

Dungeness River Comprehensive Flood Hazard Management Plan 2009

Clallam County, WA



Prepared for Clallam County

by the

Dungeness Flood Hazard Advisory Committee,

a subcommittee of the Dungeness River Management Team

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1. EXECUTIVE SUMMARY

1.1 Introduction

It's been said that the Dungeness River can make a fool out of anyone. The river finds its way around bridges and levees, leaves irrigation outtakes high and dry, washes out log jams built for salmon, and eats away the banks under houses that were once thought to be safe. In an effort to "control" the river, people have used rock and logs to build walls and levees that must be rebuilt over and over. They have dug out gravel in an effort to keep the river bed lower – only to find in 10 years that the river is scouring down and undercutting the base of a levee.

The Dungeness River looks harmless enough in the summer, when sparkling waters shimmer under the bridges and form little pools along the edges, but in the winter it can be powerful and destructive. In the late summer, typically about 180 cubic feet of water per second (cfs) flow past the US Geological Survey gauging station about 12 miles upstream from the river mouth. In the 2002 flood, 7,610 cfs came roaring down from the mountains laden with rock, silt, and logs. Flooding in the Dungeness is more than just high water. At natural or man-made bottlenecks, the river dumps its gravel load or forms log jams, then charges along alternative pathways or batters against banks and bridges. It is normal for rivers to eat away the outside of a bend, and form sand bars on the inside of the curve. Where healthy forests hold onto the banks with interlocking roots, this process of channel migration occurs over decades or centuries. In the Dungeness, where much of the lower riparian forest was once logged and banks are destabilized, the river has become unraveled and its primary channels can change by hundreds of feet in one flood.



Dungeness River Audubon Center entry road, 2002

Photo Courtesy Bob Boekelheide, Dungeness River Audubon Center

The community discussions leading up to the recommendations in this plan highlighted several assumptions. First, floods will continue to happen in the Dungeness River. Severe storm events and flooding occur during the fall and winter, particularly when heavy rain falls on accumulations of mountain snow. The working group for this plan wanted to make it clear that this is not a flood control plan—floods cannot be controlled. Instead, it is a plan to minimize or reduce flood hazard within the Dungeness River lower watershed. Secondly, the Dungeness is a river of varied uses, and actions related to property damage and flood hazard must consider these other uses. While the first goal of this plan is to, “prevent loss of life and property from flooding,” the flood plan working group also recognized that any action to reduce flood hazard must consider the impacts to irrigation, water supply, water quality, downstream residents, and fish and wildlife habitat. Several members of the salmon family in the Dungeness River are presently listed as threatened under the Endangered Species Act, including Chinook, steelhead, summer chum, and bull trout. Dungeness pink salmon populations are also considered to be “depressed.” Levees, dredging, bank armoring, and other actions to prevent flood damage can have severe negative impacts on fish habitat. Thus it is the intent of the flood hazard management plan to find compatible strategies that will protect the river from people as well as to protect people from the river.

1.2 Purpose, Scope, and Authority

The purpose of this document is to amend and update the Dungeness River Comprehensive Flood Management Plan adopted by Clallam County in 1991 (Kramer, Chin and Mayo, 1990). The plan and amendments fulfill the required elements of Washington Administrative Code (WAC) Chapter 173-145-040 for plan elements and integrate Growth Management Act requirements under Revised Code of Washington (RCW) 36.70A.060 and Chapter 365.190 WAC. The amendments reflect the updated guidelines of the Washington State Flood Control Assistance Account Program (FCAAP) to utilize an approach that integrates fish and wildlife habitat, watershed planning, growth management, and non-structural elements into the management of flood hazards. By meeting the FCAAP requirements, Clallam County retains eligibility to apply for flood hazard reduction projects in the Dungeness River. The plan also meets requirements for programs for emergency responses during disasters.

The geographic scope of the plan includes the lower 11 miles of the Dungeness River and areas in or adjacent to the channel migration zone¹ and the 100-year flood plain of the Dungeness. The plan also includes coastal areas in the Sequim-Dungeness area within a tsunami hazard zone or as identified as flood hazard areas by the Federal Emergency Management Agency (FEMA). Riparian areas of the Dungeness River upstream of River Mile 11 are presently in private, state, or federal forest land, and it is assumed that upstream land use will not change in such a way that flood hazard is increased.

This plan is an advisory document prepared pursuant to RCW 86.12.200. Implementation of the Dungeness Comprehensive Flood Hazard Management Plan is subject to adequate staffing, funding, and partnerships with cooperating organizations. Implementation is further guided by other regulatory programs, such as the Clallam County Critical Areas Code and Shoreline Master Program. Updates and amendments to these regulatory programs, as recommended herein, are subject to state guidelines and requirements, and any regulatory changes to be adopted by Clallam County will follow public notification and hearing procedures prior to adoption.

¹ The terms Channel Migration Zone (CMZ) and Channel Meander Hazard Area (CMHA) are described in the glossary. As used in this document, these terms are synonymous. CMHA is used where it is specifically referring to the provisions or applicable standards of the Clallam County Critical Areas Code (CCC 27.12.410).

1.3 Development of the Plan

The 1990 Dungeness River Comprehensive Flood Management Plan was completed by Kramer, Chin and Mayo, Inc. and the Clallam County Public Works Department in consultation with the Dungeness River Management Team (DRMT). The DRMT is a broadly representative watershed council of citizen and agency advisors which was created by Clallam County in 1988, and reappointed in 1995 in a joint resolution by Clallam County and the Jamestown S'Klallam Tribe. The DRMT authorized a Dungeness Flood Planning Committee consisting of county, tribal, and state agency staff, and property owners along the Dungeness River to prepare plan recommendations and updates in 2003 and 2008. Draft recommendations were developed in the fall and winter of 2008-2009 and distributed for public review.

The plan amendments also integrated information from a number of important studies and plans that were completed since the 1990 plan, including analyses of river processes by the U.S. Bureau of Reclamation (2002, 2003, 2007); a Land Protection Strategy developed by the Dungeness River Restoration Work Group (Hals, 2003); the Dungeness chapter of the Puget Sound Salmon Recovery Plan (Shared Strategy, 2005); an updated delineation of the channel migration zone (Rot and Edens, 2008); and other technical studies of elevations, historical river channel changes, airphotos, Light Detection and Radar (LiDAR) surveys, and hydraulic modeling .

1.4 Goals and Principles

The plan identifies four major goals related to flood hazard reduction:

- Prevent loss of life and property from flooding.
- Integrate flood hazard reduction with efforts to preserve and restore river processes, critical habitats, and fish and wildlife.
- Support the river's varied uses including agriculture, residential development, fish and wildlife habitat, water supply, open space, and recreation.
- Ensure that flood hazard management occurs in the context of an ongoing, systematic and comprehensive approach to Dungeness River basin management and preservation.

The development of the updated plan follows the principles from the Department of Ecology's 1991 Guidebook for Comprehensive Planning for Flood Hazard Management. These include recognition of and respect for natural hydrological processes in the management of flood hazards, focus on the cause of flood damage instead of the symptoms, examination of structural and non-structural solutions with both short and long term objectives, and public participation and inter-agency coordination.

1.5 Identification of Flood Hazards and Flood History

The highest instantaneous peak flow on record in the Dungeness River was the January, 2002 flood of 7,610 cfs. The probability of a flow at that magnitude is approximately 2 to 4% in any given year. Flood flow is not necessarily related to flood damage, since potential damage depends on soil erosion, movement of debris, storm surge and tidal forces near the river mouth, and most importantly, the position of residences and other structures. Flood hazards in the Dungeness are identified in four different segments, or "reaches" of the river. Table 1-1 summarizes the river reach and major flood hazards that have been identified.

Table 1-1: Summary of Flood Hazards by Reach

River Mile (RM)	Major current and potential flood hazards identified
Reach 1: RM 0.0-3.3 River Mouth to Woodcock Road	River's End residences and berm, Army Corps of Engineers Levee, Schoolhouse Bridge, Game Farm Levee, Ward Road, additional houses
Reach 2: RM 3.3-6.5 Woodcock Road to Highway 101	Ward Bridge (Woodcock Road), Burlingame Bridge (Old Olympic Highway), Railroad Bridge and Hendrickson Road, scattered residential structures (particularly in Grandview area and Kaiser Road area)
Reach 3: RM 6.5-8.6 Hwy 101 Bridge to BPA powerlines	Residential homes and property along Taylor-Cutoff Road, SP Tri irrigation outtake, CCD outtake, Dungeness Meadows levee, Independent outtake.
Reach 4: RM 6.5-10.8 BPA powerlines to Canyon Creek	Lower Haller dike, Kinkade Island/end of River Road residences, Dungeness Fish Hatchery facilities, Fish Hatchery Road, Agnew and Highland irrigation outtakes, City of Sequim water supply, other scattered residences

Of the flood hazards identified in the table, three residential areas are considered to be at exceptional risk of threat to human safety and property damage: River's End Road, Kaiser Road, and Kinkade Island. The location of residences and geo-hydrological conditions are such that even a small flood (2-year probability) has the potential to cause significant property damage and risk to human safety. All three areas have suffered flood damage within the last decade. River's End and Kinkade Island also represent high priority areas for habitat restoration actions in the salmon recovery plan and land protection strategy. Acquisition and structural removal have reduced the number of residences at risk at River's End Road but some residences remain. Another area of potential catastrophic risk is the area behind the US Army Corps of Engineers Levee in Reach 1. The levee has been evaluated by the Bureau of Reclamation and is in jeopardy of being overtopped at 100-year flood levels.

1.6 Flood Hazard Management Strategies and Recommendations

Structural methods of managing flood hazards are remedial strategies that attempt to fix or prevent damage to houses and other facilities located near a river channel. Examples of structural methods include dikes, levees, bank armoring, and rip rap. Several such structures occur in the Dungeness River. The three largest levees in the Dungeness River are the Army Corps of Engineers (ACOE) levee near the river mouth, built to protect the town of Dungeness; the Game Farm levee directly across the river from the ACOE levee; and the Dungeness Meadows levee. All three levees have substantially modified river processes, and may have increased the risk of hazard to properties located downstream or across from the structure. Proposals to set back the ACOE levee have been analyzed by the US Bureau of Reclamation, and discussions with affected property owners are occurring. Other levees, riprap, log placement, and bank armoring are present throughout the lower 11 miles. The use of structural alternatives in reducing flood hazard risk is not recommended in this plan, except as a last resort, as these disrupt river processes and habitat, often impact homes and structures downstream, and require maintenance in perpetuity.

Non-structural alternatives are preventive strategies that are designed to reduce the susceptibility to flooding and do not alter natural river processes. Examples of non-structural alternatives include purchase of undeveloped property, conservation easements, regulations, enforcement, wetland restoration, riparian revegetation, educational programs, and structural removal or setback. Since the preparation of the initial flood management plan in 1991, several changes have occurred to county

codes and plans, NOAA Fisheries has approved the Puget Sound Salmon Recovery Plan, and several key parcels or easements have been purchased. Recent recommendations for flood hazard reduction strategies generally emphasize the use of non-structural alternatives because they represent long term solutions and do not negatively impact river processes that affect threatened species or downstream property owners.

The principle recommendations for non-structural alternatives in the lower Dungeness River include:

- Utilize new scientific information to update the channel migration zone and flood plain maps that are used for regulatory and flood insurance programs.
- Protect people and property from erosion and flood hazards and protect habitat functions by updating and amending land use and related regulations. In particular, direct development away from the Channel Migration Zone and use the CMZ for establishing buffer standards.
- Improve and expand ongoing education and outreach to existing and potential landowners along the Dungeness related to land development and stewardship.
- Conduct public education programs about flood risk and emergency preparedness regularly (at least annually) through a variety of media.
- Continue programs to purchase parcels at high risk of flood hazard and high value habitat areas.
- Continue and expand monitoring and code compliance programs along the Dungeness River corridor to prevent increased flood hazard risk or habitat degradation.

Alternative actions for flood hazard reduction were considered by the Dungeness Flood Hazard Advisory Committee and recommendations were reviewed by the Dungeness River Management Team and through a local public comment process. Recommendations for site-specific flood hazards in each segment of the river are included in Chapter 5.

1.7 Relationship to other Regulatory Programs

The Dungeness River and associated floodplains are governed by numerous federal, state, and local regulations. The Clallam County Critical Areas Code and Shoreline Master Program are directly relevant to flood hazard reduction on the Dungeness. At least three categories of critical areas apply to parcels adjacent to the Dungeness River such as Frequently Flooded Areas, Class I Habitat Conservation Areas, and Geologically Hazardous Areas (which includes the Channel Meander Hazard Area). The Critical Areas Code and other County codes regulate uses within 200 feet of the shoreline, set buffer requirements, and establish requirements and restrictions on buildings, vegetation removal, and excavation. The plan recommends that future updates to the Critical Areas Code and/or Shoreline Master Program incorporate amendments for flood hazard management, such as a requirement to set the aquatic and wildlife habitat conservation buffers from the edge of the channel migration zone rather than the ordinary high water mark. Continuation and expansion of active outreach and compliance monitoring programs are also recommended.

A biological opinion was issued by NOAA /National Marine Fisheries Service in September, 2008 related to the National Flood Insurance Program (administered by the Federal Emergency Management Agency) and the listing of several Pacific Northwest salmon species as threatened under the Endangered Species Act. Site-specific information about the Dungeness has been collected that will be useful for the County and other agencies to update maps and procedures as FEMA and NOAA develop additional guidance.

1.8 Emergency Management

Clallam County Emergency Management Division operates a Comprehensive Emergency Management Plan jointly with the cities of Port Angeles, Sequim, and Forks using the Incident Command System.

Information on planning for floods and other hazards is available on the Clallam County website at <http://www.clallam.net/html/emergencies.htm>.

Additional information to assist homeowners and businesses to plan and prepare for emergencies is available from the Washington Emergency Management Division www.emd.wa.gov or the Washington State Department of Health www.doh.wa.gov. The state Emergency Resource Guide publication is available at www.doh.wa.gov/phepr/factsheets as DOH publication #821-001.

Information on flows and emergency notification is available in several ways:

- **The US Geological Survey website** provides real-time data for the Dungeness River from a gaging station at River Mile 12 approximately one mile downstream from the boundary of Olympic National Forest: <http://waterdata.usgs.gov/wa/nwis/current?type=flow>
The gaging station describes the flow in two ways—as the discharge of water flowing past the gaging point measured in cubic feet per second, and as stage measured as the height in feet above the river bed at the station site. Flood stage occurs when the flow begins to overtop the streambank at the gage site. This occurs at an elevation of 7.0 feet at the USGS gaging station.
- **The Washington Department of Ecology** maintains a telemetered gaging station at the Schoolhouse Bridge at river mile 1 which transmits updates of the discharge every three hours and is loaded to the following internet site:
<https://fortress.wa.gov/ecy/wrx/wrx/flows/regions/state.asp?region=1>
- **Local Radio:**
KONP-1450 AM 360.457.1450
KBDB -103.9 FM 360.374.6233
KAPS 660 AM Mt. Vernon, 800.827.7660
KSQM – 91.5 FM Sequim 360-681-0000
- Flood (and other emergency) watches and warnings are available at <http://www.wrh.noaa.gov/sew/> and will be broadcast on NOAA weather radio.

Flood-related problems (e.g. active erosion or high water conditions) may be reported to the Emergency Management Center at (360) 565-2680 or 2681 when the center is activated. Life threatening conditions, emergency rescue requests, and medical emergencies should be reported to 911.

Residents of flood hazard management areas are advised that notification or assistance from County or other emergency officials may not always be available during a flood event and they should assume that they are on their own. Residents are advised to be prepared for flood emergencies, monitor flood watches and warnings, and take appropriate action to remove themselves from harm's way in advance.

2. WATERSHED CHARACTERISTICS AND PLANNING HISTORY

2.1 Description of the Watershed²

Originating in the Olympic Mountains of Washington State, the Dungeness River and its main tributary, the Gray Wolf, drain a 270-square-mile watershed of steep mountains, deep forested canyons, and a broad open valley. With headwaters at 6,400 feet in Olympic National Park, the steep, 32-mile course of the Dungeness flows almost due north before emptying into Dungeness Bay along the Strait of Juan de Fuca. Dungeness Bay is formed by Dungeness Spit, the longest natural sand spit in the United States, and is the site of the Dungeness National Wildlife Refuge. The lower ten miles of the Dungeness River flow through a broad alluvial valley, which is characterized by a mixed use of small forested parcels, agriculture, and increasingly, a mix of rural/urban residential development in proximity to the City of Sequim. Characteristics of the Dungeness Watershed including climate, geology, hydrology, soils, biotic communities, land use, and demographics are described more fully in the Appendices as well as several planning documents including the Water Resources Inventory Area (WRIA) 18 Watershed Plan (Entrix, 2005).

