditional ocean outlets have not been maintained. This has resulted in localized ponding in residential areas. This has been made worse by filling associated with residential development. The fill blocks the movement of surface and ground water. Additional runoff is created by the additional impervious surfaces. Additional groundwater results from new drainfields.

Need for Plan

Rapid development and severe flooding in portions of the Pacific Northwest have caused flood hazard management to become a large focus of Washington's state and local governments.

Citizens and public officials are increasingly aware of the interrelated issues of comprehensive planning, stormwater management, resource preservation, and flood damage protection. Within this context, it is also acknowledged that floods are natural events and often it is the human activities that must be managed to minimize watershed impacts that make flooding a serious hazard.

The State of Washington has made grant funds available to help communities and local governments comply with state statutes calling for watershed-based flood protection activities. To qualify for these funds, an FHRP must be developed to ensure that an overall watershed approach to flood hazard management is being taken. Because activities throughout the watershed can directly and indirectly impact localized flood control projects, a complete understanding of the drainage basin, including its soil types, land uses and hydrology are imperative. Poor management in one part of the watershed can adversely affect drainage and result in flooding in another part.

This FHRP addresses the watershed contributing to the Grayland Area and evaluates the potential for flooding and its impacts. It proposes possible structural and alternative management solutions to reduce flood hazards.

Principles of Comprehensive Flood Hazard Management

Flood hazard management is an important planning tool because it encompasses not only the floodplain but environmental and economic issues and land uses beyond the designated floodplain.

This FHRP recognized or worked to meet the following fundamental and important principles. These principles and other information are elaborated upon in Appendix A.

- It is often more cost-effective and beneficial to accommodate a waterway's dynamic nature.
- The causes of flood damage must be identified and understood early in the planning process.
- Public and agency participation is an important part of the FHRP process.

- Issues of construction, maintenance, funding, and public approval should be thoroughly examined during the alternative selection process.
- Modifications to and preservation of natural hydrologic processes can help meet other resources protection goals.
- FHRPs can be a vehicle to improve interdepartmental coordination.
- Comprehensive planning solutions should be included in the FHRP.

Flood Control Assistance Account Program

The Flood Control Assistance Account Program (FCAAP) provides matching reimbursable grants for county and local jurisdictions planning and maintenance efforts to reduce flood hazards and damages.

Administered by Ecology's shoreland and coastal zone management program, FCAAP promotes a watershed approach to minimizing flood hazards. To be eligible for funding, jurisdictions must participate in the National Flood Insurance Program. The maximum amount of initial emergency funds available per county is $500,000 per biennium, subject to availability. Grants up to 50 percent of eligible maintenance and construction and 80 percent for emergency flood repair costs are also subject to availability.

PLANNING PROCESS

As detailed in Ecology's *Comprehensive Planning for Flood Hazard Management*, public and agency participation is critical to a flood hazard management plan's success for several reasons:

1. Proposed measures will affect many local property owners and their support will be needed.
2. WAC 173-145-070 calls for the review of all FCAAP projects by associated state agencies and affected parties. Therefore, appropriate public agencies, such as the State Department of Fisheries and Wildlife, the Department of Natural Resources, affected Native

American tribes, and other public entities should be involved throughout the process for plan formulation and comments.

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

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

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

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

Role of the Project Committee

The Grayland Community Advisory Committee (the committee) was formed to ensure public and agency participation in the planning process. Because flood hazard management actions can have implications across jurisdictional lines, not only local property owners and representatives of public groups were consulted. Staff persons from neighboring jurisdictions and Native American tribes were also consulted during the planning process.

The committee was generally advisory in nature, providing direction throughout the planning process and recommending adoption of the final plan to the County. Building a consensus that balanced competing objectives was the main goal of the committee. Because most members represented their community, they were also an excellent resource for adding to independent determinations of community concerns and interests.

Group Size and composition of the committee was an important consideration in the attempt to encourage meaningful discussions. For this reason, the committee was composed of 17 members including: homeowners, business owners, and cranberry farmers; the Grays Harbor Water District No. 1; Grays Harbor Drainage District No. 1; Pacific County Drainage District No. 1; Grays Harbor County; and the Washington State Department of Transportation.

The advisory committee met three times to discuss, evaluate, and recommend actions to the County and the CH2M HILL consultants preparing this FHRP. The key points and conclusions drawn at each meeting are described below.

Meeting No. 1

- Developed a positive working relationship within the committee.
  - Introduced the committee members and their affiliations.
  - Defined the goals of the committee, the elements involved in a comprehensive approach to flood hazard reduction planning, and the process that the advisory committee would undertake.
  - Began the process of voicing drainage concerns and working toward their resolution.
- Refined the consultant's understanding of local drainage issues (extent, frequency and duration of flooding).
  - Defined areas known by the committee to flood during frequent storm events. Flooding areas were marked directly on an aerial photograph covered with a sheet of acetate.
  - Clarified the frequency and duration of the pooled water through group and individual discussions
  - Defined historical drainage routes by the same method
- Refined the committee's understanding of drainage related options, their costs, limitations on available funding, and alternative funding sources.
  - Presented solutions, alternatives (where applicable), and costs for local drainage issues at the Tingstrom Lane area, the Post Office site, and the Lamplighter/Mutiny Lane site.
  - Provided possible funding options for these local drainage improvements.

Conclusions. There are many areas of localized flooding in the Grayland Area (see Historical Flooding Map in Appendix E). The committee members feel that flooding has increased in recent years and that filling of drainage courses and/or diversion for construction purposes is largely the reason. The consensus was that for the Tingstrom Lane area and other flooding sites west of SR 105, the conveyance of water west (to the ocean) should be investigated further.