Precipitation and Streamflow

While the Dungeness watershed drains over 172,000 acres, it is located in the arid “rainshadow” of the Olympic Mountains, receiving only a fraction of the precipitation typical of other western Washington rivers and streams. Average annual precipitation in the upper watershed is approximately 63 inches, while the Sequim area experiences only 16 inches. Roughly 75 percent of annual precipitation occurs during the October to March period.

Streamflow has been measured at river mile 11.8 by the USGS for over 80 years. Typical late summer streamflows average less than 200 cubic feet per second (cfs), while average winter flows in December through February are approximately 400 cfs. Peak sustained flows occur during snowmelt in June and July. Instantaneous peak flows have been measured in excess of 7,500 cfs, with a record flow of 7,610 cfs on January 6, 2002, resulting in extensive flooding in portions of the lower 10 miles. River basin hydrology has been dramatically altered by an irrigation system initiated in 1896, and an estimated 173 miles of canals and ditches spread Dungeness River water throughout the lower watershed area (Newberry, 2003). Since 1993, water conservation projects have been implemented on the irrigation system to reduce the impacts of water withdrawal on instream flow. Projects include piping, lining ditches, replacing siphons, and outreach. The Washington Department of Ecology intends to adopt new rules for Dungeness area water use in 2009. Studies of aquifer recharge, water re-use, and the development of a water exchange have been occurring in 2007-2009.

Plant, Fish and Wildlife Communities

The Dungeness Basin is predominantly in the Western Hemlock forest zone, with small portions of the upper basin in the sub-alpine and alpine zone (Kruckeberg, 1991). The dominant forest tree species in the basin include Douglas fir, Western hemlock, and Western red cedar; the dominant riverside trees include red alder, black cottonwood, and willow. Forest lands in the mid to upper basin host various terrestrial wildlife species typical of the Pacific Northwest, such as black-tailed deer, Roosevelt elk, black bear, and cougar. Bird species vary by the successional stage of the forest and include numerous

² Adapted from *Protecting and Restoring the Waters of the Dungeness*; Jamestown S'Klallam Tribe, 2007

species of owls, hawks, woodpeckers, flycatchers, warblers, sparrows, and other species. Protected bird species include the Northern spotted owl, marbled murrelet, and bald eagle.

Seven species of Pacific salmonids utilize the Dungeness watershed for all or a portion of their life cycle - Chinook (1 run), coho (1 run), chum (2 runs), pink (2 runs), steelhead (2 runs), cutthroat trout (anadromous and resident), and bull trout (anadromous, resident, and fluvial). Chinook and summer chum salmon, steelhead, and bull trout are presently listed as threatened species under the Federal Endangered Species Act. The early-timed upper river stock of pink salmon is considered depressed while the lower river stock of pink is critical (WDFW et al., 1993).

Human Communities

Evidence of human civilization in the Dungeness dates back as far as 11,000 years ago, with a projectile found embedded in the bone of a mastodon (Kirk and Doherty, 2007). At the time of European contact in the late 1700s, 13 permanent S'Klallam villages existed along the shores and bays of the Strait of Juan de Fuca, plus numerous camps as the native population moved around to take advantage of the availability of seasonal food sources at traditional fishing, hunting and gathering sites. It has been estimated that the population of S'Klallam Indians in the Dungeness watershed ranged from 400 to 2100 prior to white settlement (Lichatowich, 1992).

Settlers to the Dungeness valley rapidly exerted major changes in the watershed and landscape, with the removal of forest cover (especially adjacent to the river), construction of an irrigation system, construction of bridges and levees, and the draining and diking of tidal areas near the river mouth to create farmland. Numerous forest fires burned large areas in the upper watershed in the 1890s. While portions of the upper watershed were protected within Olympic National Park beginning in the late 1930s, other areas of federal and state forest land were managed for extensive timber harvest. Land use change has been concentrated in the river corridor below river mile 11, where the steep gradient from the Olympic Mountains flattens into suitable terrain for farming and residential use. The 2005 Watershed Plan (Entrix) estimated that 20,000 people make their home in the Dungeness watershed, and growth in and around the City of Sequim continues at a dramatic rate due to the mild, relatively dry climate and beautiful scenery.

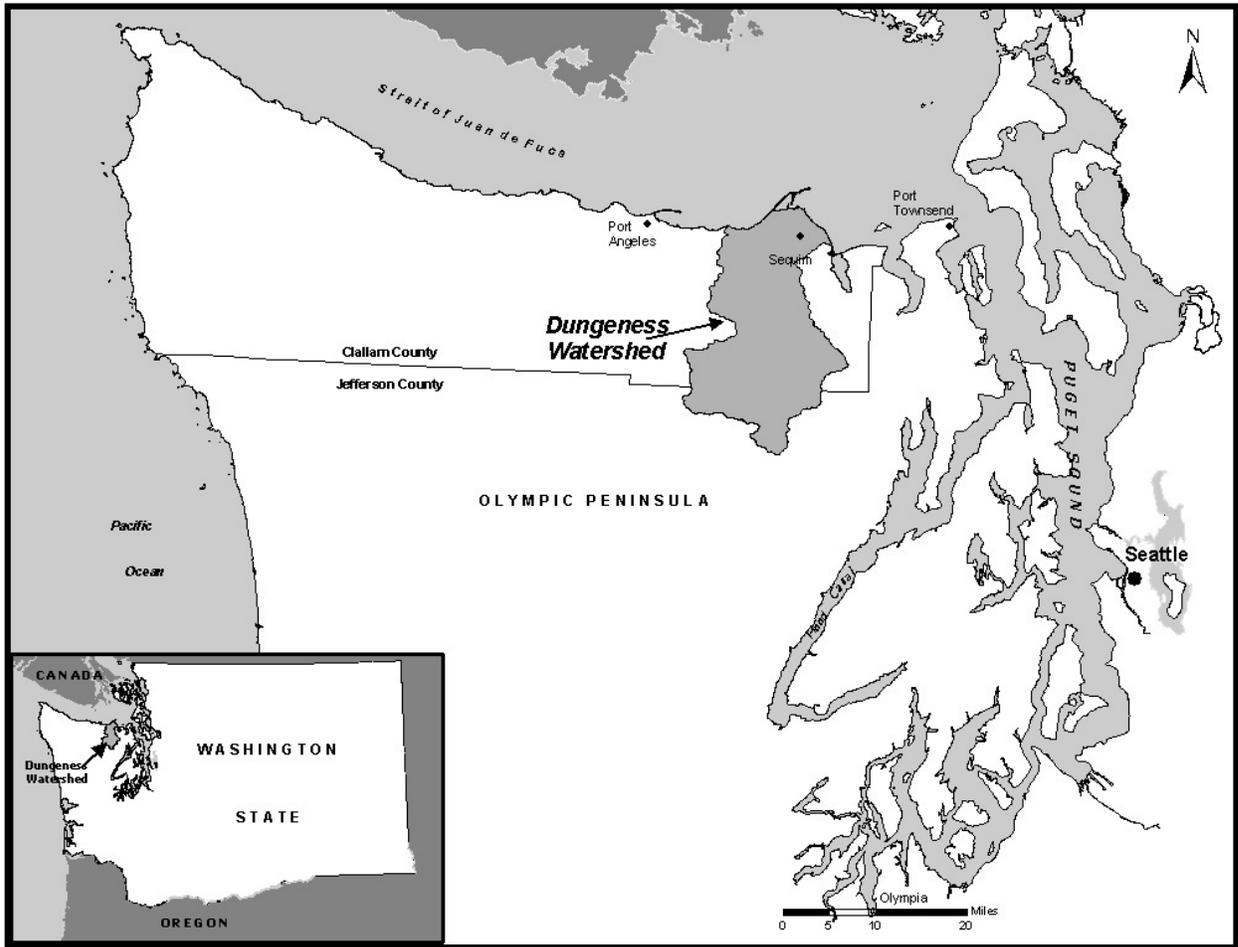


Figure 2-1: General Location of the Dungeness Watershed

2.2 Watershed Planning and Implementation History

Dungeness River Management Team: The Dungeness watershed has been subject to multiple processes of watershed planning for two decades addressing water quantity, water quality, flood control, forest management, salmon recovery, and other critical watershed issues. Nationally recognized for cooperative resolution of these issues, the watershed council, known as the Dungeness River Management Team (DRMT), has operated since 1988. The DRMT was initially organized and appointed by the Clallam County Board of Commissioners, and was reorganized in a joint resolution by the County and the Jamestown S’Klallam Tribe in 1995; staff activities are supported by both governments. The DRMT has no official decision-making or enforcement authorities in the Dungeness watershed; all research, restoration, and enforcement activities remain under the jurisdiction of the various federal, state, local, and tribal governments. The DRMT functions as an important, ongoing forum for communication, coordination, and sharing of resources in the watershed.

Two standing committees work closely with the DRMT: The Dungeness River Restoration Work Group consists of federal, state, tribal, and county fisheries biologists and planners, along with riverside property owners; and has prepared specific recommendations for long term habitat restoration and

protection projects and strategies. The Clean Water Work Group is a work group of federal, state, county, and tribal representatives, and citizen advisors, and is focused on the implementation of water quality clean-up plans for Dungeness Bay, Sequim Bay, and tributaries. Other ad hoc committees have been formed by the DRMT for flood hazard planning, educational projects, planning for setting back the Army Corps of Engineers levee in the lower river, groundwater analysis, pesticide/herbicide use and other subjects. The DRMT and sub-committees coordinate data collection, monitoring, public education and other watershed activities, and provide adaptive management oversight for the watershed.

The 1990 Dungeness Comprehensive Flood Control Management Plan (Kramer, Chin and Mayo for Clallam County Public Works) was approved by the Washington Department of Ecology and adopted by Clallam County. The Dungeness River Management Team served as the advisory body for the flood plan, which identified structural and non-structural approaches to flood control, and provided consideration to habitat as well as property protection.

Several of the non-structural recommendations in the 1990 plan have since been implemented, including the following:

- Mapping and designation of Critical Areas, including frequently flooded areas, channel meander hazard areas, and wetlands;
- Adoption of the Critical Areas Ordinance (CAO) which limits development and land use change within designated critical areas;
- Changes in the Clallam County Code (CCC) to reflect and incorporate the new CAO;
- Ongoing public education, including the development of a County web site where many types of information, including the ordinances and zoning regulations, are available;
- Continuation of a single watershed management council to coordinate research, planning, funding, and project implementation.

The 1990 Flood Plan also recommended prioritization of several critical hazard areas and provided sketches and brief descriptions of conceptual solutions for each area. The need for site-specific engineering plans for each project was noted. These areas included:

- Burlingame Bridge
- Railroad Bridge and downstream of Railroad Bridge
- Dungeness Meadows Levee
- Irrigation diversion upstream of Dungeness Meadows (Independent Company)
- Cut bank upstream of Schoolhouse Bridge
- Army Corps Levee, RM 0.9-RM2.8

Of those identified hazards, the Burlingame Bridge has been replaced and widened, however the response of the river was not as expected (river did not downcut). Log revetments have been placed at the Railroad Bridge. The Dungeness Meadows Levee was originally built in the 1960s and extended in 1992. A modeling analysis of levee setback alternatives for the Army Corps levee was completed by the Bureau of Reclamation in 2007. Numerous parcels and conservation easements have been purchased throughout the lower river for habitat protection and restoration, many with the dual objective of minimizing flood hazard by eliminating development potential or removing structures at risk.

2.3 Other Key Plans and Related Studies

Appendix A contains a bibliography of plans, studies, and restoration and education projects that have been prepared and implemented in the Dungeness watershed area since 1989. Technical studies address hydrological characteristics, instream flow for salmon, water consumption, water quality, riparian conditions, channel morphology, circulation patterns in Dungeness Bay, sanitary surveys, salmon status, habitat utilization, groundwater characterization, and other important inventories and assessments. Numerous agencies were involved in leading and funding these projects including Clallam County, Jamestown S'Klallam Tribe, Clallam Conservation District, US Environmental Protection Agency, US Forest Service, US Geological Survey, US Fish and Wildlife Service, US Bureau of Reclamation, Natural Resource Conservation Service; and the Washington State Departments of Ecology, Fish & Wildlife, Agriculture, Health, and Natural Resources.

In 1994 the Dungeness-Quilcene Water Resources Plan was completed. Although it was initiated largely in an effort to resolve the competition for limited water supplies in the Dungeness, the plan integrated habitat conditions, river processes, and human development issues into the plan recommendations. The recommendations of the DQ plan were revisited in 2003-2005 during the preparation of the Watershed Plan for Water Resource Inventory Area 18 (Entrix, 2005). One of the core recommendations that moved forward is closely tied to flood hazard management, and illustrates the updated emphasis on river processes as a solution to flood hazard management and habitat restoration:

R.9: Protect, and in some cases restore, floodplain and estuarine habitat to provide functions and values necessary for native and wild or hatchery fish and other wildlife resources, to reestablish naturally functioning stream geomorphology, reconnect river and streams to their floodplains and tidal estuaries, restore natural river and floodplain processes, and maintain river channels and banks in dynamic equilibrium, as well as to provide protection for life, safety, and property. A gradual evolution away from floodplain development and occupation and impacts on the ecosystem should be the goal (Dungeness-Quilcene Regional Planning Group, 1994).

Major Studies Relevant to Dungeness Flood Hazard Management since 2001:

- ***Recommended Land Protection Strategies for the Dungeness River Riparian Area*** (Hals/DRRWG, 2003): The “Green Book” (also known as the Land Protection Strategy) is a detailed analysis of every parcel in the lower 11 miles of the river describing fish use, habitat value, bank stability, current land use, development potential and restoration needs. Further, with the long term objective of optimizing salmonid habitat, the DRRWG prescribed and prioritized recommended actions to purchase property or conservation easements, and highlighted parcels where technical assistance could benefit landowner stewardship.
- ***Dungeness Salmon Recovery Planning Notebook*** (Jamestown S’Klallam Tribe for the Dungeness River Management Team, 2004-5): This compilation of information on Dungeness salmon and recovery actions was integrated into the Puget Sound Salmon Recovery Plan prepared by Shared Strategy in 2005, and approved by NOAA Fisheries in 2007.
- ***Physical Processes, Human Impacts, and Restoration Issues of the Lower Dungeness River*** (U.S. Bureau of Reclamation, 2002): In this multi-year assessment, the BOR utilized cross sections, sediment samples, and historical information to analyze changes in channel geomorphology and the impacts of structures on river processes.
- ***Kinkade Island Geomorphic Assessment*** (BOR, 2003): As a followup to the 2002 study, the BOR conducted a closer examination of flood hazard and channel modification from Kinkade Island downstream to and including Dungeness Meadows Dike.
- ***Numerical Modeling Study of Levee Setback Alternatives for Lower Dungeness River, WA*** (BOR, 2007): This report describes the results of two-dimensional numerical modeling to evaluate potential setback alternatives of the US Army Corps of Engineers levee area in the lower 2.7 miles of the Dungeness River.
- ***Airphotos of the Dungeness River Corridor*** have been collected annually by the Jamestown S’Klallam Tribe since 1994, and a LiDar survey was conducted by Clallam County in 2001. A high resolution LiDar survey of the Dungeness River corridor was completed by the Tribe in 2008.
- ***Delineation of the Dungeness River Channel Migration Zone*** (Rot and Edens; October, 2008): Utilizing many of the sources listed above and Geographic Information System capabilities, the Jamestown S’Klallam Tribe updated the delineation of the Channel Migration Zone including historic boundaries and potential future migration anticipated in the next 100 years.

3. GOALS AND PRINCIPLES FOR FLOOD HAZARD MANAGEMENT

3.1 Goals and Objectives for Flood Hazard Management in the Dungeness River

1. Prevent loss of life and property from flooding.
 - Flood hazard reduction measures at a particular site should be implemented with careful consideration for the risk to the lives and property of others.
 - Nonstructural measures to reduce flood hazards are preferred over structural measures, and long term solutions are preferred over temporary fixes.
 - To prevent future hazards, land use and zoning regulations should be implemented to guide development of flood hazard areas as defined by Clallam County, FEMA, or otherwise identified in this plan.
2. Integrate flood hazard reduction with efforts to preserve and restore river processes, critical habitats, and fish and wildlife.
 - Flood hazard reduction activities should not result in a net loss of or damage to fish and wildlife resources.
 - Flood hazard reduction activities should be consistent with the implementation of the Dungeness chapter of the federally-approved Puget Sound Salmon Recovery Plan, specifically the strategic elements for floodplain restoration, constriction abatement, and restoration of functional riparian and riverine habitat.
3. Maintain the river's varied uses. Flood hazard management of the Dungeness River should support the river's varied uses including agriculture, residential development, fish and wildlife habitat, water supply, open space, and recreation.
 - Flood hazard reduction measures should preserve to the fullest extent possible opportunities for other future uses, including public access.
 - Structural flood hazard management measures should preserve or enhance existing river characteristics that support fisheries, irrigation, and other river uses, and accommodate the dynamic nature of the river's processes.
4. Flood hazard management should occur in the context of an ongoing, systematic and comprehensive approach to Dungeness River basin management and preservation. Related objectives include:
 - Continue the role of the Dungeness River Management Team or similar body in an advisory role to the entities responsible for river management. This body should represent local and tribal governments, regulatory agencies, other government agencies, riverfront property owners, sports fishers, and other affected groups.
 - A stable, adequate, and publicly acceptable long-term source of financing should be established and maintained for flood hazard reduction and/or comprehensive management of the river.
 - Adapt and improve river flood hazard management strategies by incorporating new data and scientific studies of biological, hydraulic, and geologic processes, engineering and economic analyses, and community plans as necessary.