Meeting No. 2

- Discussed regulations pertaining to stormwater and drainage that affect Grayland property owners
  - Established that there is a perceived lack of enforcement by County and Federal agencies.
  - Recognized that there must be a balance between private property rights regarding development on one's own property and the rights of affected owners with existing homes.
  - Reached a consensus that additional regulation is needed and it must be enforced to be effective.
- Developed the committee's understanding of alternative solutions and relative costs.
  - Established the need to identify pathways for the drainage of flood waters and the need for maintenance of proposed drainage systems. Additionally, maintained opinion from previous meeting that the waters that have traditionally drained to the ocean should continue to drain to the ocean, rather than be routed to the District's main drainage ditch.
  - Reached a consensus that a local organization could probably construct and maintain the necessary drainage systems for less money than the County (due to proximity, availability of local labor and equipment, and lower standards for design and construction).
- Discussed funding sources.

- Resolved that local funding for solutions and control was necessary as the community should not rely on "big government" (the County) to solve their problems.
- Recognized that the solutions involve multiple property owners and require long-term maintenance, thereby making some form of formal funding mechanism necessary.
- Reached the conclusion that the local community would have to pursue and promote formation of funding mechanisms with their neighbors. This will require engineering and legal assistance from the County.

Conclusions. Regulations that balance the rights of private property owners and those affected by their actions must be identified/created and enforced. Local efforts to develop funding mechanisms and implement suggested improvements are favored. This will require technical and procedural guidance from the County.

Meeting No. 3

- Discussed the methodology, limitations and preliminary results of the hydrologic and hydraulic modeling of runoff and conveyance conditions in the Grayland Basin.

- Refined the consultants' understanding of the responses of the main drainage channel to storm events (historic extent, frequency and duration of flooding). This provided the consultants with some calibration (verification) of the modeling results (flood event recollections are discussed in depth in the Flood Damage History Section).

  - Acknowledged that it is likely that no committee member present had observed the results of a 100-year storm event in Grayland, rather they have seen only the smaller (2- to 10-year) events and possibly a 25-year event.

- Determined that the Grange Road Bridge is the only area bridge known by the committee to be overtopped by main drainage channel floodwaters.

- Related observed responses in the main drainage channel to the local drainage issues discussed in previous meetings.
  - Reached consensus that frequent pooled water at the Post Office site is the result of backup in the culverts leading to the main channel during high flows, not the result of channel overtopping.

- Enhanced the committee's understanding of flood-mitigation options and helped to determine a focus for further alternative evaluations.
  - Discussed alternatives to reduce water levels in the main drainage channel, including conveyance improvements, storage, pumps, containment, elevation of structures, and the removal of structures.
  - Established that the committee does not see flooding in the main drainage ditch as a major issue or a cause of local drainage problems (with the exception of high waters near the Post Office Site and a few homes near the fire station) and would rather pursue alternatives to resolve local, frequent flooding.

Conclusions. The residents on the advisory committee were much more concerned with the local flooding issues than the main channel, since it apparently does not present a significant frequent flood hazard.

Public Participation Process

The entire community of Grayland was encouraged to join the planning process by participating in a public meeting held on May 30 at the Grayland Community Center.

The items accomplished during this meeting are as follows:

- Refined the public's understanding of the study underway, the goals of the study, and the alternatives under consideration.
- Gathered historical flooding data in the form of recollections of high water levels and flooding associated with storm events.
- Evaluated preliminary alternatives to provide meaningful solutions in the final report.
- Enhanced the community's knowledge of funding options and implementation steps.
- Gauged public response to the proposals expected in the final report.

Although the public meeting was advertised in the *Grays Harbor - South Beach Bulletin* (the local daily newspaper) and by word of mouth; only 10 community members attended. Members from the Shoalwater Tribe and government agencies were also invited to attend and participate in this meeting.

Conclusions. The participants in the community meeting voiced no disagreement with the focus, progress, and solutions of the FHRP. They added only a few more areas of local flooding, and they confirmed the earlier conclusion that localized flooding is a more relevant issue to the residents than the less frequent flooding in the main drainage ditch.

Agency, Tribal, and Special Interest Coordination

The Shoalwater Tribe's reservation is located southeast of Grayland in Tokeland, Washington. An attorney representing the tribe was contacted to determine if there would be any tribal interest in the FHRP. According to the attorney, the Shoalwater Tribe's treaty for fishing rights was never ratified. Their rights are therefore more limited than other Northwestern tribes. The Shoalwater Tribe has rights to fishing within their reservation, which means that they have rights to prevent upstream pollution or other activities with the potential to damage resources on their reservation. Although the Shoalwater tribe is normally in a separate drainage basin from Grayland's main drainage channel, during some storm events the drainage ditch south of County Line Road may reverse direction and flow towards the south. The tribe's primary

concern (voiced in a conversation between the consultants and the Health and Human Services Chairman of the Shoalwater Tribe) is that flood waters do not carry fertilizers, pesticides, or other chemicals south through the main drainage ditch towards Tokeland during large storm events.

Overview of Technical Planning Methods

Preparation of the FHRP required technical analyses to forecast flooding levels. The first step was to prepare topographic mapping from aerial photographs. Then, more detailed topographic information was obtained by field surveys. Separate field surveys were prepared for the main channel and the three local drainage areas selected for additional analysis (Tingstrom, Post Office, and Mutiny/Lamplighter). Rainfall records for the area were obtained and analyzed. Computer models were then used to forecast runoff, to test the ability of the drainage system to convey the runoff and to forecast flood levels. The results of the models were verified by comparing them with the residents' observations of flooding.

Once they are developed and verified, computer models allow proposed solutions to be tested prior to investing in design and construction. For the local drainage issues, simple methods were used to estimate peak flows resulting from the local rainfall. For the main channel, more sophisticated methods were necessary. Both analyses are discussed below.

Main Drainage Channel Analysis

Two computer models were used to evaluate the main drainage channel. The first, HEC-1, estimates the amount of runoff entering the system. The second, HEC-2, uses the results of the first and evaluates the capacity of the channel to convey that water to the bay. To begin the hydrologic modeling, the watershed contributing to the main drainage channel in the Grayland area was delineated. Stormwater runoff depends on not only the amount of precipitation but also the characteristics of the land upon which the precipitation falls. Impervious and steeply sloped areas will produce more runoff than well-vegetated flatter areas. For this reason, the following characteristics of the watershed were evaluated to create the input data for the hydrologic modeling (HEC-I):

- Land use

- Soil type
- Topography
- Precipitation patterns

Using the model, peak flows and times of these peaks for the following design storms for Grayland were evaluated throughout the main drainage channel.