- Continue and enhance educational efforts to promote public understanding of flood hazards and the various uses and limitations associated with alternative flood hazard reduction measures.
- Conduct reviews of the recommendations and effectiveness of this plan, status of implementation of flood hazard reduction efforts, and consistency with changing regulatory frameworks.

3.2 Principles of Comprehensive Flood Hazard Management Planning

(Adapted from the Guidebook for Comprehensive Planning for Flood Hazard Management; WA Department of Ecology, 1991)

1. Respect the river's natural hydrological processes.
Rivers are dynamic systems and flooding, erosion, stream braiding, sediment deposits, and channel migration result from natural processes. Flood hazard management recognizes that it may be more cost-effective and environmentally sound to work within a river's hydrological dynamics. Experience has shown that fighting a river's natural tendency is often more costly and can result in other problems downstream.
2. Focus on the cause of flood damage.
Traditional efforts for flood control treated the symptoms of the problem, e.g. by building up walls instead of examining the land use that created the hazard.
3. Consider the entire watershed, not just local conditions.
Poor management of one portion of a watershed can result in flooding problems in another. Comprehensive flood hazard management requires that address a variety of rural, suburban and urban environments.
4. Incorporate public participation and inter-agency coordination into decisions.
Comprehensive flood hazard management requires inter-jurisdictional solutions and a public decision-making process to recommend a course of action. Citizen participation is essential to consider community concerns and to educate local residents on effective flood hazard management.
5. Examine flood hazard issues in an open planning process.
Comprehensive flood hazard management plans should provide a process for examining the causes of flooding, alternative non-structural and structural solutions, short and long term solutions, and examine the following:
 - Construction and maintenance costs
 - Environmental impacts, both site specific and cumulative
 - Funding capabilities
 - Public acceptance
 - Establishment of priorities for recommended solutionsAn open planning process will help government officials balance the costs of specific flood hazard management measures against the benefits. For example, benefits to individual property owners can be weighed against the monetary and environmental costs born by the general public.

6. Pursue other resource protection goals.
Implement solutions that embrace other resource protection goals including the protection of wildlife habitat, preservation of a river's natural beauty, and enhancement of water quality.
7. Coordinate between public works, planning, building, natural resources, and other departmental activities.
8. Incorporate comprehensive planning solutions into flood hazard management.
Utilize planning tools to achieve a range of objectives such as:
 - Acquisition of flood sensitive areas for low impact recreation activities.
 - Use of zoning and development standards that are responsive to flood management issues, such as stormwater management systems.
 - Forest management and agricultural practices that reduce runoff and attenuate peak flows.
 - Shoreline Master Program regulations that restrict inappropriate development and encourage compatible land uses.
 - Park and recreation programs that utilize existing dikes and levees for public access to water and recreational trails.
 - Design of transportation facilities to reduce their impact on the watershed.
 - Protection and creation of wetlands for stormwater storage and bio-filtration as well as fish and wildlife habitats.

4. FLOOD HISTORY AND IDENTIFICATION OF FLOOD HAZARDS

River channels shift naturally, and can have dramatic impacts on houses and structures built close to the river when flood events occur (photo). Historically, flood prevention along the river often consisted of the construction of levees, bank armoring, and other shoreline structures. These structures have had a profound impact on the in-river habitat and the processes of channel formation. The US Bureau of Reclamation (BOR) summarized several studies related to the impact of channel morphology and cited five primary human activities that have altered the Dungeness River: construction of levees, clearing of riparian vegetation, construction of bridges, gravel extraction, and water diversions. The BOR completed a comprehensive analysis of historic river channels in the Dungeness for the Jamestown S’Klallam Tribe to identify opportunities and constraints in restoring fish habitat in the lower river (Bountry et al. 2002). Due to the gradient and soil conditions, the Dungeness is a highly dynamic river, with shifting channels and bank erosion in many locations.

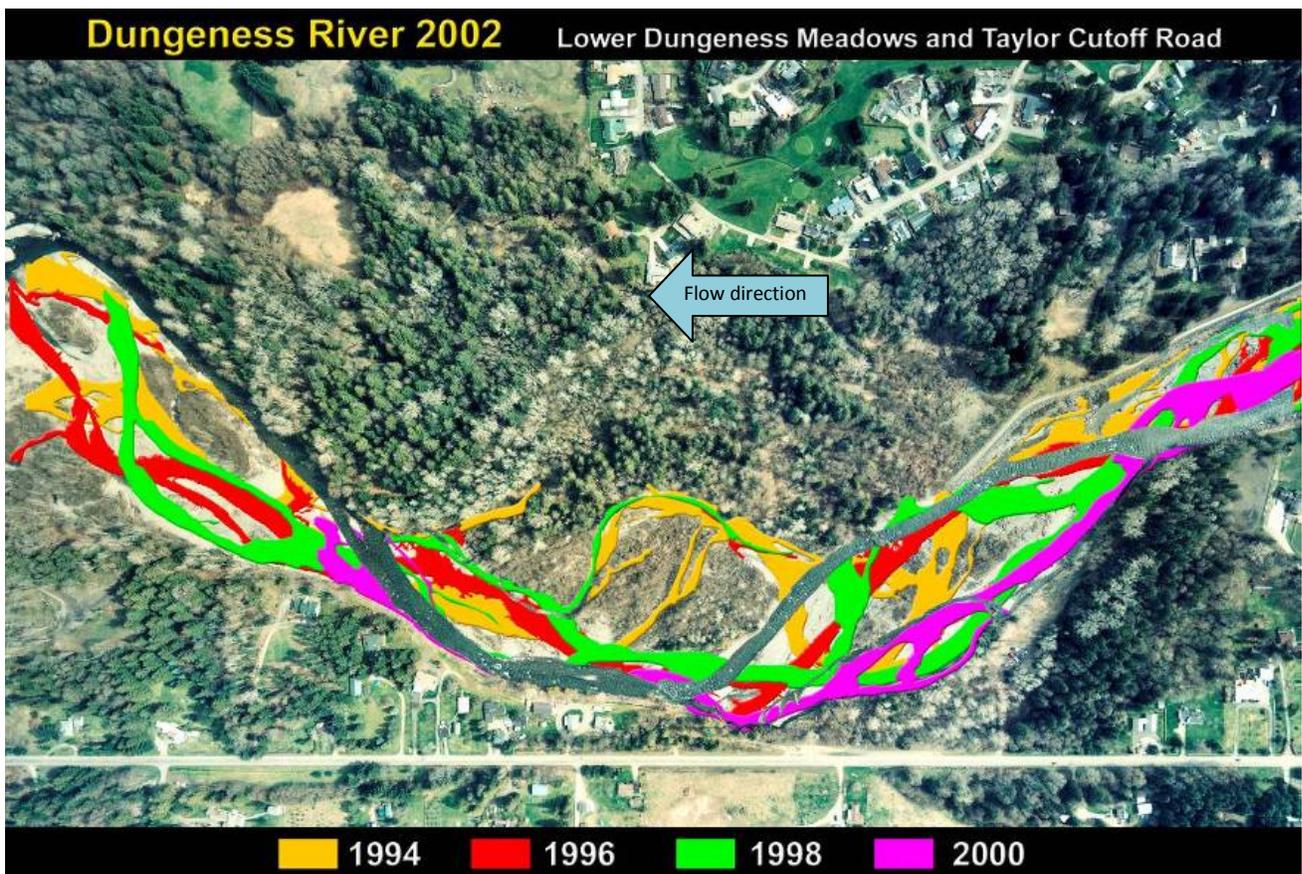


Figure 4-1: Variation of mainstem channels of the Dungeness River near Taylor Cutoff Road

(R. Johnson, adapted from Bountry 2002)

4.1 Flood History and High Flow Events

Floods in the Dungeness River differ in their impact depending on the instantaneous flow (measured as peak flow in cfs) and on the duration of relatively high flows (measured as mean daily flow in cfs) and also as the volume (in total acre-feet) delivered during the event. High flows that appear by one measure to be significant are not necessarily highly damaging. For example, the highest instantaneous peak flow on record occurred in January, 2002 at 7,610 cfs. However, it is only the third largest daily mean flow event and only the 11th largest flood event in terms of acre-feet of water delivered.

Table 4-1 shows the peak flood frequency estimates based on the USGS stream gage (12048000). Table 4-2 (next page) shows the flood events of record for each of the three ways of estimating “flood event,” based on measurements at the same USGS stream gage.

Table 4-1: Flood Discharge and Probability

(From England 1999 as Appendix G, Bountry et al. 1999) Revised flood frequency estimates from BOR 2007 modeling study. BOR prepared a new flood frequency curve in 2007 based on newer peak flows in 2002 and 2003, and additional USGS gage records.

Return Period (years)	Annual Exceedance Probability (percent)	Peak Discharge (cfs) 1999 estimate	Revised Peak Discharge (cfs) 2007 estimate
1.5			2,400
2	50	2,990	3,060
5	20	4,690	4,800
10	10	5,780	5,910
25	4	7,120	7,250
50	2	8,060	8,190
100	1	8,960	9,080

Predicting future flooding is very difficult due to changing trends for temperature, precipitation, and runoff in the region. Records have been maintained at the USGS gaging station for approximately 80 years (1899-1901, 1924-1930, 1938-present). The largest peak flow recorded was experienced in 2002, at 7,610 cfs. Other very large flows were experienced during periods of no gaging, and may have been as large. It might be reasonable to base future estimates of likely maximum flood levels on this past record, were it not for the measured change in climate and snowpack experienced in the area in the last several decades. Climate models indicate the likelihood of more frequent high magnitude storm events, with consequences for flood levels and frequency. Apart from evidence for global warming, there is localized evidence in the flow record that the Dungeness River does not enjoy some, “steady state” condition but varies widely across a range of peak flood values. England (1999) estimated that the 95% confidence limit on the 100-year flood that could be experienced on the Dungeness River is 11,400 cfs, substantially higher than the 2002 flood of record. Floods at that level would redefine the entire river morphology and would likely overtop many existing flood structures. It is therefore even more important to focus on reducing susceptibility to flooding by emphasizing funding efforts on removing or relocating residences and other structures from the floodplain and on restoring natural river processes.

Table 4-2: Top 20 flood events of record on the Dungeness River by total volume, peak flow, and daily mean flow, 1924-2008
 (for years when records available). Flood events which appear in the top 20 for all three methods of calculation are highlighted.

Sorted by Total Volume in Event					Rank < >	Sorted by Peak Flow				Rank < >	Sorted by Daily Mean Flow		
Water Year	Total Flow Over Event in acre ft	Peak Flow in cfs	Highest Daily Mean Flow in cfs	Date of start of event		Water Year	Peak Flow in cfs	Highest Daily Mean Flow in cfs	Total Flow Over Event in acre ft		Water Year	Equiv Daily Mean Flow Over Event Days in cfs	Highest Daily Mean Flow in cfs
1968	36,080	3,920	3,160	1/14/1968	1	2002	7,610	4,640	20,117	1	1986	3,570	4,070
1980	35,280	5,350	3,660	12/14/1979	2	1991	7,120	5,280	19,820	2	1924	3,490	4,820
1956	29,410		1,760	5/31/1956	3	1950	6,820	3,800	23,930	3	2002	3,387	4,640
1974	26,850	4,320	3,400	1/14/1974	4	1956	6,750	5,060	19,540	4	1991	3,340	5,280
1999	25,918		2,190	6/13/1999	5	1924	6,340	5,140	24,970	5	1956	3,290	5,060
1924	24,970	6,340	5,140	2/11/1924	6	1986	6,250	4,070	14,120	6	1924	3,150	5,140
1950	23,930	6,820	3,800	11/26/1949	7	1997	5,990	4,690	18,254	7	1996	3,120	3,120
1992	23,520	5,090	3,900	1/28/1992	8	2003	5,920	3,060		8	1961	3,080	3,830
1976	21,580	5,150	3,900	12/2/1975	9	1961	5,900	3,830	12,180	9	1997	3,073	4,690
1948	21,560		2,200	5/26/1948	10	1984	5,510	3,570	14,790	10	1999	3,000	3,000
2002	20,117	7,610	4,640	1/7/2002	11	2002	5,450	2,510	4,962	11	2003	2,990	3,060
1991	19,820	7,120	5,280	11/23/1990	12	1938	5,380	3,240	15,210	12	1976	2,730	3,900
1956	19,540	6,750	5,060	11/3/1955	13	1980	5,350	3,660	35,280	13	1995	2,640	3,320
1991	19,250		3,480	11/9/1990	14	1976	5,150	3,900	21,580	14	1960	2,640	3,300
1996	18,826	4,500	3,240	12/11/1995	15	1992	5,090	3,900	23,520	15	1999	2,590	3,500
1991	18,490		2,840	2/2/1991	16	1995	4,850	3,320	10,450	16	1973	2,590	2,590
1997	18,254	5,990	4,690	3/18/1997	17	1960	4,800	3,300	10,450	17	1951	2,570	3,020
1967	17,780	2,960	2,630	12/12/1966	18	1999	4,640	3,500	10,256	18	1938	2,560	3,240
1999	17,068		1,960	6/22/1999	19	1951	4,600	3,020	15,290	19	1939	2,560	2,560
1963	15,740	3,670	2,180	2/4/1963	20	1996	4,500	3,240	18,826	20	1980	2,550	3,660

Note: Will miss events for which peak flow not recorded.

4.2 Flood Damage History

The Federal Emergency Management Agency (FEMA) keeps records of all claims made by federal flood insurance policyholders. The information is tabulated on a community basis. The Lower Dungeness Basin is part of the community of Clallam County in the program, and figures are not broken out specific to the Dungeness. The cumulative payments to Clallam County since the inception of the program in 1979 through December 31, 2002 amount to \$863,250.42.

A private landowners group, the Dungeness Meadows Dike Committee, spent over \$75,000 on levee and river maintenance between the years 1981 and 1986. In 1986, the County spent \$2,800 on repair of the Dungeness Dike and \$12,000 on road repairs associated with the flood damages from the January 18-20, 1986 storm.

Two houses were destroyed by flooding in the Dungeness since 1988 – one on Kinkade Island and one across from the May Road area. One of the access bridges to Kinkade Island was washed out in the 2002 flood. Several property owners in the Rivers End area have reported repeated damage, and bank erosion downstream from the 101 Bridge on the Kaiser Road properties has damaged well heads and outbuildings. Extensive erosion has occurred along Taylor Cutoff Road, the west bank downstream from the Railroad Bridge, and other scattered sites throughout the lower river. Areas at high susceptibility to erosion are reported in the 2002 Bureau of Reclamation Report.



A well head stands in the active river channel downstream from the Highway 101 bridge (Kaiser Road area) following a flood event that dramatically eroded the river bank.

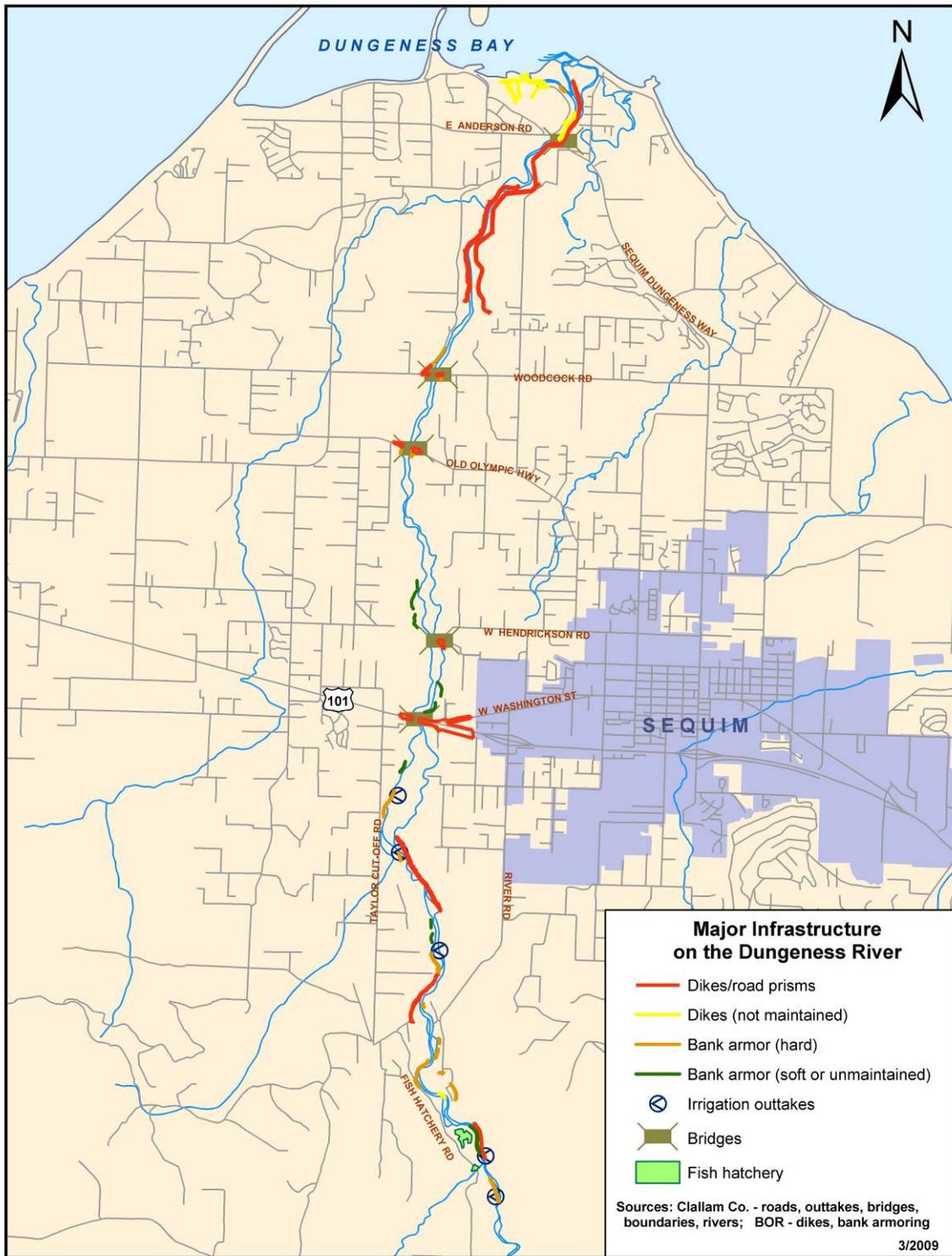


Figure 4-2: Major infrastructure on the Dungeness River

4.3 Levees, Bridges, and other Modifications to the Dungeness River

4.3.1 Levees and major bank protection structures:

“Levees (sometimes referred to as dikes) and bank protection have been constructed along several areas of the lower 10.5 river miles since at least the early 1900’s. Levees are structures typically built of native material, that are higher in elevation than the natural ground surface to provide protection to a given area from flooding. Levees are often lined with rock to provide additional protection from floods. A 1935 map of the Dungeness River shows wooden bulkhead structures in many of the same areas where levees exist today (Metzger, 1935).” (Bountry et al, 2002)

Levees in the Dungeness have been identified as the greatest single factor altering physical river processes. Levees cut off access to side channel habitat for salmonids, act as constrictions which increase the velocity and depth of flood flows, reduce the recruitment of woody debris and corresponding channel complexity, and reduce groundwater contribution to the stream. Additionally, levees can increase downstream erosion and scouring by increasing velocity and modifying the direction of flow, adding more sedimentation to the system. Several major levees and large bank structures occur along the banks of the lower 10 miles of the Dungeness (Figure 4-2) (Table 4-3), and smaller levees occur throughout the lower watershed. Unless otherwise noted, levee maintenance is the responsibility of the property owners and is subject to permit requirements.

Table 4-3: Major levees and bank protection structures in the Dungeness River

(modified from Bountry, 2002)

Levee/Structure	River Mile	Bank	Description
River’s End berm	0-0.8	West	Berm constructed from pushing up river gravel onto bank. Constructed by private landowners in 1960s in response to ACOE levee on opposite bank.
Army Corps of Engineers Levee	0-2.6	East	Built in 1963-4 by the ACOE. Maintained by Clallam County. Largest levee on the river.
Olympic Game Farm Levee	1.0-2.1	West	Private levee originally built as farm levee in 1900s, later connected to other local levees. Levee was raised and expanded in 1960s in response to increased flood stage created by the ACOE levee on opposite bank. Modifications and expansions have continued to occur.
Dungeness Meadows Levee	7.5-8.1	East	Built approx 1965-1972 by homeowners association, designed by ACOE. Extended north in 1993. Maintained by Dungeness Meadows Dike Association.
Lower Haller Dike	8.57-8.87	West	Private levee constructed by property developer in 1960s. Replaced, set back, and extended by County in 1997 with NRCS funding.
Kinkade Levee	9.6-9.9	East	Private levee originally built in 1940, reconstructed 1971 following a flood. Portions removed for habitat restoration in 2001.
Sequim levee	10.8	East	Levee constructed to protect City of Sequim infiltration well facility.

The effectiveness of the levees and structures in reducing flood hazard for property owners varies considerably and has changed over time. Additionally, the levees impact flood hazards located both up and down stream:

- The berm at River’s End prevents flooding to River’s End Road residences only up to a 2-year (50%) flood level and residential structures have been flooded frequently. The berm is composed of unconsolidated gravel and is actively eroding. Recent modeling by the BOR

indicated that the constriction associated with the River's End berm increases flood stage upstream of the Schoolhouse Bridge by one foot at a 2-year flood level or two feet at a 5-year flood. The purchase of properties at River's End by Clallam County, the Jamestown S'Klallam Tribe, WDFW, and conservation entities since 2000 has reduced the number of residences that are exposed to flood hazard to seven as of 2009.

- The ACOE levee was installed to protect the town of Dungeness, Towne Road, and residential and agricultural property and structures. Personal communication with long-term landowners indicates that the location of the original levee was proposed to coincide with Towne Road, but was moved closer to the river at the landowners' request. As noted in table 4-3, levees were subsequently constructed across from the ACOE levee. The ACOE levee was designed to prevent flooding at a level exceeding the 100-year frequency. However, repairs to the levee in 2002 indicate that the structure is deteriorating due to erosion at the base. *"Clallam County believes that the ACOE levee is no longer functioning as designed. Sediment accumulations due to the levees' constriction have reduced the conveyance capacity of the river channel. The levee was designed to provide three feet of freeboard to the 200 year flood but water has been observed within 2.5 feet of the top at a flood of approximately 4,500 cfs (near a 10-year event)."* (Hals/DRRWG, 2003) The levee did not overtop in the January 2002 flood of 7,610 cfs.
- The Dungeness Meadows Levee was built to protect houses in the Dungeness Meadows subdivision from flooding. Consequently, much of the active channel and floodplain was cut off, causing flooding and erosion of residential properties on the opposite bank along Taylor Cutoff Road. The levee is maintained by the Dungeness Meadows Dike Association. The levee extension was constructed in 1993 to prevent flooding at the downstream end of the Dungeness Meadows development following a flood. Since that time, the downstream properties within and adjacent to Dungeness Meadows have largely been purchased outright or have conservation easements. The Dungeness River Restoration Work Group has proposed revisiting the flood protection utility of the extension due to the impact on the Spring Creek channel behind the extension, as well as the impact to residences along Taylor Cutoff Road.
- The Lower Haller Dike was built to protect erosion of residential property on the west bank. The dike forces the river eastward and has caused considerable erosion of residential properties along the eastern banks. The dike prevents the river from accessing floodplain and side channels on the western bank.
- The levee on the eastern bank at RM 10.5 protects the gravity-fed water supply for the City of Sequim's Ranney well system. This water supply augments the City's groundwater system and as an emergency water supply. The levee also protects Highland Ditch.
- Other smaller levees include the Railroad Bridge embankment on the east bank. In addition to levees, several reaches of river have riprap or other forms of bank protection (material placed along the bank, but not higher than the bank elevation). The majority of levees also have riprap on them, and often private landowners on the other side have responded by hardening the opposite bank with riprap to prevent erosion. In some areas such as downstream of the Railroad Bridge on the west bank, logs and/or log jams have been used to protect the bank.



Railroad Bridge and damaged entry road following flooding.

Photo courtesy Bob Boekelheide, Dungeness River Audubon Center

4.3.2 Roads and Bridges

Five highway and railroad bridges span the lower Dungeness River (table 4-4). In some instances the bridges constrict the active river channel, their associated levees cut off access to side channels and the floodplain, and some inhibit sediment transport through the river system.

The Schoolhouse Bridge is located at a stable geological feature at River Mile 0.7. Recent modeling by the BOR indicates that the bridge is above tidal influence, and that the bridge itself only slightly constricts the flow of the 100-year flood level (less than one foot elevation rise). Historically, a significant portion of the Dungeness flow discharged east of the bridge location to Meadowbrook Creek. The construction of the ACOE levee cut off this flow distributary and the entire flow of the river currently passes under the bridge. Increases in flood stage at the site are due to extensive levees in that section of the river, rather than the bridge. A series of culverts are present to the west of the bridge to alleviate flood flows at the site by directing a portion of the flow to the west at River's End.

Ward Bridge is a wooden structure that presently constricts channel function more than any of the other bridges. Downstream of Woodcock Road, the west bank has been protected with riprap along Ward Road, cutting off portions of the floodplain. The upstream side of the Woodcock Bridge embankment and the east river bank have also been covered with riprap to protect the bridge abutment.

The Burlingame Bridge was rebuilt in 1998-99 by Clallam County to increase the opening from 130 to 430 feet. This new opening allows for access to the flood plain and side channels which were previously

inaccessible. The eastern end of the new bridge structure was built as a piling structure to enable easterly expansion in the future if necessary due to channel migration.

The Railroad Bridge is owned by the Jamestown S’Klallam Tribe as part of Railroad Bridge Park. The bridge was built in 1914-1915 and is an iron and wood truss structure with creosote-treated wood. Railroad traffic ceased in 1985 and the right of way, including the bridge, is now part of the non-motorized Olympic Discovery Trail. The western approach trestle to the bridge crosses several side channels but provides significant flood plain capacity. However, the trestle collects significant quantities of log debris, which may undermine the trestle structure in the future. The eastern approach trestle was breached in a flood in 1961, and was replaced with a 150 foot levee. This levee was modified in 1995 and log structures have been added.

“The Highway 101 Bridge does not significantly cut off the prehistoric flood plain because the bridge is at a natural constriction created by terraces. However, just downstream of the bridge a large portion of the east floodplain has been cleared of trees and vegetation. Similar to the area downstream of the Railroad Bridge on the west side, clearing the riparian zone has made this area susceptible to an accelerated rate of erosion.” (Bountry et al, 2002)

Table 4-4: Bridges spanning the lower Dungeness River

Bridge	River Mile	Span (ft)
Schoolhouse Bridge	0.7	200
Woodcock Bridge (aka Ward Bridge)	3.3	405
Burlingame Bridge on Old Olympic Highway	4.0	430
Railroad Bridge (including approach trestle)	5.7	1005
Highway 101 Bridge	6.4	590

“At least three more bridges existed in the past across the main Dungeness River as indicated by remnants that are still visible, historical accounts, or photographs. These bridges were located at RM 5.5, about 0.1 mi (.16 km) downstream from the Railroad Bridge (known as the Canfield Bridge); at RM 9.5, about 1 mi (1.6 km) downstream of the Fish Hatchery (known as the Duncan Road Bridge); and at RM 13.3, about 3 mi (4.8 km) upstream of the Fish Hatchery (known as the Clink Bridge).” (Bountry et al, 2002)

County roads that have been subject to repeated flooding and flood damage include Sequim-Dungeness Way west of Schoolhouse Bridge, Ward Road downstream of Ward Bridge, Hendrickson Road by the Railroad Bridge, Taylor Cutoff Road downstream and across from the Dungeness Meadows dike, and Fish Hatchery Road.

4.3.3 Clearing of riparian vegetation

Loss of riparian vegetation reduces bank slope stability, increases sedimentation to the river, reduces the ability of riparian areas to filter nutrients and other pollutants, removes shade thereby increasing stream temperatures, and reduces the production of macroinvertebrates used as food supplies by salmonids. The loss of riparian vegetation will impair the recruitment of large woody debris for decades, which may inhibit the formation of side channels, pools, and other habitat requirements for aquatic species. The Dungeness River Restoration Work Group identified key areas in the lower river where the loss of riparian vegetation is a factor impairing habitat. Major sites include restoration of the Dungeness estuarine delta, the lower river floodplain at the site of the Game Farm levee, tributary systems such as Matriotti Creek, areas targeted for levee removal and/or setback, and reforestation of riparian parcels

along the Dungeness River below Canyon Creek. Table 4-5 contains information on the locations of unvegetated sections of the river.

Table 4-5: Dungeness River reaches without riparian vegetation in 2003
(within 50' of channel meander hazard mapped by Clallam County).

Source: Hals, 2004 from aerial photographs taken 4-14-03 and 5-6-03 for Jamestown S'Klallam Tribe

Reference Landmarks	Approximate West Bank Unvegetated Reaches	Approximate East Bank Unvegetated Reaches
River Mouth (RM 0.0)	RM 0.7 – RM 0.9	
Schoolhouse Br. (RM 1.0)	RM 1.0 – RM 1.25	RM 0.9 – RM 1.9
	RM 2.75 – RM 3.25	RM 2.8 – RM 3.0
Woodcock Rd. (RM 3.25)	RM 3.45 – RM 3.54	
Old Oly. Hwy. (RM 3.8)	RM 3.8 – RM 3.85	
Railroad Bridge (RM 5.6)	RM 4.95 – RM 5.5	RM 6.22 – RM 6.75
Hwy. 101 (RM 6.4)	RM 6.5 – RM 6.8	
	RM 7.3 – RM 7.5	
	RM 7.85 – RM 7.9	RM 7.95 – RM 8.2
Powerline Crossing (RM 8.8)	RM 8.9 – RM 9.3	
	RM 9.5 – RM 9.65	
Canyon Creek (RM 10.8)	RM 10.6 – RM 10.8	

4.3.4 Other Modifications

- Gravel extraction:** Gravel extraction occurred along the lower Dungeness until the mid-1990s; these activities were for commercial gravel-mining purposes, and to compensate for perceived aggradation caused by levees and other channel modifications. Gravel “traps,” consisting of intensive mining sites in the river channel, were excavated in the early 1990s upstream from the Highway 101 bridge specifically to address aggradation issues. Problems associated with gravel extraction include channel avulsion, headcut erosion in the channel, sedimentation, and fish mortality. Significant channel downcutting has occurred in the vicinity of the gravel traps located near the Dungeness Meadows dike. A more detailed discussion of gravel removal in this reach is located in the report on the Dungeness channel migration zone (Rot and Edens, 2008).
- Water diversions:** There are five principal water diversions for the Dungeness irrigation system located between river mile 11.1 and 6.9. Each of the diversions is maintained by the water users and includes a diversion structure, canal/pipe, fish screen, and bypass channel to return fish to the river. The lateral and vertical instability of the Dungeness mainstem channel has prompted the water users to actively modify channel structures in some locations as needed to ensure a water supply during low flows. Several of the outtakes are heavily armored and have been repeatedly damaged during floods. The fish screens must be maintained to ensure that sediment deposition does not alter the approach velocity above fish requirements or that the screens themselves do not become clogged with silt and debris. The CCD outtake is located in a highly unstable section of the river and was rebuilt in 1993. The previous outtake structure is now approximately 3 feet above the active channel due to downcutting. Of the five irrigation diversions, the Independent Irrigation outtake, located at RM 8.5 at the upper end of Dungeness Meadows dike, is situated in the outside of a meander bend and is susceptible to accelerated

erosion. Due to the concern that the river channel could avulse into the irrigation ditch, it is being considered for elimination.

The City of Sequim maintains an infiltration water outtake from the Dungeness River at Kinkade Island. However, it is currently used primarily as a back-up system for groundwater sources due to sedimentation and maintenance issues.

4.4 Identification of Flood Hazard Areas

4.4.1 Hazard from high flows and channel migration

Unlike the Mississippi River or other well known flood-prone areas, flood hazards in the Dungeness are as much a function of vegetation and soil movement as high water. Homes and structures placed in the floodplain or the channel migration zone are in danger of bank erosion and the lateral movement of river channels as well as inundation during high water. This is a river of water, wood, and stone that continually adjusts to the steep gradient of the Dungeness valley. The Dungeness River drops 3800 ft over 30 miles; the roughly 1% gradient from the Dungeness hatchery to Old Olympic Highway is the driving force behind its erosive energy during floods. Due to channel migration and erosion in the Dungeness River, even houses above the level of the 100-year flood elevation may be at risk.