- 2-year event (3.3 inches precipitation in 24 hours)
- 10-year event (4.3 inches precipitation in 24 hours)
- 25-year event (4.8 inches precipitation in 24 hours)
- 100-year event (5.8 inches precipitation in 24 hours)

Verification of the modeling results was based on engineering judgment and USGS streamflow statistics from the closest gauged stations to Grayland.

The results of the hydrologic analysis were used in the hydrologic model (HEC-II), along with the following information, to estimate the expected water surface elevations in the channel during storm events:

- Cross-section data at approximately 20 sections along the main drainage channel
- Topographical maps with overbank land elevations
- Visual field observations of roughness characteristics within the channel and on the overbanks
- Survey data detailing the major bridge crossings

The hydraulic modeling was performed using the HEC-II backwater analysis program. Verification of the model was based on engineering judgment, the high water recollections of Grayland area residents, and agency officials.

Local Drainage Issues

Three sites of frequent local flooding were analyzed as part of this FHRP. The three sites are the Tingstrom Lane area, the Post Office site, and the Mutiny Lane/Lamplighter area. The existing runoff conveyance at these sites was evaluated, modifications to the existing drainage systems were developed, and cost estimates for these modifications were generated.

The hydrologic conditions at each of these three sites were evaluated using the same parameters discussed above. Survey data for the areas was reviewed to assess the existing condition of the drainage systems, and visual field inspections were also performed. Where possible with the existing data, analyses of the site runoff were performed using the Rational Method for a 25-year design storm. Due to available data limitations, flows at the Post Office site were approximated by evaluating the capacity of existing conveyances and using engineering judgment to estimate the necessary size of a replacement system. Mannings Equation was used at all three sites to determine the ditch and pipe sizes necessary to provide adequate stormwater conveyance.

DESCRIPTION AND CHARACTERISTICS OF PLANNING AREA

Planning Area Boundaries

Grayland is an unincorporated community located in the southwestern portion of Grays Harbor County along SR 105. It consists of the low-lying area along the ocean, shown in Figure 3-1.

For the purposes of this FHRP, an overall study area boundary was established that is roughly defined by the drainage basin boundary for the Grayland area and those areas to the west. As shown in Figure 3-1, the northern extents of the study area are defined by the levee extending from Hunt Club Road to the tide gates at the outlet of the main drainage channel and the surrounding topography. The southern border of the study area is delineated topographically, falling due east of Grayland Beach State Park. The peaks of the upland areas east of Grayland form a natural drainage divide. Although the western edge of the drainage basin does not extend much further than SR 105, the entire area between it and the Pacific Ocean is addressed in this report in order to include the many houses along beach access roads through the sand dunes.

Topography

The western portion of the FHRP study area is characterized by flat, low-lying areas supporting many localized depressions, and wetlands. The elevation throughout this portion ranges from sea level to approximately 25 feet. The higher elevations represent ridges of sand dunes bordering the ocean and the built-up areas along SR 105. Near the tide gates, the low-lying land is a hummocky marsh. Forested uplands on the eastern one-third of the planning area have an average top elevation of approximately 200 feet. The highest peak within this area is 300 feet above sea level.

Soils Characterization

Throughout Grays Harbor County, sands, sandstone, and glacial runoff constituents comprise the parent material of the lowland soils, while the mountainous regions are underlain by sandstone and basalt. The northern marshy portion of Grayland is likely of a silt, peat, and clay composition parent material.

Based on the soil maps prepared by the US Department of Agriculture (USDA) and the US Soil Conservation Service (SCS), the following generalizations can be made about the study area:

- **Foothills on the Eastern Border of Grayland:** Soils tend to be very deep and well-drained.

- **Base of Foothills Westward to the Ocean:** Portions have very deep, somewhat poorly drained soils, other portions are formed in sand that would typically be well drained, but because of the high water table, tend to be saturated most of the year.

- **Marshlands at the North End of the Main Drainage Channel:** Soils are nearly level, very deep, and poorly drained.

Climate

As a coastal community along the Pacific Ocean, Grayland is influenced by the prevailing wind direction, the surface temperature of the Pacific Ocean, the Coast and Cascade Ranges, and the

position and intensity of the large high- and low-pressure centers over the ocean. The air is generally moist, and the fluctuation in annual temperature is moderate. Summers in Grayland are relatively cool and dry, and the winters are mild, wet and cloudy.

Figure 3-2 shows the monthly average precipitation in Grayland. Annual average precipitation is listed by the National Oceanic and Atmospheric Administration as 74.59 inches, with 80 percent occurring between October and March. The month of December typically has the maximum average precipitation, but localized flooding is an issue throughout the fall and winter. The water table in the flat lowland areas near SR 105, where most of the community is centered, is relatively high in the winter months. Infiltration and runoff of surface water cannot readily occur; therefore, the frequent winter rainfalls produce localized pools of standing water and result in peak flows throughout the main drainage channel.

Mineral Resources

Mineral resources in the Grayland area are limited to the peat that is formed and accumulated in the many marshes and bogs in the lowlands.

Hydrology and Watershed Characteristics

Although none of the County's major rivers lie within the study area, Grayland has diverse surface water features. The Pacific Ocean borders the community on the west and provides a number of recreational activities such as clamming and sightseeing. Small lakes, wetlands, and drainage channels cover the low-lying interior, and several hillside streams come down from the uplands. The hillside streams contribute runoff to the cranberry bogs, their drainage ditches, and localized depressions in the land.

Extreme tide levels in Grays Harbor are reported by the Federal Emergency Management Agency (FEMA) as follows:

- **10-year high tide:** 8.8 feet above mean sea level
- **50-year high tide:** 9.7 feet above mean sea level

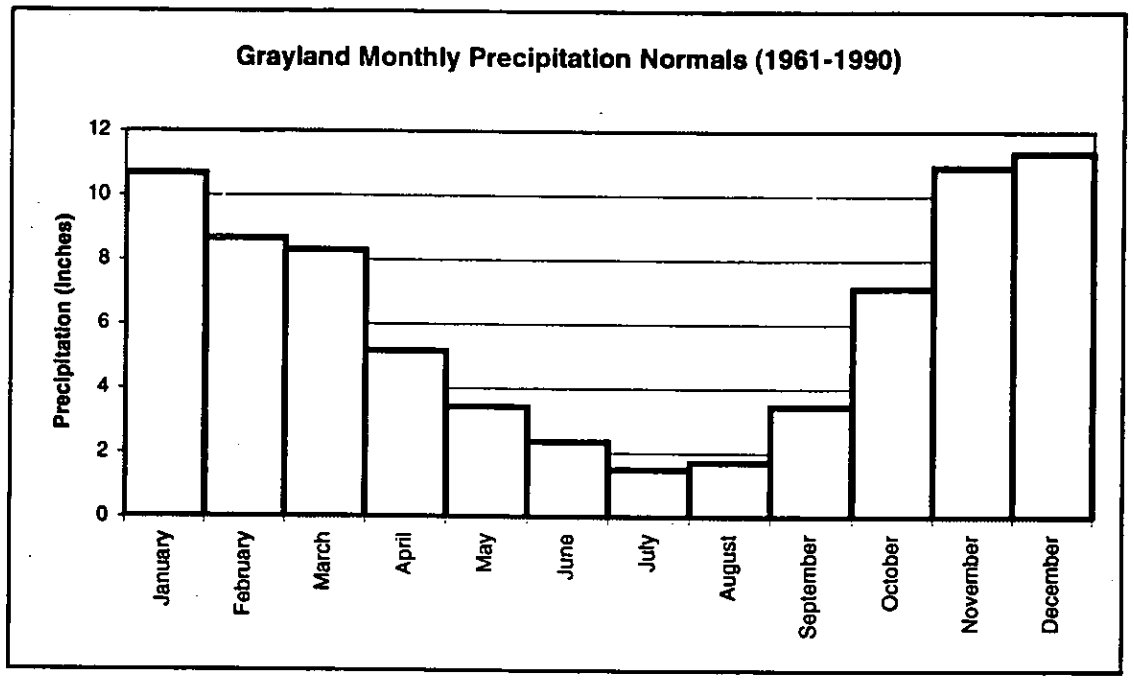


Figure 3-2
Grayland Monthly Precipitation

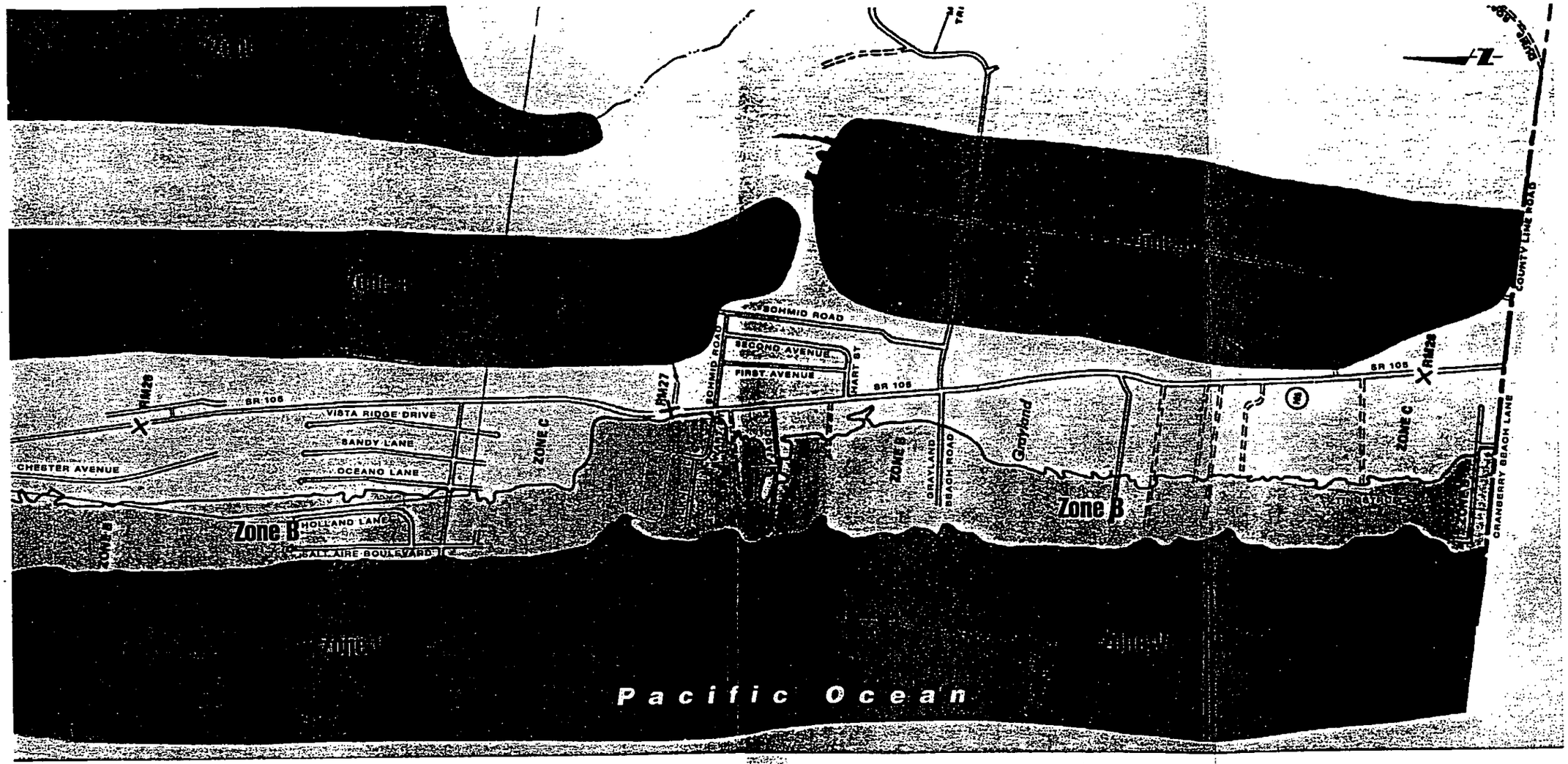
- **100-year high tide:** 10.0 feet above mean sea level
- **500-year high tide:** 10.5 feet above mean sea level

Extreme values in an average year range from -9.0 feet (low tide) to 6.5 feet (high tide) above sea level.