Composed of mostly gravel and cobble, the banks of the Dungeness River erode naturally--contributing trees which form logjams and gravel which creates gravel bars. Over time, the channels of the river migrate laterally across the floodplain. Floodplain areas provide room for the river meanders to move and a place for high flows to spread out. Mature riverside forests function to help provide structure for the river. Intertwined root systems and large trees line the banks, and the movement of wood and gravel in the stream forms and destroys salmon habitat in a repetitive and naturally dynamic cycle. In the lower Dungeness, many areas of riverside forest have been altered by logging over several decades; forested areas along the river are smaller and the trees are immature. A few decades ago, many people believed that flood damage could be reduced by increasing river channel conveyance—removing log jams and digging out gravel so that the high flows could move unimpeded. However, these actions accelerate the erosive forces of the river and destabilize the river channel. The energy and erosive forces of high flows are actually slowed down by meanders, eroding banks, the gravel load that the river transports, and logjams. Where riverside forests have been altered and the banks have been armored or diked, the river tends to move much more rapidly and dramatically in floods. The levees and armored banks also create poor salmon habitat conditions and increase flood hazard to downstream landowners.



Photo: Channel migration on the Dungeness River 1997

(Photo courtesy Randy Johnson)

Channel migration is the natural movement of a river across its floodplain. In the Dungeness, the channel can move by eroding the outside of a meander, or also through channel avulsion. The channel migration zone is the outermost boundary that the river has historically used or will potentially use through bank erosion or avulsion into new channels. Although the CMZ is usually contained within the boundaries of the 100-year floodplain, in some cases the CMZ may extend outside of it. For example, the river may erode against a high bank or hill, and roads and structures (while above the area inundated by a 100-year level flood) are at risk from erosion and eventual flood damage. Where vegetation along the river has been removed, the erosion risk is generally greater.

The location of a building within the Channel Migration Zone is more descriptive of the potential risk than whether the structure is above the 100-year flood plain elevation. The CMZ encompasses the historical channels in the floodplain as well as the river's erosive potential.

Figure 4-3: Illustrated risk of development in the Channel Migration Zone



Figure 4-3a: The Dungeness River has an active river channel that moves over time. Houses that are built within or near the channel migration zone are at risk from flood damage, even if the flowing portion of the river is a substantial distance away. This risk is present even if the structures are above or outside of the 100-year flood plain.



Figure 4-3b: Rivers naturally erode the outside banks of a meander. The homeowners may have assumed that their risk of flooding was low, but bank erosion and flow have damaged the houses. How fast this process occurs depends on several factors, such as whether bank vegetation was left in place to keep the bank less erodible, the type of soil, and the force and velocity of the flow.



Figure 4-3c: As normal river channel migration processes move the active channel toward a structure, many property owners respond by installing rip rap or other bank armoring. This requires ongoing effort and substantial expense to maintain.



Figure 4-3d: Bank hardening accelerates the velocity of the flow and translates the stream's erosive force downstream, potentially creating new problems for other property owners.

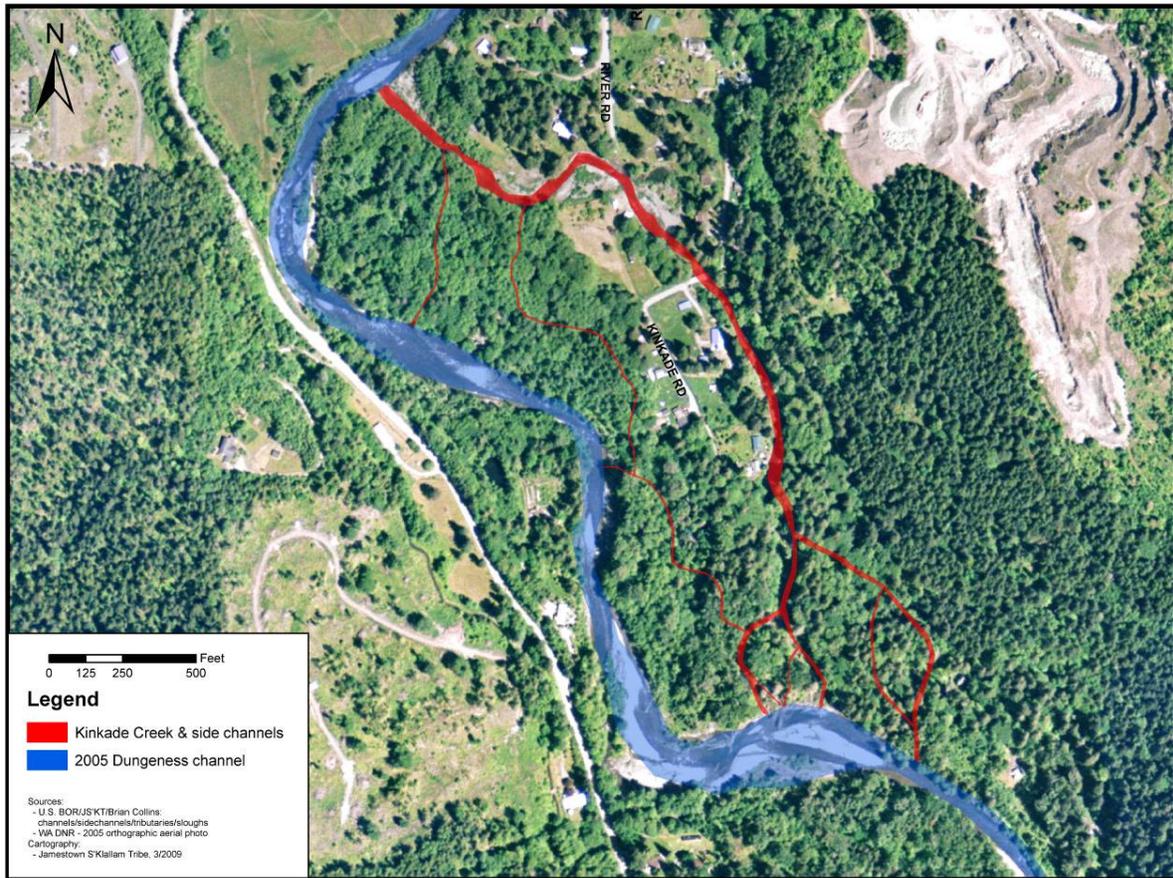


Figure 4-3e: Houses that are built outside of the channel migration zone are less subject to flood risk. Maintenance of the forest in the CMZ will slow erosive processes and provide fish and wildlife habitat.

Channel aggradation and degradation: The river not only moves laterally, but the bed also naturally moves up and down. When the riverbed increases in height (relative to a previous height), it is called *aggradation*, when it decreases in height it is called bed *degradation*. Numerous studies have found that sediment moves through a watershed like waves. Pulses of gravel accumulate and decrease in response to the volume of gravel input as well as flood frequency, magnitude, and height. Riverside landowners tend to respond when the river aggrades in their section of river, removing gravel or constructing bank protection structures and levees. However, these actions are a response to a temporary condition of gravel movement and the long term result may be the opposite of what the landowner has intended when the river begins to downcut once again. In the Dungeness River since the 1950s and 1960s photo records, the channel bed has actually degraded at least several feet in most places between Burlingame Bridge and Dungeness Hatchery. Extensive gravel removal during the 1990s exacerbated channel downcutting within a decade--negatively impacting some levees and irrigation outtake facilities.

Avulsion: An additional hazard to structures in the floodplain and channel migration zone occurs during an *avulsion*. An avulsion occurs when the river moves to a new channel, either by creating a new channel or reoccupying an old side channel or low area. Generally the river re-enters its channel shortly downstream creating an island in between the banks of the two channels. In the Dungeness, the area known as Kinkade Island is formed by the river mainstem to the west, and a side channel known as Kinkade Creek to the east. Studies by the Bureau of Reclamation indicate a substantial risk that the main channel of the river will avulse into Kinkade Creek. Several structures on Kinkade Island are currently at risk of flood hazard, and a potential avulsion would be likely to damage or eliminate the bridge that currently provides access.

Figure 4-4: Kinkade Island

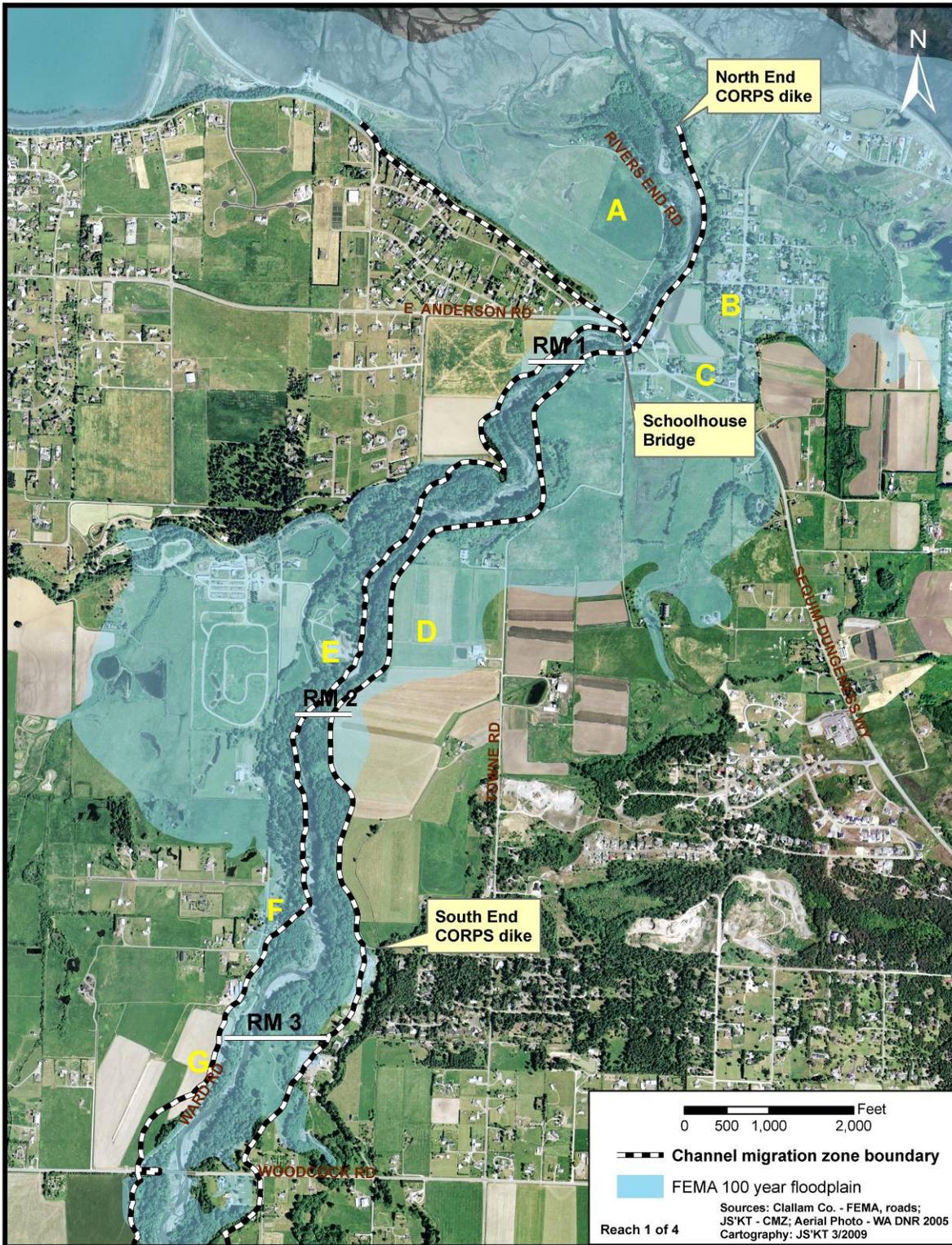


4.4.2 Location of Channel Migration Zone and 100-Year Flood Plain

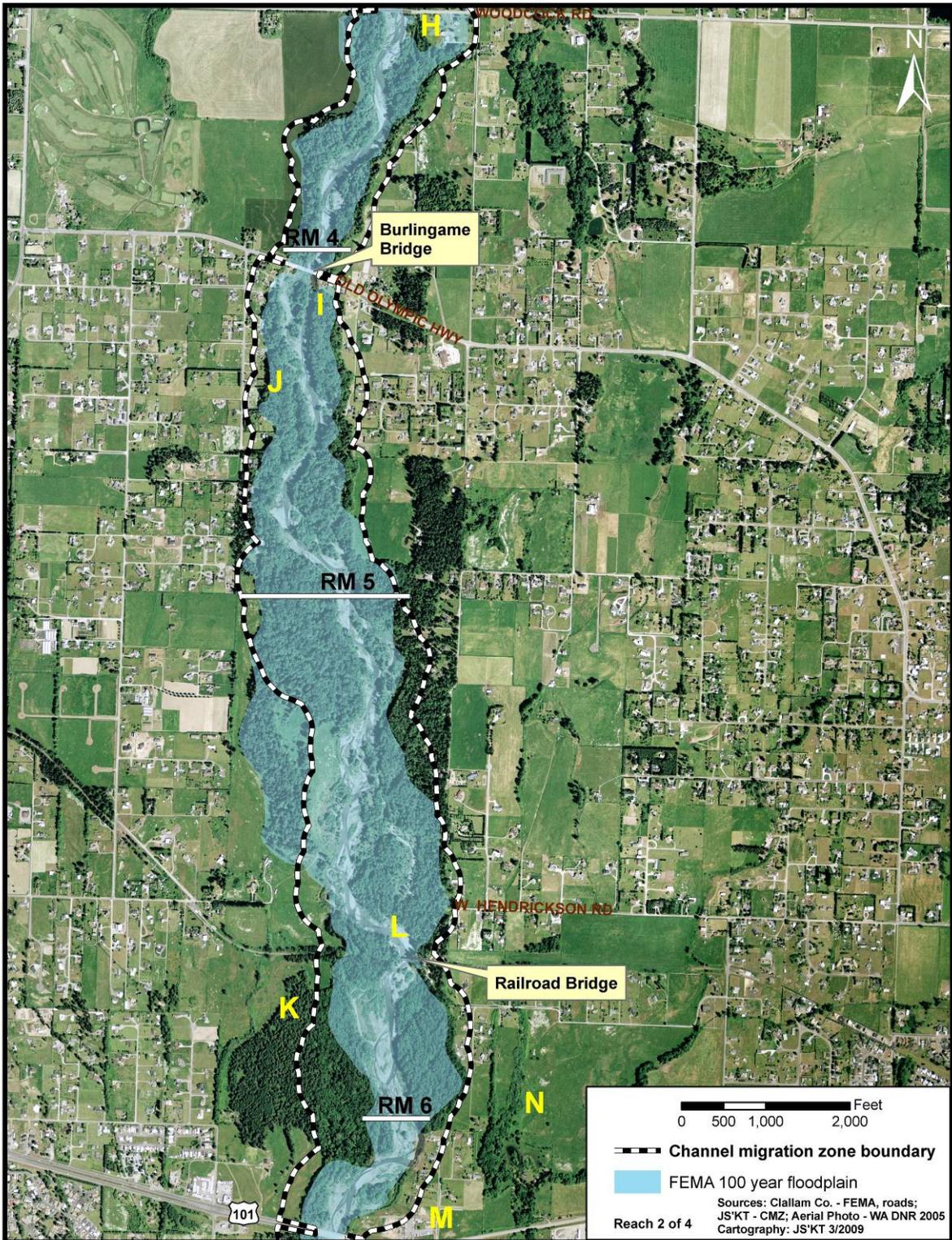
A 2008 study by Rot and Edens from the Jamestown S'Klallam Tribe utilized recent data in order to update the delineation of the Channel Migration Zone. In addition to Bureau of Reclamation studies in the past decade, data sources included historical and recent airphotos dating to 1942, an 1855 map of the river mouth area, the 1914 Clallam County Tax Assessors map (ortho-rectified by University of Washington), and LiDar data obtained by Clallam County in 2001. The study analyzes avulsion hazards and pathways, erosion hazard areas, locations where the historical flood plain has been disconnected from the river due to structural modification of the river channel, and the channel migration zone boundary. The entire report is located in Appendix C.

Figure 4-5 consists of a set of airphotos depicting the revised channel migration zone delineated by Rot and Edens and the 100-year flood plain, using the Clallam County GIS layer based on FEMA maps. This analysis applies to the lower 11 miles of the Dungeness River. The land use above that point is commercial forest or conservancy status. Structures within the floodplain and/or the channel migration zone are considered to be at risk of flood hazard. Letters denote identified flood hazards listed in Section 5.2.