Flooding in Grayland occurs mainly during the winter months. High tides and winter storm winds combine with the heavy seasonal rainfall to create coastal flooding. The 1983 FEMA *Flood Insurance Study for Grays Harbor County, Washington (Unincorporated Areas)* documents the extent of the 100- and 500-year floodplains in Grays Harbor County. Figure 3-3 shows the floodplain boundaries for the Grayland area. These limits were established in accordance with FEMA's national standards for flood hazard management purposes (100-year) and additional risk indicators (500-year). In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year boundary is shown. Occasionally, small areas within the floodplain boundaries may lie above the flood elevations. These locations were not shown on the original FEMA maps due to limitations of the map scale and/or a lack of detailed topographical data.

Encroachment on floodplains, whether by structures or fill material, reduces flood-carrying capacity, increases flood heights and velocities and increases flood hazards in areas outside of the encroachment. Floodplain boundaries can be an important management tool in balancing the economic gain from floodplain development against the resulting increase in flood hazard.

As seen in Figure 3-3, approximately 1,000 feet of the Grayland beach and portions of the lowlands east of SR 105 are well within the 100-year floodplain. Between the coastal floodplain and SR 105, an area designated as Zone B covers many of the existing houses and businesses of Grayland. this area is designated as Zone B because it is subject to 100-year flooding with average depths less than one foot, or it has a contributing drainage area that is less than 1-square mile.



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Zone A Areas of 100-year flood

Zone B Areas between limits of 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one foot, or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood.

Zone V Areas of 100-year coastal flood with velocity (wave action)

**Note: This map was developed for flood insurance purposes. It does not necessarily show all areas subject to flooding.*

Figure 3-

Floodplain Designations from FEMA Flood Insurance Map for Grays Harbor County

The low-lying areas of Grayland support several wetlands (identified by the presence of standing water during the growing season, hydric soils and hydrophytic vegetation). These wetlands, shown in Figure 3-4, can provide significant natural stormwater storage and attenuation of stormwater runoff peaks. Because wetlands are a habitat for many species of wildlife, and they perform many useful water quantity and quality functions, regulations exist to prevent changes in their natural characteristics. This means that draining, filling, or otherwise dramatically altering their hydrology is not permitted.

The presence of both wide floodplains and many wetlands throughout the Grayland area is indicative of the propensity towards regional flooding.

Drainage District No. 1, a local special district created to provide storm and irrigation water drainage for the area's cranberry farms, maintains a roughly trapezoidal channel running north to the east of SR 105. The ditch dimensions vary, but it can be approximated as having a 20-foot bottom width and depths that vary from approximately 10 feet at the south end to three feet on the north end at the tide gates. Side slopes are approximately 2.25 feet horizontally to each vertical foot, but they become flatter near the tide gates.

The drainage district was created in 1916 and has primarily served the needs of the cranberry farms; however, a few natural feeder streams, private lots, and County streets discharge to the ditch. The ditch continues through the marsh area approaching the tide gates, where it ultimately discharges to the saltwater bay. Because the outlet, Grays Harbor, is tidally influenced, during medium to high tides, drainage is controlled by three 4-foot diameter tide gates that keep water from the harbor from entering and bringing saltwater inland. At high tide, when the ditch is unable to freely drain, elevated water levels develop within the ditch. Generally this is not a problem, but during large storm events, flooding may occur.

The ditch is regularly maintained; however, it has low vegetation in portions of the bottom and scrub-shrub type vegetation along the channel slopes. Overhanging vegetation and channel obstructions are kept to a minimum by the maintenance. The vegetation and related roughness of the channel changes near the tide gates, as discussed in more depth in the section on hydraulic modeling.

An investigation detailed in the Phase I, *Utilities Comprehensive Plan for Grays Harbor County* (Parametrix, 1991), shows that the entire Grayland study area is underlain by the Grayland Aquifer and a small portion of an undefined aquifer. The investigators appraised the quality of the water in a representative portion of the County's wells and issued a very general summary of the major aquifers as well as a more detailed report. Their summary states that the water is of "good" quality. An investigation of two wells in Grayland also resulted in a determination of "good" water quality, and the water meets the criteria for use without treatment. The Grayland Aquifer provides the sole source of drinking water for the area.

Biological Resources

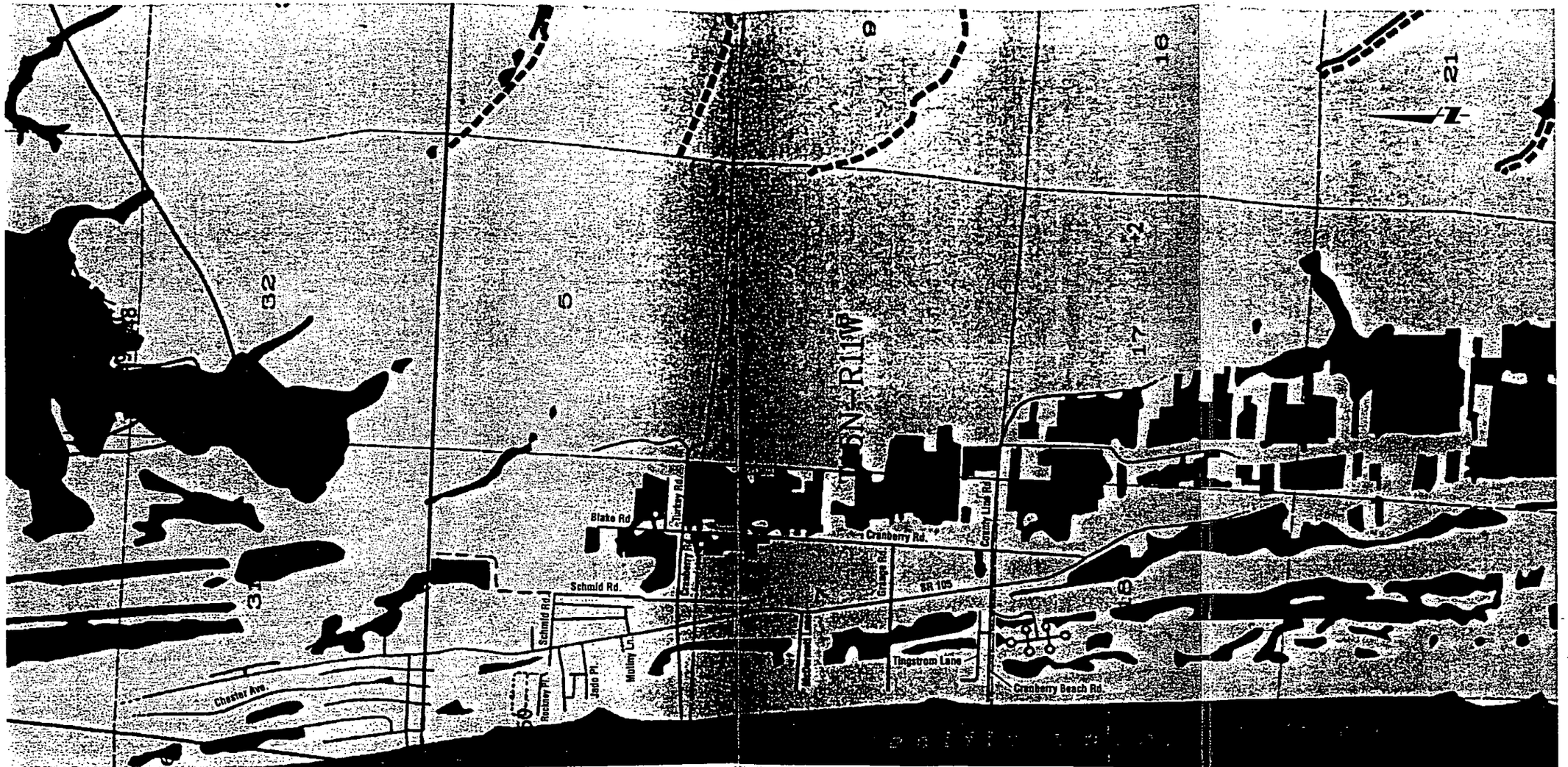
Vegetation

The vegetation within the study area is generally a function of the land use, which is discussed in more detail later in this section. More than 50 percent of the Grayland area is undeveloped, uncultivated land. Logging, cranberry production, and urban development account for the other half.

Grays Harbor County supports some of the best timber-growing regions in North America. The upland areas that form the eastern border of the FHRP study area have the favorable climate, fertile soils, and timber species that make the region so productive. Trees on the uplands are primarily coniferous, consisting of firs, spruce, and other species. Spruce also grow along the main drainage channel.

Cranberry farming is a major industry in Grays Harbor County. A 1992 Census of Agriculture shows that there were 28 separate cranberry farms within the County. All of these farms are irrigated. Most of these farms are located in Grayland, one of the three major cranberry production sites in the state of Washington.

Stormwater runoff in the Grayland area can have a large impact on the viability of cranberry crops. Drought or long periods of inundation can ruin crops. In terms of this FHRP, inundation is the main concern. During storm events, the flat cranberry bogs serve as temporary storage of runoff. This can be sustained for several days; however, prolonged periods of runoff storage or repeated flooding within a short time period may be detrimental to the crops.



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Wetlands

Figure 3-4
Wetlands

Fisheries Resources

Because changes in existing hydrologic patterns in a watershed can directly impact fish and aquatic wildlife, the FHRP must take their habitats and sustainability into account. Species that are listed as endangered, threatened, sensitive, or candidate by the Washington State Department of Fish and Wildlife (WDFW) must be identified and considered in any improvement projects that would impact their viability. Additionally, if a species priority habitat (e.g., the breeding habitat of a particular unlisted fish) is identified within a proposed improvement area, special steps must be taken before habitat changes are implemented (if they are allowed at all).

Region 6 of the WDFW was contacted by the consultants to determine fish usage in the study area watershed. The habitat biologist for the Grayland area indicated that cutthroat trout commonly travel through the main drainage channel, coming and going through the tide gates. He was not aware of spawning activity in the watershed, but acknowledged that it is a possibility. Any proposed projects in the hillside streams above the ditch would require a field review to identify the potential for spawning habitat. In particular, the southernmost drainage in the area, Seastrand Creek, is a valuable habitat resource. A few salmon are occasionally found in the main drainage channel, but have strayed from their normal habitat and do not use the system as a habitat.

In general, the main drainage channel is not a productive habitat, and it is not a high priority area. Permits are required but will be granted for work along the ditch.

One possible concern would be any major expansion of the channel that might affect the surrounding spruce forest. The spruce forest in the area has been identified as a potential habitat of the Marbled Murrelet. The Marbled Murrelet has recently been listed as a threatened or endangered species.

Wetland Resources

Wetlands having any of the following criteria are described as priority areas.

- Comparatively high wildlife density or species diversity
- Important wildlife breeding habitat or seasonal ranges

- Limited availability
- High vulnerability to habitat alteration

Although there are many productive wetlands throughout the Grayland study area, none are known to be ranked as priority wetlands. The WDFW has emphasized that for the proposed improvement projects in Grayland, drainage systems should not drain wetlands. Additionally, no ditch cleaning or dredge spoils should be side-cast into any wetlands.