Figure 4-5: River reaches with CMZ, 100-yr flood plain, & identified hazards (4 reaches)
Reach 1: River Mile 0.0 to 3.3--River Mouth to Woodcock Road



Reach 2: River Mile 3.3 to 6.5--Woodcock Road to Highway 101



Reach 3: River Mile 6.5 to 8.6--Highway 101 to BPA power lines



Reach 4: River Mile 8.6 to 10.8--BPA Lines to Canyon Creek



4.4.3 Coastal flood hazards near the mouth of the Dungeness River

Areas along the Strait of Juan de Fuca in the vicinity of the mouth of the Dungeness River are also susceptible to flooding due to a combination of storm events, tides, wave action, shoreline processes, and tsunamis. Because Pacific storms can result in large rainfalls, coastal and riverine flooding can combine to increase flood hazards near river mouths. The interrelationships of these processes are complex and site specific, and mapping the risk of flooding is challenging. A map of tsunami hazard areas in the Sequim-Dungeness area is located in Section 7.4.

Meadowbrook Creek is located to the east of the Dungeness River mouth and historically provided a channel path for Dungeness flows to be conveyed through the east floodplain and out to the Strait of Juan de Fuca. The Creek was segregated from the Dungeness River by the US Army Corps of Engineers levee. The area in the vicinity of Meadowbrook Creek and Three Crabs Road is susceptible to flooding from coastal flood events as well as the potential for flows overtopping or breaching the levee during a 100-year flood event.



Above: Three Crabs Road/ Meadowbrook Creek area east of the mouth of the Dungeness River.

Below: Flooding along Three Crabs Road (Photos courtesy Clallam Conservation District)



The Clallam County Conservation District is presently working on a report for the eastern Dungeness River mouth area in the vicinity of Three Crabs Road and Meadowbrook Creek to investigate water quality issues and localized flooding near the mouth of Meadowbrook Creek. The purpose of the study has been to involve local residents, develop solutions to these problems, and identify ecological restoration opportunities. The report is scheduled to be released in 2009.



Meadowbrook/Cooper/Cassalery Creek Study Area – Clallam Conservation District

Other studies have been completed in the Dungeness River delta in support of habitat restoration efforts and flood hazard analysis. A study of the “Historical geomorphology and ecology of the Dungeness River delta and nearshore environments from the Spit to Washington Harbor” was completed by the University of Washington (Collins, 2005). The study used historical maps, air photos, field notes, and LiDAR to construct a detailed description of the physical landscape in the 1850’s, changes in the last 150 years, and nearshore processes affecting the present environment in the river delta. The Dungeness River and Meadowbrook Creek had a complex system of saltmarsh, lagoons, channels, sandspits, and wetlands in the area of present-day Three Crabs Road. This information may be used to assist in predictions of how the landscape may respond to land use and engineering changes.

The Bureau of Reclamation completed a “Numerical Modeling Study of Levee Setback Alternatives for Lower Dungeness River, Washington” in 2007 to evaluate potential levee setback alternatives in the lower 2.7 miles of the river channel. Simulations of the 100-Year flood level (at a flow of 9,080 cfs) indicate the potential for the ACOE levee to be overtopped or breached, and that the water is predicted to flow along the historic location of Meadowbrook Creek, potentially affecting downstream residents. A levee breach of 150 feet is estimated to create flood flows of 3,400 cfs in the right flood plain and Sequim-Dungeness way would be overtopped. Modeling of different tidal elevations indicated small differences in surface water elevation upstream of the Schoolhouse Bridge at the 100-year flood level. Clallam County is proceeding with actions to set back the ACOE levee between the Schoolhouse Bridge and River Mile 2.7 to address the potential for flood hazard from the levee overtopping or breaching, and to improve habitat function in the lower river floodplain.



Sequim-Dungeness Way
(Clallam Conservation District Photo)

5. STRATEGIES AND RECOMMENDATIONS FOR FLOOD HAZARD REDUCTION

One of the first tasks of the Dungeness River Management Team after it was founded in 1988 was to serve as the advisory body for the 1990 Comprehensive Flood Management Plan. Since then several recommendations of the plan were implemented, including the modification of County critical areas and building codes, and the purchase of numerous parcels for the dual purposes of habitat restoration and the reduction of flood hazard. Additionally, many technical studies of fish habitat and river processes were completed, and the community has experienced several more floods and learned from them. After 20 years, the DRMT members and partner organizations have an extensive “institutional memory” and are now better prepared to make long term recommendations about flood hazard reduction as it relates to the risk to property owners, impact on fish habitat, and other river activities. In accordance with the goals and objectives described in Section 3, and experience and information gained over 20 years, these recommendations for flood hazard reduction generally emphasize the use of non-structural alternatives because they represent long term solutions and do not negatively impact river processes that affect threatened species or downstream property owners.



Kinkade Island, 2002

(Randy Johnson photo)

Nonstructural solutions refer to actions designed to reduce the susceptibility to flooding, and do not include structural measures that may alter natural river processes.³ Nonstructural solutions may result in physical changes in the river or watershed that restore natural processes, including wetland restoration. Nonstructural solutions include land ownership change, land use management, regulations, monitoring, maintenance, emergency response, enforcement, and intergovernmental agreements. They can include habitat reclamation activities like wetland restoration, riparian revegetation, septic system removal, and structural removal or setback.

Structural alternatives for flood hazard management include a variety of physical changes to structures and the river environment, including flood proofing, relocation of existing structures, bank reinforcement, levees, deflection structures, and other modifications. Structural alternatives have varying levels of impact to river processes, fish and wildlife habitat, and the extent of flood hazard reduction. Structural alternatives are subject to numerous requirements for design, permitting, and construction on a site-specific basis. B describes structural measures for flood hazard management in general.

Section 5.1, General Recommendations, describes a number of proposed non-structural actions to reduce flood hazard in the Dungeness which are summarized in Table 5-1. Section 5.2 contains a reach-by-reach description of specific flood hazards in the lower Dungeness, and recommended actions. With the exception of structural removal or setback as described in section 5.2, structural measures are generally not recommended as long term solutions in the Dungeness River. **Property owners who intend to undertake new development (including wells and septic systems), remove vegetation near the river, or construct structural flood control measures are advised to contact the Clallam County Department of Community Development for a full list of permits and requirements prior to initiating work.**

³ Executive Office of the President, June 1998. *Federal Programs Offering Flood Recovery and Floodplain Management Alternatives.*

Table 5-1: Summary of general recommendations

Recommendation	Actions
5.1.1 Utilize best available science to update maps of flood hazard areas and the channel migration zone.	<ul style="list-style-type: none"> • Update maps of the Channel Migration Zone. • Request update to FEMA maps of the 100-Yr Flood Plain. • Continue modeling and mapping studies and incorporate into land management activities.
5.1.2 Protect people and property from erosion and flood hazards and protect habitat functions by updating and amending land use and related regulations.	<ul style="list-style-type: none"> • Incorporate flood hazard management into amendments of Critical Areas Code and Shoreline Master Program. • Direct development away from the CMZ. • Establish aquatic habitat conservation area buffers from the edge of the CMZ. • Establish mitigation policies for upgrading degraded habitat in the CMZ and buffer areas. • Meet or exceed FEMA requirements. • Review and update regulatory standards applicable to levees, and conduct a comprehensive levee inventory.
5.1.3 Improve ongoing education and outreach to existing and potential landowners along the Dungeness related to land development and stewardship.	<ul style="list-style-type: none"> • Develop and implement an ongoing outreach program for property owners along the river about development and land clearing constraints in and adjacent to the CMZ. • Continue and improve procedures to notify prospective buyers about potential flood hazards and land development requirements. • Continue and expand technical assistance programs to improve stewardship.
5.1.4 Provide education and outreach about flood hazards and emergency preparedness.	<ul style="list-style-type: none"> • Conduct public education programs about flood risk and emergencies regularly through a variety of media, including the County’s website and annual mailings. • Emphasize implementation of the Map Your Neighborhood program along the river.
5.1.5 Continue programs to purchase high risk flood hazard and high value habitat areas.	<ul style="list-style-type: none"> • Seek and support funding programs to purchase properties at flood hazard risk. • Continue to implement the 2003 Dungeness Land Protection Strategy. • Enhance public access, parks, and recreational opportunities along the river.
5.1.6 Continue and expand monitoring and code compliance programs along the Dungeness River corridor.	<ul style="list-style-type: none"> • Conduct monitoring of land use and land cover along the Dungeness, particularly in high risk flood areas. • Emphasize outreach and education activities in the implementation of monitoring programs. • Continue annual airphoto and other monitoring actions of the Dungeness River corridor, and share among cooperating agencies for adaptive management.

5.1 *General recommendations*

- 5.1.1 Utilize best available science to update maps of flood hazard areas and the channel migration zone.

Recommended Actions:

- 5.1.1.1 Update Clallam County Dungeness River Channel Meander Hazard Maps based on the report: "Delineation of the Dungeness River Channel Migration Zone (River Mouth to Canyon Creek)," prepared by the Jamestown S' Klallam Tribe (Rot and Edens, 2008)⁴. (Appendix C)
- 5.1.1.2 Request updates of the FEMA floodplain maps incorporating new information and mapping technology as it becomes available, such as Bureau of Reclamation models and reports, and LiDAR analysis.
- 5.1.1.3 Continue modeling and mapping studies to improve flood hazard analysis and incorporate into codes and land management activities.

Discussion of Recommended Actions in 5.1.1: Several studies and LiDAR flights have been completed in the last 5-10 years by Clallam County, Bureau of Reclamation, US Geological Survey, and the Jamestown S' Klallam Tribe that provide a more accurate delineation of the Dungeness Channel Migration Zone and floodplain than the information presently being used in land development permit processes and the FEMA flood insurance program. The September, 2008 Biological Opinion from NMFS related to the National Flood Insurance Program and the Endangered Species Act requires FEMA to expedite the update of flood hazard maps and to prioritize updates where sensitive species of salmon are present.

- 5.1.2 Protect people and property from erosion and flood hazards and protect habitat functions by updating and amending land use and related regulations. Regulations should reflect the natural constraints, hazards, and habitat values of the Dungeness River floodplain, channel migration zone, and riparian habitat.

Recommended Actions:

- 5.1.2.1 Prevent additional construction of dwellings in harm's way from flooding and erosion as well as loss of critical habitat function through updates or changes to Clallam County codes. In particular, consider new data and studies and the information and strategies in the Dungeness River Comprehensive Flood Hazard Management Plan when updating the Clallam County Shoreline Master Program and Clallam County Critical Areas Codes.
- 5.1.2.2 Direct development to locate outside of the delineated Dungeness River Channel Migration Zone and associated upland buffers in order to protect people and property from flooding and erosion hazards and to conserve important fish and wildlife habitat functions.

⁴ All recommendations in section 5 that refer to the channel migration zone refer to the delineation by Rot and Edens, 2008.

- 5.1.2.3 Establish aquatic habitat conservation area buffers standards from the delineated Dungeness River Channel Migration Zone to further protect people and property from flooding and erosion hazards and to conserve important upland fish and wildlife habitat and movement corridors.
- 5.1.2.4 Establish mitigation policies and regulations for new development on lots where prior human activities have eliminated or significantly degraded native shoreline vegetation and/or habitat within the channel migration zone and upland buffer areas.
- 5.1.2.5 Review and update, if needed, land use, critical area, habitat management plan, and shoreline regulations to meet or exceed FEMA and NMFS guidance for meeting the requirements of the Federal Endangered Species Act and the National Flood Insurance Program.⁵

Discussion of Recommended Actions in 5.1.2.1 through 5.1.2.5:

Land use activities along the Dungeness River are regulated by Clallam County through the Critical Areas Code and the Shorelines Master Program. New information and studies regarding Dungeness River flooding, channel migration, and fish and wildlife habitat have been completed since the last major amendment of the County's critical area regulations and shoreline master program. Scheduled updates of the CAC and SMP present an opportunity to incorporate new information and implement flood hazard reduction policies and strategies specific to the Dungeness River shoreline.

Clallam County has established a Shoreline Master Program under the requirements of the Washington State Shoreline Management Act (SMA), RCW 90.58. The original plan was adopted in 1976, and was last amended in 1992. Clallam County is scheduled to review and update the Shoreline Master Program by December 1, 2011, which provides an opportunity to make specific changes to the policies and regulations affecting shoreline development along the Dungeness River. For example, state rules to guide updates of local government SMPs state that: *"applicable shoreline master programs should include provisions to limit development and shoreline modifications that would result in interference with the process of channel migration that may cause significant adverse impacts to property or public improvements and/or result in a net loss of ecological functions associated with the rivers and streams"* (WAC 173-26-221 (3)).

Clallam County is also required to evaluate and update (if needed) its critical area development regulations (last major updates 2001 & 2005) by December 1, 2011, for consistency with the Washington State Growth Management Act (GMA). The County's upcoming SMP update must provide a level of protection to critical areas within the shoreline area that is at least equal to that provided by the local government's critical area regulations adopted pursuant to the GMA.

The Dungeness River Flood Hazard Advisory Committee has recommended that updates and amendments to county codes incorporate provisions to prevent additional construction of new structures in harm's way or that impair the function and value of fish and wildlife habitat along the Dungeness River. The erosive forces of the Dungeness make it hazardous for property

⁵ Note that FEMA guidance for communities is undergoing review and revision in 2009 per the NMFS Biological Opinion.

owners to develop in or in proximity to the Channel Migration Zone. As described in Chapter 6, the Committee is also concerned about current provisions of the Critical Areas Code that measure Aquatic and Wildlife Habitat buffers from the Ordinary High Water Mark rather than the Channel Migration Zone. The OHWM is subject to change over time and channel migration can lead to legally-established non-conforming uses within the habitat conservation buffers. Please see Chapter 6 for more information about codes and ordinances related to flood hazard management. The Flood Hazard Advisory Committee also emphasized the need to prevent site clearing and excavation activities in, or in proximity to, the Channel Migration Zone as these activities may exacerbate erosion processes and damage habitat. As noted earlier, permits and other requirements apply to clearing and vegetation removal as well as structures.

5.1.2.6 Review and update the standards and definitions applicable to levees for purposes of permit and regulatory review. Determine what constitutes a legal levee for establishing the Channel Meander Hazard Area.

5.1.2.7 Conduct a comprehensive inventory of levees along the Dungeness River specifying when and how they were constructed, by whom, the degree of flood protection provided, and maintenance records. Maintain the inventory in Clallam County DCD.

Discussion of Recommended Actions in 5.1.2.6 through 5.1.2.7:

Critical Areas Code section 27.12.410(1)(a)(x) indicates that areas protected by “permanent levees or infrastructure improvements such as roads and bridges constructed and maintained by public agencies” are considered to be excluded from the Channel Meander Hazard Area.

Numerous privately constructed and maintained levees are located throughout the lower 11 miles of the Dungeness River that provide inadequate long-term protection from flood hazard and impair river habitat functions. Properties behind such levees may be at risk, and should be considered as part of the Channel Meander Hazard Area for purposes of permit review and regulation, despite the presence of an existing structure. See also recommended action 5.1.1.1, action 5.1.2.1, and action 5.1.2.2.

A comprehensive inventory of levees along the Dungeness will provide improved information related to liability, flood hazard, and maintenance responsibilities for public and private landowners. An inventory will also provide information to County staff to use in evaluating development proposals and the applicability of codes and standards.

5.1.3 Improve ongoing education and outreach to existing and potential landowners along the Dungeness related to land development and stewardship.

Recommended Actions:

5.1.3.1 Develop an on-going public outreach program to increase and maintain awareness of property owners along the Dungeness River regarding the importance of: (a) avoiding development and disturbance (clearing, grading, excavation) within and adjacent to the channel migration zone; (b) conserving shoreline vegetation and corridors for fish and wildlife; (c) restoring and enhancing degraded shoreline areas; and (d) obtaining required permits and approvals from county, state and federal agencies. The targeted geographic outreach area should include the channel migration zone, aquatic habitat conservation areas, and other areas along the river within the jurisdiction of Clallam

County's Shoreline Master Program. The public outreach program should utilize a variety of methods, including, but not limited to direct mailings, web sites, informational workshops, press releases, displays or brochures at the Department of Community Development office, and other measures. Near-term outreach efforts should include informing property owners of the updated Dungeness River Channel Migration Zone Maps and information about flood hazards and erosion processes in the Dungeness River.

Discussion of 5.1.3.1: Clallam County offers several opportunities for landowners to access information about the location of critical areas and land management regulations and requirements on-line or at the permit counter. While these are important educational resources and should be maintained, the Flood Hazard Advisory Committee also seeks targeted outreach programs specifically for Dungeness River property owners.

- 5.1.3.2 Continue and expand efforts to inform potential and new buyers of parcels along the Dungeness River about the presence of Frequently Flooded Areas, the Channel Migration Zone, Habitat Conservation Areas, and other provisions in County codes related to critical areas and standards for setback, building elevation, excavation, vegetation removal, and other development activities. (a) Maintain maps and regulations on-line. (b) Develop information about flood hazards specific to the Dungeness that can be used at the permit counter, and an on-line site. (c) Inform realtors, builders, contractors, clearing and grading operators, and designers of standards and procedures and changes to the delineation of the Channel Migration Zone. (d) Develop a detailed map and letter about the CMZ and distribute to realtors operating in the Sequim area for them to use to advise clients; request that buyers be referred to the Clallam County Department of Community Development prior to undertaking clearing, design, or construction activities.

Discussion of 5.1.3.2: Notice to title under the Clallam County Critical Areas Code is required only after a development permit application has been submitted. Prior to 2007, no disclosure or notice to title was required to inform prospective buyers that a parcel was subject to limitations as a flood hazard or critical area. Since 2007, RCW 64.06.020 has required that property transactions include a mandatory disclosure statement. The seller must complete a disclosure checklist that requires the seller to check "Yes," "No," or "Don't know" to a series of questions, including, "Are there any shorelines, wetlands, floodplains, or critical areas on the property?" Although the disclosure form provides some notification to prospective buyers, new landowners and buyers may not be fully aware of the applicable standards and protective restrictions. Clallam County maintains critical areas and shorelines maps and regulations on-line but prospective buyers and new landowners may need assistance from realtors and County staff to view and understand these materials.

- 5.1.3.3 Provide outreach and education to existing landowners to foster stewardship. (a) Encourage property owners to exceed minimum buffer standards and setback requirements for critical areas. (b) Continue technical assistance programs to assist and encourage riparian property owners with stewardship activities that will minimize the

risk of flood hazard and disruption of river processes as they manage their property. (c) Continue to work with property owners on habitat restoration projects.

Discussion of 5.1.3.3: Technical assistance and outreach programs to landowners along the river are conducted by the Clallam Conservation District and others, but funding for outreach and education is limited and sporadic.

- 5.1.4 Conduct public education programs about the risk of flood hazard on the Dungeness River, tsunami hazard areas, and procedures for emergency preparedness and management. See Chapter 7 for more information on emergency management.

Recommended Actions:

- 5.1.4.1 Continue to provide information on flood preparation on the Clallam County website, including planning and readiness, what to do before, during and after a flood, and contact/link information for radio stations, emergency message centers, and real-time flow information.
- 5.1.4.2 Prepare and mail out annual newsletters or flyers (if funding available) to property owners in flood hazard and tsunami hazard areas with emergency information.
- 5.1.4.3 Emphasize the implementation of Map Your Neighborhood programs for areas along the River and in tsunami hazard areas (see Chapter 7).

Discussion of 5.1.4: Information about emergency programs and contacts on the web and via mail needs to be updated and re-distributed annually for residents so that it is easily accessible during emergency situations.

- 5.1.5 Continue and support programs to fund and implement the purchase of parcels at high risk of flood hazard and/or high habitat value.

Recommended Action:

- 5.1.5.1 Seek and support programs and funding sources to purchase property or conservation easements in areas at high risk of flood hazard along the river, particularly frequently flooded areas and areas within the channel migration zone, even where the properties do not currently exhibit high habitat functions and values.

Discussion of 5.1.5.1: Although public and private funds have been obtained and utilized for land purchases associated with habitat protection and restoration, securing funding for the purchase of residential properties at risk of flood damage remains challenging, especially those parcels which currently do not have high habitat values. A funding strategy is needed to make funds available for opportunities to acquire high risk properties and remove structures or development potential in flood hazard areas.

- 5.1.5.2 Implement the 2003 Dungeness River Comprehensive Land Protection Strategy recommendations for acquisition, conservation easements, and stewardship.

Discussion of 5.1.5.2: The Land Protection Strategy identifies high value areas for habitat protection and/or for the restoration of wetlands, riparian forests and side channels that also provide buffer areas for flood waters. As used in the report, acquisition is the fee simple purchase of property at fair market value. Where properties are acquired in fee simple, it is the intent of the strategy that all structures be removed and septic systems pumped or removed and decommissioned on purchased property. This allows for more rapid restoration and eliminates future water quality challenges during flood events. A conservation easement is a legal mechanism to conserve the natural resource values of a land parcel in perpetuity. Stewardship, as used in the report, refers to the continued management of the property by the owner, with an opportunity for technical assistance on retaining or enhancing habitat functions and values.

5.1.5.3 Enhance public access, parks, and recreational opportunities along the Dungeness River.

Discussion of 5.1.5.3: As properties are acquired to remediate or protect from flood hazards, there may be opportunities to enhance public access for parks and recreation. With appropriate design and coordination with adjacent landowners, public access and parks provide a land use opportunity that is compatible with flood hazard mitigation.

5.1.6 Continue and expand monitoring and code compliance programs to prevent the placement of structures in harm's way and/or the degradation of fish and wildlife habitat along the Dungeness River corridor.

Recommended Actions:

5.1.6.1 Develop and implement a land use/land cover monitoring program for the Dungeness River Channel Migration Zone and adjacent lands, particularly for areas at high risk of flood hazard and channel movement. High risk areas include Kinkade Island, areas immediately upstream and downstream of the Highway 101, Old Olympic, and Woodcock Road bridges, and River's End Road. Monitoring programs should include training of County staff for reporting and follow-up, mechanisms for resolving identified problems and hazards, and partnerships with other agencies and governments.

5.1.6.2 Emphasize outreach and education activities as initial steps in contacting landowners as monitoring programs are implemented.

5.1.6.3 Seek partnerships and opportunities to continue to take high resolution airphotos of the Dungeness River corridor (such as those taken by the Jamestown S'Klallam Tribe) and share with cooperating agencies and governments for monitoring, adaptive management, and to assist in permit review.

Discussion of 5.1.6 recommended actions: Monitoring programs are operated in the Dungeness watershed for a variety of purposes including habitat protection and restoration, code compliance, and analyzing physical changes to the river channel over time to improve scientific information and predictive capability. The rate of change and development in the Dungeness River corridor necessitates frequent (annual) monitoring as a source of information for adaptive management. Monitoring programs should be coordinated and data shared among partner

agencies. Land use and land cover monitoring activities are particularly relevant for managing flood hazards in the future in order to prevent placement of structures in harm's way, reduce flood hazard for adjacent landowners, and/or retain fish and wildlife habitat functions and values. Occasional violations of County codes have occurred in the past with respect to unpermitted structures, clearing and excavation, and failure to comply with requirements to limit the size of the building footprint (see the discussion in section 6.5.3). In some cases, the failure to comply with codes results from the lack of information. County staff indicate their preference for improving outreach to landowners as preliminary steps, and using code enforcement as a last resort if other approaches fail. The Flood Hazard Advisory Committee is particularly concerned about ensuring that high risk areas are monitored proactively to prevent additional flood hazard and harm.

5.2 Analysis of alternatives and Reach-by-Reach Recommendations

The following table contains a summary of the flood hazards for the lower 10.8 miles of the Dungeness River, along with flood hazard reduction alternatives that were considered, and the site specific recommendations of the Dungeness River Flood Hazard Advisory Committee. For the purpose of this analysis, the table and corresponding maps are broken into four reaches:

River Mile 0.0-3.3: River Mouth to Woodcock Road (Ward Bridge)

River Mile 3.3-6.5: Woodcock Road to Highway 101 Bridge

River Mile 6.5 -8.6: Highway 101 to the Bonneville Power Lines

River Mile 8.6-10.8: Power Lines to Canyon Creek

This table corresponds to the set of airphotos in Figure 4-5 which show the Channel Migration Zone (Rot and Edens, 2008) and the 100-Year Flood Plain as delineated by FEMA as of January, 2009. The letters on the maps correspond to the letters in the column labeled "location" which also provides the river mile and bank direction (east or west) for each of the identified flood hazards.

Unless otherwise noted, the Flood Hazard Advisory Committee did not include reach-by-reach recommendations for undeveloped parcels in the lower 11 miles. Recommendations related to new development are described in section 5.1. However, the Committee noted that new development, if permitted, in several locations along the lower river would be at substantial flood risk. The recommendations in section 5.1 describe the importance of setting new development back from the Channel Migration Zone to reduce future flood hazard.

Table 5-2: Analysis of alternatives and reach-by-reach recommendations

Reach 1: River Mouth upstream to Woodcock Road (RM 0 –3.3): The most heavily modified section of the Dungeness River, this river delta area is constricted to a narrow channel by levees on both sides. A 2.6 mile US ACOE levee on the east side was constructed in the 1960s to prevent flooding from reaching the town of Dungeness. Increased flooding to the west side resulted in construction or expansion of levees at the Olympic Game Farm and Rivers End Road. Other major manmade structures include Schoolhouse Bridge. Downstream from the Schoolhouse Bridge, levees are present on 60% of the east bank and 37% of the west bank. Upstream, levees are present on 97% of the east bank and 65% of the west bank.					
Hazard	Location Map Ref	Analysis of Present Conditions	Flood Hazard Reduction Alternatives Considered	Recommended Actions for Flood Hazard Reduction	Additional Notes
Rivers End residences and berm	West 0-0.7 Map reference A	<ul style="list-style-type: none"> • 7 residences are subject to risk of repeated flood damage • Berm overtops at 2 yr flood level and is subject to erosion • High flood hazard area • High risk to human well being • Program to buyout and remove structures in progress • Identified as high priority habitat restoration project 	<ul style="list-style-type: none"> • No action • Acquisition of properties and berm removal • Construction of ACOE-like levee on west side 	<ul style="list-style-type: none"> • Continue property acquisition from willing sellers • Removal of houses, wells, septic, from flood plain • Implement re-vegetation program 	<ul style="list-style-type: none"> • Future removal of berm subject to property acquisition • Interim damage to levee and road to be addressed on case-by-case basis, subject to applicable permits.
ACOE levee from mouth to SH Bridge	East 0-0.7 B	<ul style="list-style-type: none"> • Sediment deposition into Bay • Model runs do not indicate flood hazard potential 	<ul style="list-style-type: none"> • No action • Remove last 200-500' • Set levee back 100' 	<ul style="list-style-type: none"> • No action 	
Schoolhouse Bridge	0.7 C	<ul style="list-style-type: none"> • BOR analysis indicates that the bridge does not increase upstream flood hazard/backwater. 	<ul style="list-style-type: none"> • No action • Lengthen bridge span • Culvert modifications west of bridge 	<ul style="list-style-type: none"> • No acquisition or structural action • Review maintenance procedures for bridge and culverts. 	<ul style="list-style-type: none"> • Bridge located at stable geological feature; may need to re-evaluate if river meander changes.
ACOE Levee from SH Bridge to RM 2.6	East 0.7-2.6 D	<ul style="list-style-type: none"> • BOR analysis indicates potential for overtopping levee at 100-yr flood • Moderate flood hazard on west bank due to erosion downstream from Game Farm levee 	<ul style="list-style-type: none"> • No action • Alternatives for levee setback have had preliminary modeling (BOR 2007) 	<ul style="list-style-type: none"> • Continue analysis of Corps levee setback alternatives in this reach. • Proceed with property acquisition from willing sellers • Proceed to design phases from Bridge to Brown property. 	

Hazard	Location Map Ref	Analysis of Present Conditions	Flood Hazard Reduction Alternatives Considered	Recommended Actions for Flood Hazard Reduction	Additional Notes
Olympic Game Farm Levee	West 1.5-2.5 E	<ul style="list-style-type: none"> • Low risk flood hazard under present configuration 	<ul style="list-style-type: none"> • No action • Acquisition and removal • Move levee to Ward Road • Extension of levee 	<ul style="list-style-type: none"> • Consider as part of continued analysis of Corps levee setback alternatives in this reach. • Property acquisition/easement from willing sellers (Land Strategy 2003) 	
Residences upstream from GF levee	West 2.6 – 3.0 F	<ul style="list-style-type: none"> • High flood hazard area; present development is within or near CMZ 	<ul style="list-style-type: none"> • No action • Acquisition and removal 	<ul style="list-style-type: none"> • Property acquisition/easement from willing sellers • Interim recommendation to prevent additional development due to flood hazard potential. • Continue riparian stewardship programs for property owners. 	
Undeveloped properties u/s from GF levee	Both 2.6 - 3.0	<ul style="list-style-type: none"> • High flood hazard area if parcels are developed. 	<ul style="list-style-type: none"> • Prevention of potential structures in floodplain 	<ul style="list-style-type: none"> • Riparian stewardship • Set back from CMZ 	At least one parcel on east bank is proposed for development; continued development in close proximity to CMZ should be discouraged or precluded.
Ward Road	West 3.0-3.3 G	<ul style="list-style-type: none"> • Erosion presently controlled with rip rap 	<ul style="list-style-type: none"> • No action • Set Ward Road Back to edge of floodplain 	<ul style="list-style-type: none"> • Acquire property west of Ward Rd. for future road relocation 	

Reach 2: Ward Bridge (Woodcock Road) upstream to Highway 101 (RM 3.3-6.5): This reach includes the bridges at Woodcock Road, Old Olympic Highway and the Railroad Bridge. Between Woodcock Road and Old Olympic Highway, an estimated 17% of the east bank has been modified and 40% of the west bank. The reach has active channel migration zones with areas of development close to or within the CMZ. The salmon-productive Anderson side channel is located upstream from Woodcock Road on the west bank. The relatively low gradient of this area of the river has resulted in lower stream velocity and active sediment deposition areas. The Burlingame Bridge (Old Olympic) was rebuilt in 1998-9 and the opening was widened from 130 to 430'.

From Old Olympic Highway to the 101 bridge, the river is characterized by a wide active channel with vegetated and unvegetated gravel bars and side channels on both sides of the river. The river still accesses most of the historic flood plain except near the bridges, and there is less development and less bank protection than in other parts of the lower river. There is an embankment upstream of the Railroad Bridge that was constructed following flooding in the 1960s and has been repeatedly repaired. Significant erosion occurs downstream of the bridges, and vegetation clearing downstream of Hwy 101 has increased bank erosion and the risk to houses. Implementation of engineered log jams has been occurring in this section in 2007-2009. Highly productive side channels for salmon are present in this reach associated with forested areas.

Hazard	Location	Analysis of Present Conditions	Flood Hazard Reduction Alternatives Considered	Recommended Actions for Flood Hazard Reduction	Additional Notes
Ward Bridge (Woodcock Road)	Both 3.3 H	<ul style="list-style-type: none"> • Areas u/s of bridge are riprapped to protect abutments • Flood waters enter side channels and under culverts along Woodcock road. 	<ul style="list-style-type: none"> • No Action • Widen Ward Bridge 	<ul style="list-style-type: none"> • Include bridge widening in County roads plan 	
Residential structures near Woodcock Road	Both 3.0-3.75	<ul style="list-style-type: none"> • Active CMZ u/s and d/s from Woodcock Road • Development close to CMZ or Anderson side channel. • High flood hazard area • High habitat quality areas 	<ul style="list-style-type: none"> • No Action • Property acquisition • Conservation easement • Prevent potential structures in floodplain 	<ul style="list-style-type: none"> • Riparian stewardship • Revegetation • Set back from CMZ • Conservation easements 	
Burlingame Bridge (Old Olympic Highway)	Both 4.0 I	<ul style="list-style-type: none"> • Bridge widened in 1998-9 • Armoring has occurred on both sides of bridge upstream. 	<ul style="list-style-type: none"> • No Action • Extend east end by 130' (would require property acquisition) 	<ul style="list-style-type: none"> • No structural action until channel migration makes it necessary to reevaluate expansion. • Property acquisition from willing sellers upstream of bridge 	<ul style="list-style-type: none"> • Bridge was designed to accommodate easterly expansion.
Residential structures between Burlingame Bridge and Railroad Bridge.	Both 4.0-4.5 J	<ul style="list-style-type: none"> • Erosion occurring along Grandview on west bank. Some houses at risk on both sides of river. • Development close to or within CMZ • High flood hazard area • Riparian forest has been removed near houses 	<ul style="list-style-type: none"> • No Action • Map flood channels • Conservation easement • Revegetation • Bank protection with wood • Acquisition-low priority 	<ul style="list-style-type: none"> • Acquisition and removal of house closest to Burlingame Bridge on west bank. • Riparian stewardship • Revegetation • Set back from CMZ • Conservation easements 	