Wildlife

Peregrine falcons, a WDFW-listed species, have been identified along the dunes west of SR 105. If improvements to drainage have a potential to disturb these birds during feeding or migration, an Endangered Species Act Section 7 consultation will be required. Likewise, any improvements to the main drainage channel that could impact the spruce forests potentially supporting the Marbled Murrelet (a recently listed species) will require a Section 7 consultation. In general, before major drainage improvements are undertaken, a consultation with WDFW is recommended.

According to the USDA/SCS Soil Survey for the area, the following broad categories for habitat exist in Grays Harbor County. Based on the land use and soil types in Grayland, these are probable habitats for the study area.

- **Habitat for Openland Wildlife** - meadows and areas that are overgrown with grasses, weeds and/or shrubs. These areas produce grains, seeds, grasses, legumes, and wild herbaceous plants that attract wildlife (California quail, pheasant, meadowlark, robin, field sparrow, crow, killdeer, and rabbit).
- **Habitat for Woodland Wildlife** - regions of deciduous and/or coniferous plants and associated grasses, legumes, and wild herbaceous plants. These areas attract pigeon, ruffed grouse, woodpeckers, mountain beaver, squirrels, black-tailed deer, and black bear.
- **Habitat for Wetland Wildlife** - open, marshy, or swampy shallow water with typical wetland vegetation (hydrophytic sedges, rushes, grasses, and shrubs).

Some of the wildlife attracted to these regions includes ducks, geese, herons, shore birds, kingfisher, muskrat, mink, and beaver.

Current and Projected Population

The current population in the Grayland FHRP study area was determined from 1990 Washington State Office of Financial Management (OFM) census tracts (see Table 3-1). The 1990 populations were translated to 1995 populations using an annual population growth rate of 1.5 percent and a housing growth rate of 0.75 percent. These growth rates are explained below.

Table 3-1
1995 Grayland Population (based on OFM Census Tracts)

Year	Total Housing Units	Units with Attachable/ Detachable Units	Owner-Occupied	Renter-Occupied	Total Population
1990	406	281	166	63	493
1995 (extrapolated)	422	292	173	66	532

To predict the impacts of local growth on stormwater conveyance and flood hazard issues, the current population in Grayland was projected to develop 6- and 20-year population forecasts. This is consistent with the 6-year financial planning period and the 20-year future growth horizon recommended in the Growth Management Act.

Like many portions of the North and South Beach areas, Grayland is influenced by the tourist industry seeking Pacific Ocean beach access and activities. The area also relies partially on the timber and cranberry farming industries. Population projections are difficult to make because these influences are highly variable from year to year. The tourist industry depends on economic trends and the timber industry can be greatly impacted by reigning politics, market conditions, and regulatory movements.

Because no population predictions exist specifically for the Grayland area, several different local predictors for the entire county of Grays Harbor were examined. Within the same county,

unincorporated and incorporated areas tend to have different growth rates because of the availability of land, the economic draw, and other factors. For this reason, only those growth rates for unincorporated areas within Grays Harbor County were considered. Additionally, some studies have delineated regions within the county that can expect similar annual percentage changes in population. Although Grayland falls within the South Shores Division region it is a coastal community and can likely expect a greater growth rate than some of the inland, timber dependent communities in South Shores. Bearing these uncertainties in mind, three sources for population projections were found to suggest reasonable rates of growth. They are as follows:

- Washington State Office of Financial Management (OFM) 1990-1994 Census Data
- *Grays Harbor County Capital Facilities Plan* (CH2M HILL, 1994) - Projections based on historical population in Grays Harbor County, OFM population projections for Grays Harbor County and surrounding counties, Washington State Superintendent of Public Instruction enrollment forecasts for school districts within the County, Grays Harbor Regional Planning Council population information, and Port of Grays Harbor estimates of industrial development.
- *Utilities Comprehensive Plan: Grays Harbor County* (Parametrix, 1991) - Projections based on data from the U.S. Census Bureau and Grays Harbor County Regional Planning Commission.

Data from these sources were compared, and it appears that although the 1994 Capital Facilities Plan by CH2M HILL reports small or stagnant growth rates in the South Coastal Division between 1995 and 2014, these are not directly applicable to the Grayland area. Housing starts in the area are up, and new enrollment in local schools is on the rise. On the other hand, OFM data for the entire county (unincorporated) may be overestimating the growth in Grayland. The data from the Utilities Comprehensive Plan for the South Shore Division is based on an analysis of the growth trends over 10 and 30 years of historical data. This shows moderate growth in the division. It may be difficult to relate to present and future conditions, however, because it is already 4-years old.

After compiling the statistics, general population growth rates of 1.5 percent to reach 1995 populations, 1.3 percent for the 6-year planning period, and 1.10 percent for the 20-year period

were selected. The housing statistics presented in Table 3-1 are based on the average occupancy of two persons per household (one-half of the 1.5 percent annual growth rate results in a 0.75 percent annual housing rate). All of these assumed rates are for medium growth in the Grayland area. High and low rates should also be considered (with the former being approximately 5 percent higher than the medium rate, and the low rate assumed to be zero), but for the purposes of this FHRP, a medium rate has been selected. This will give a somewhat conservative stormwater sizing input, yet should not result in an unnecessarily overdesigned and/or costly drainage system. The population growth rates used to predict future population in Grayland and the final populations for the planning periods are presented in Table 3-2.

Table 3-2
Population Projections for Grayland

Planning Period	Base Population	Growth Rate	Final Population
1990-1995	493	1.5%	532
1995-2001	532	1.3%	575
2001-2015	575	1.1%	670

Land Use

Current Land Use

Table 3-3 shows the present land uses in the Grayland study area. It was created by visual inspection and proportioning of observed land coverage using a 1992, aerial photograph. The actual drainage area for the study contains only a small portion of the area west of SR 105 (the 320 acres of undeveloped sand dunes and 42 acres of the residential property are not included in the drainage area). For the purposes of this discussion, however, the entire FHRP boundary has been delineated.

From the table, it can be seen that as of 1992, urbanization in the basin had reached almost 25 percent (Residential and Small Businesses plus logged areas). Agricultural uses (cranberry bogs) cover almost 14 percent of the area. The remaining land supports timber, open areas, and salt marshes.

Table 3-3 Grayland Area Land Use		
Land Use Description (from 1992 aerial photograph)	**Area (acres)**	**Percent of Study Area**
Undeveloped sand dunes/beach	320	11.1
Residential and small business	315	11.0
Cranberry bogs (dormant and in use)	390	13.6
Sparse woods	475	16.6
Meadow	65	2.3
Dense woods	590	20.6
Logged woods	375	13.1
Salt marsh	340	11.8

Future Land Use

Although Grayland has no zoning code of its own, there is a county-wide zoning code for Grays Harbor County. From this, it can be seen that the majority of the Grayland area is zoned as R3, Resort/Residential, with some small areas allowing commercial development. Based on the assumed growth rate of 1.3 percent over the next 6 years and 1.1 percent over the following 14, it can be estimated that there will be a very slight increase in the urban land use. Census data shows that Grays Harbor County had 36 harvested cranberry farms in 1982, 29 in 1987 and 28 in 1992. Although this supports a general decline in farms, no hard predictive information exists for Grayland. For this reason, it will be assumed for planning purposes that the area used for farming will remain the same throughout the study period. The net result of this is only a minor change in future land use. It is likely that the increased urbanization (less than 1 percent by 2001 and less than 2 percent by 2014) will encroach only slightly on the undeveloped half of the study area. Although impacts from future growth in Grayland are predicted to be insignificant, it is likely that there will be some growth in the area. Therefore, planning efforts and recommendations in this FHRP will address new development.

REGULATORY OVERVIEW

Federal, state and local regulations directly affect flood hazard management and improvements to local drainage systems. These regulations are in place to ensure that all development, changes in land use, and utility improvements give proper consideration and planning to potential impacts to human safety and convenience and natural resources. The regulations pertaining to stormwater runoff collection and conveyance can be grouped into the following four major categories.

- Land Use Management
- Resource Management
- Environmental Protection
- Flood Hazard Management

The laws under each of these categories and their implementation mechanism are summarized in Table 3-4. More detailed explanations of the regulations, their rationale and the responsibilities of the jurisdictions can be found in Appendix B.

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Table 3-4
Regulations Pertaining to Flood Hazard Management

Law	Brief Summary	Implementation
Land Use Management		
Comprehensive Plan/Growth Management Act (State)	Gives long-range direction and guidance for systematic growth and development. County-wide planning required.	NA
Zoning Ordinance (County)	Regulates land uses and densities. Implements growth management policies of the Comprehensive Plan.	By County, through zoning codes
Uniform Building Code (Regional, not actually a law)	Provides jurisdictions with an adoptable set of building regulations.	By County, through zoning codes
Subdivision Ordinance (County)	Sets procedures for land division. Includes drainage plans and drainage system standards.	By County
Washington State Shoreline Management Act (SMA) (State)	Establishes priority of shoreline uses to preserve natural resources. Regulates development in shoreline area.	By State and local, through WAC 173-14, 16, 17, 18, 19, 20 and 22
Shoreline Master Program (County and Local)	Mandated by the SMA as the principal planning tool to protect shoreline resources.	By County and local through WAC 173
Resource Management		
Hydraulic Code (State)	Preserves fish and wildlife by requiring a permit for any work using, diverting, or changing the flow or bed of any waters of the State.	By State (DFW) through WAC 220-110 and Hydraulic Permit Approval
Section 404–Clean Water Act (Federal)	Maintains the biological integrity of the nation's waters (including wetlands and adjacent tributaries) through actions such as the regulation of dredge/ fill materials.	By Federal (COE) through 40 CFR
Section 401–Clean Water Act (Federal)	Federal permit prerequisite certification process for discharge into a waterbody. Important in the construction phase of flood hazard protection measures.	By Federal through 40 CFR, also State through WAC 173-201
Section 10–Rivers and Harbors Act (Federal)	Prohibits unauthorized obstruction or alteration of navigable US waters.	By Federal (COE) through 33 CFR 320-330

Table 3-4
Regulations Pertaining to Flood Hazard Management

Law	Brief Summary	Implementation
Environmental Management		
National Environmental Policy Act (Federal)	Requires Federal agencies to consider environmental impacts of projects requiring agency permits.	By Federal and CEQ through 40 CFR 1500-1508
Washington State Environmental Policy Act (State)	Requires agencies to determine (and make information available to the public about) the environmental impact of actions for which they issue permits. For significant adverse impacts, agencies mandated to require mitigation.	By State (Dept. of Ecology) through WAC 197-11 and WAC 400-04-902
Executive Order 11990 (Federal) and Executive Order 90-40 (State)	Mandate that agencies exercise to the extent permissible, their powers to require mitigation, and condition, deny or appeal permits, for all adverse impacts to wetlands.	All levels
Executive Order 11988 (Federal)	Mandates that agencies exercise to the extent permissible, the avoidance of adverse impacts from their activities in floodplains.	All levels
Flood Hazard Management		
National Flood Insurance Program (Federal)	Makes affordable flood insurance available to communities that have adopted approved floodplain management regulations.	By State and County/ local through zoning and floodplain restrictions
State Floodplain Management (State)	Adopts the NFIP minimum standards, and also prohibits new or substantially improved residential development in any designated floodway.	State (Dept. of Ecology) and Local through WAC Ch. 173-158, zoning and floodplain restrictions
Floodplain Management Ordinance (Local)	Requires development permits to restrict dangerous uses due to water or erosion hazards	By County through zoning code

Notes:
DFW = Washington State Department of Fish and Wildlife.
COE = Army Corp of Engineers.
CEQ = Council on Environmental Quality.
Ecology = Washington State Department of Ecology.
WAC = Washington Administrative Code.
CFR = Code of Federal Regulations.