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Hazard	Location Map Ref	Analysis of Present Conditions	Flood Hazard Reduction Alternatives Considered	Recommended Actions for Flood Hazard Reduction	Additional Notes
Small privately-owned undeveloped properties	Both 3.0-5.8	<ul style="list-style-type: none"> • Present level of development is low, but flood hazard potential would increase if developed. • High quality forested riparian habitat 	<ul style="list-style-type: none"> • No Action • Property acquisition • Conservation easements • Prevent potential structures in floodplain 	<ul style="list-style-type: none"> • Riparian stewardship • Set back from CMZ and forest edge • Retain riparian forest • Conservation easements 	<ul style="list-style-type: none"> • Preventive strategy to avoid continued development in or near CMZ
Large undeveloped parcels RM 4.6 to Hwy 101	Both 4.6 – 6.4 K	<ul style="list-style-type: none"> • Large single-owner property along west bank with high quality riparian forest habitat • Erosion history hayfield area on west bank and d/s 101 bridge 	<ul style="list-style-type: none"> • No Action • Acquisition • Conservation easement • Prevent potential structures in floodplain 	<ul style="list-style-type: none"> • Mixed easements and acquisition for east bank; purchase of west bank • Riparian stewardship • Revegetation 	<ul style="list-style-type: none"> • Emphasize preventive strategy to avoid continued development in or near CMZ • High priority acquisition area due to habitat value
Railroad Bridge Park/ Hendrickson Road	Both 5.7-6.5 L	<ul style="list-style-type: none"> • Active erosion to east bank and Hendrickson road. Occasional flooding of parking area • Active channel migration u/s of Railroad Bridge and high hazard to trestle. • Bridge embankment restricts flood plain area. 	<ul style="list-style-type: none"> • No Action • LWD placement • Relocate Hendrickson road and parking lot eastward • Remove or set back embankment • Modify trestle 	<ul style="list-style-type: none"> • LWD placement in progress 2008-2009 for habitat restoration • Property acquisition • Analysis of bridge and embankment modification • Potential damage to trestle and embankment will require replacement options that accommodate flood flows. 	<ul style="list-style-type: none"> • O&M plan for RR bridge in process (2009) • Relocation of parking/road will require property acquisition.
Kaiser Road residences d/s of 101	East 6.4 M	<ul style="list-style-type: none"> • Riparian vegetation has been removed • Active erosion and loss of property and infrastructure; owners are actively installing wood and bank hardening. • High flood hazard area due to channel migration and active erosion d/s of 101 bridge 	<ul style="list-style-type: none"> • No Action • LWD placement • Bank hardening • Acquisition and removal of structures 	<ul style="list-style-type: none"> • Property acquisition of high hazard parcels (long term) • Short term bank hardening (interim/ short term) • Prevent additional development due to flood hazard potential. 	
Other residences d/s of 101	East 6.0-6.4 N	<ul style="list-style-type: none"> • Old flood channel (swale) exists to the east of Kaiser Road area. 	<ul style="list-style-type: none"> • No action 	<ul style="list-style-type: none"> • Notify property owners that swales and elevation differences result from presence of old channel. 	<ul style="list-style-type: none"> • Risk that channel will reactivate is low due to configuration of 101 bridge

Reach 3: Highway 101 Bridge to Bonneville Power Lines (RM 6.5 to 8.6): Due to levee building and bank armoring, this reach has become straightened and entrenched and the channel shifts frequently due to levees and sediment deposition. Extensive gravel mining occurred from 1992-1996. The Dungeness Meadows dike was constructed by the USACOE in 1972 and extended north in 1993. Spring Creek and other east side channels are disconnected from the river by the levee. Bank armoring across from the Dungeness Meadows dike has been extensive to protect CCD irrigation outtake, residences, and Taylor Cutoff Road. It is estimated that levees line approximately 1/3 of this reach on each side of the river.					
Hazard	Location	Analysis of Present Conditions	Flood Hazard Reduction Alternatives Considered	Recommended Actions for Flood Hazard Reduction	Additional Notes
Residential properties u/s of 101 to DM dike	Both 6.4 – 7.0 O	<ul style="list-style-type: none"> • High flood hazard area u/s of 101 bridge • Erosion potential west bank; some log revetments were installed • Productive Dawley side channel on east bank 	<ul style="list-style-type: none"> • No Action • Bank hardening –east • Conservation easement • Acquisition 	<ul style="list-style-type: none"> • Re-vegetation • Conservation easements • Acquisition of side channel property • Riparian stewardship 	Several parcels have already been purchased or have easements on east bank.
SP Tri outtake	East 6.5 P	<ul style="list-style-type: none"> • Sediment deposition at outtake 	<ul style="list-style-type: none"> • No Action • Maintain outtake 	<ul style="list-style-type: none"> • Maintenance of outtake structures • Re-evaluate irrigation outtakes if/when irrigation infrastructure is modified. 	
Residence property along Taylor-Cutoff Road	West 7.0-8.0 Q	<ul style="list-style-type: none"> • High risk of bank erosion and flooding of residential homes and property • Extensive bank armoring 	<ul style="list-style-type: none"> • No action • Bank Armoring • LWD placement • Building setback • Acquisition 	<ul style="list-style-type: none"> • LWD placement • Conservation easements and acquisitions on selected properties • Prevent additional development in high risk areas 	Flood hazard on T-C Road was likely exacerbated by extension of Dungeness Meadows dike.
CCD Irrigation Outtake	West 7.6 R	<ul style="list-style-type: none"> • CCD outtake was rebuilt in 1994 with new fish screen. Repeatedly damaged from active channel movement and debris during flood. 	<ul style="list-style-type: none"> • No action • Maintain armoring • Build log jam • Relocate 	<ul style="list-style-type: none"> • No action on CCD outtake 	
Independent Outtake	East 8.5 T	<ul style="list-style-type: none"> • High potential for channel avulsion into Independent ditch outtake on east bank at RM 8.5. Independent requires high maintenance due to deposition at outtake. 	<ul style="list-style-type: none"> • No action • Maintain armoring • Build log jam • Relocate 	<ul style="list-style-type: none"> • Relocate Independent outtake and evaluate need for modification of remaining structures to prevent channel avulsion u/s and behind Dungeness Meadows dike. 	CIDMP recommends elimination of Independent outtake and combine with Highland.

Hazard	Location Map Ref	Analysis of Present Conditions	Flood Hazard Reduction Alternatives Considered	Recommended Actions for Flood Hazard Reduction	Additional Notes
Dungeness Meadows Dike	East 7.5-8.5 S	<ul style="list-style-type: none"> • Dike was extended d/s in 1993. Flood hazard across and downstream on west bank is high due to increased velocity and flood stage from DM dike • Spring Creek side channel complex is blocked by dike • Extensive development behind dike. • Property acquisitions near d/s end of dike as recommended in Land Strategy have mostly been implemented. 	<ul style="list-style-type: none"> • No action • Remove lower portion of DM dike • Set back DM dike • Install culvert in dike to feed side channel complex 	<ul style="list-style-type: none"> • No action for major portion of dike. • Acquire property near north end for potential removal of extension (most are already acquired by NOLT) 	<ul style="list-style-type: none"> • Extension appears to have put houses and roads at risk along T-C Road. • Potential removal of north portion of dike would require analysis of flood hazard, but has potential habitat benefit. • JS'KT flood modeling in progress.

Reach 4: BPA Powerlines to Canyon Creek (RM 8.6 – 10.8): This reach is heavily wooded and characterized by complex and single channel structure. Kinkade Island is formed by the mainstem river and the Kinkade Creek side channel. Flooding in 2002 eliminated one of two bridges to access the island and one home was destroyed. There is spot bank protection throughout the reach and along Kinkade Creek; levees in this section include the Lower Haller Dike, berms protecting the WDFW Fish Hatchery, and the City of Sequim levee. Two irrigation outtakes are located in this section—one on each side. In the main channel, approximately 25% of the west bank and 20% of the east bank are lined by levees, and another 5% of each bank has been subject to other man-made modifications.

Hazard	Location	Analysis of Present Conditions	Flood Hazard Reduction Alternatives Considered	Recommended Actions for Flood Hazard Reduction	Additional Notes
Lower Haller Dike	West 8.6-8.9 U	<ul style="list-style-type: none"> • Dike failed in March 1997 and was reconstructed by NRCS. • Two houses are protected by the dike. • Houses on west side d/s of LH dike to Clover Lane are at potential risk of avulsion. 	<ul style="list-style-type: none"> • No action • Acquire all properties and remove dike • Acquire portions of property d/s of houses and remove portions of dike. 	<ul style="list-style-type: none"> • Riparian stewardship • Conservation easements on selected properties • Evaluate flood risk potential for downstream properties and homes. 	
Kinkade Island	East 9-9.75 V	<ul style="list-style-type: none"> • 6 residences are located on island along with ~6 RVs • Single bridge access • High risk that mainstem will avulse into Kinkade Creek, putting residents of island and Kinkade Creek at risk. • Highly erodible area at high risk of flood hazard 	<ul style="list-style-type: none"> • No Action • Add LWD at entrance to Kinkade Creek to control volume of water entering channel • Other levees or armoring • Acquisition and removal of structures 	<ul style="list-style-type: none"> • Acquisition and removal of structures. • Interim recommendation to prevent additional development due to extremely high levels of flood hazard. • Enforcement of CAO provisions and codes should be emphasized in this location due to the high risk to human well being. 	<ul style="list-style-type: none"> • Removal of structures would have high value for both reduction of flood hazard and habitat function. • LWD placement considered to be uncertain as an effective strategy. • Flood modeling study in progress by JS'KT.
WDFW Fish Hatchery	West 10.6 W	<ul style="list-style-type: none"> • Rearing ponds are located in flood plain (1914 channel) and there is an avulsion hazard. • Berms protect floodplain d/s of Canyon Creek • Outtake and access road to Agnew intake are armored. 	<ul style="list-style-type: none"> • No Action • Relocate ponds • Remove berms and set back 	<ul style="list-style-type: none"> • Analyze feasibility and impact of removing berms. • Relocate ponds. 	<ul style="list-style-type: none"> • Berms are presently vegetated and do not appear to impair habitat functions.

Hazard	Location Map Ref	Analysis of Present Conditions	Flood Hazard Reduction Alternatives Considered	Recommended Actions for Flood Hazard Reduction	Additional Notes
Fish Hatchery Road	West Y	<ul style="list-style-type: none"> • Bank undercut on Fish Hatchery Road • County relocated road to the west, with heavy armoring. 	<ul style="list-style-type: none"> • No Action 	<ul style="list-style-type: none"> • No action at this time. 	
<ul style="list-style-type: none"> • Agnew irrigation outtake • Highland irrigation outtake 	West 11.2 Z East 10.9 Z	<ul style="list-style-type: none"> • Agnew outtake and pipeline heavily armored at canyon • Highland outtake is heavily armored and connected to the dike protecting Sequim water system. 	<ul style="list-style-type: none"> • No Action 	<ul style="list-style-type: none"> • No action • Re-evaluate irrigation outtakes if/when irrigation infrastructure is modified. 	<ul style="list-style-type: none"> • CIDMP has recommendations to modify diversion structures.
City of Sequim water supply	East 10.8 X	<ul style="list-style-type: none"> • Ranney system and building located behind a dike. 	<ul style="list-style-type: none"> • No action 	<ul style="list-style-type: none"> • No action • Re-evaluate dike and structures if water system infrastructure is modified. 	
Other residential properties		<ul style="list-style-type: none"> • Active erosion occurring on east bank at RM 9 across from May Road • Rock placement and logs have been placed along both banks, particularly along the outside of meanders. • Property owner at RM 10 has installed log revetments and spur dikes 	<ul style="list-style-type: none"> • No Action 	<ul style="list-style-type: none"> • Riparian stewardship • Set back from CMZ • Conservation easements 	

5.3 Summary of estimated costs for recommended actions

The estimated costs for implementing the recommendations in the Dungeness River Comprehensive Flood Hazard Management Plan are approximate estimates based primarily on recent plans and studies related to riparian land protection and salmon recovery. Expenditures for flood hazard management fall into five general categories and are summarized in Table 5-3: 1) purchase of land or conservation easements from willing sellers for habitat protection /restoration and/or flood hazard abatement; 2) levee removal /setback; 3) re-vegetation of riparian parcels; 4) large-scale engineered log jams; and 5) programs to provide stewardship education, technical assistance, monitoring or outreach to riparian landowners.

Table 5-3: Summary of estimated costs at 2009 levels.

These are approximate estimates. See source documents and description following table

RIPARIAN LAND VALUES: See Tables 5-4 and 5-5 for breakout		
<i>Reach</i>	<i>Assessed Value of parcels recommended for purchase or conservation easement</i>	<i>Estimated Market Value at 150% of assessed</i>
River Mouth to Woodcock Road	\$2,854,110	\$4,281,165
Woodcock to Hwy 101	\$12,105,984	\$18,158,976
Hwy 101 to Power line	\$2,870,105	\$4,305,023
Powerline to Hatchery	\$1,261,390	\$1,892,085
TOTAL LAND VALUE ESTIMATES	\$19,091,499	\$28,637,249
LEVEE REMOVAL / SETBACK		
<i>Reach/Location</i>	<i>Levee recommended for setback</i>	<i>Estimated project cost</i>
River Mouth to Woodcock Road	ACOE and Game Farm levee setback	\$9,250,000
Hwy 101 to Power line	Remove lower 2,000 LF DM dike	\$1,100,000
Powerline to Hatchery	Lower Haller Dike Setback	\$2,200,000
Other scattered constriction abatement		\$2,000,000
subtotal		\$14,550,000
RE-VEGETATION		
<i>Activity</i>		<i>Estimated project cost</i>
4.52 linear miles planting, maintenance, monitoring, and re-planting		\$150,000
Control of invasive plants (\$25,000 for 5 years)		\$125,000
Subtotal		\$275,000
ENGINEERED LOG JAMS		
<i>Activity</i>		<i>Estimated project cost</i>
Reach scale engineered log jam projects above Highway 101		\$2,500,000
STEWARDSHIP, TECHNICAL ASSISTANCE, AND MONITORING		
<i>Activity</i>		<i>Estimated project cost</i>
Part time staff at County, Conservation District and annual mailings for a 5-year period, education workshops at Dungeness River Center.		\$350,000
High resolution airphotos 1:6,000 scale (\$10,000/yr for 5 yrs)		\$50,000
Subtotal		\$400,000
TOTAL ESTIMATED PROJECT COSTS, EXCLUDING LAND PURCHASES		\$17,725,000

Sources for cost estimates:

Land values: *Recommended Land Protection Strategies for the Dungeness River Riparian Area* (Hals, Dungeness River Restoration Work Group; 2003) and Clallam County Assessor website. The Hals/DRRWG report provides detailed tables of parcels that were recommended for purchase or conservation easement for habitat or flood hazard abatement. Current assessed values were obtained for these parcels, where available, from the Assessor's office and tabulated <www.clallam.net/>. More information on the land value estimate is located in Tables 5-4 and 5-5.

Riparian Restoration Projects: The Dungeness Chapter of the Puget Sound Salmon Recovery Plan (Shared Strategy, 2005) and three-year work list included over \$40 million in projects for salmon recovery in the Dungeness watershed. Many of these projects are unrelated to flood hazard reduction (such as water conservation and hatchery upgrades) but several would directly or indirectly contribute to flood hazard management. In particular are projects to set back or remove levees, revegetation of cleared riparian areas to prevent erosion and improve habitat function, and placement of large woody debris in areas where it may direct flow away from eroding banks.

- **Levee removal or setback:** These projects will require separate engineering analysis and cost estimates prior to construction. Cost estimates used in the Puget Sound Salmon Recovery Plan were based on communication with the Washington Department of Ecology which established a range of \$500 to \$1400 per linear foot, excluding engineering and land acquisition. A review of recent (2006-2008) projects in Hood Canal and South Puget Sound indicated that this range is still valid for rough estimation purposes. Costs for large projects (>500 LF) were based on \$500 per LF, while smaller constrictor abatement projects were based on \$1,000 per LF.
- **Re-vegetation:** Estimates were based on the need to plant an estimated 30 acres (4.52 linear miles x 50 feet) at a cost of \$5,000 per acre, including re-planting, maintenance, and monitoring for 5 years (linear estimate from airphoto analysis by Hals, 2004). Invasive species in the Dungeness riparian corridor include butterfly bush and Japanese knotweed which require expensive, labor intensive treatments including individual stem injections.
- **Engineered Log Jams:** The Jamestown S'Klallam Tribe has recently completed reach-scale large woody debris placement in the area near Railroad Bridge Park at a cost of over \$1.5 million. Similar work is anticipated in the area upstream of Dungeness Meadows (pers. comm. with B. Rot).

Technical assistance, monitoring, outreach, and public education: These are ongoing programs operated by the County, Conservation District, or other appropriate entity, funds permitting. The Clallam Conservation District 5-year work plan estimates the program costs for staff, technical assistance, and cost share for working with urban and forest landowners and conducting education programs at \$800,000 (excludes agricultural work which is substantially higher). The Conservation District work plan is available at <www.clallam.scc.wa.gov/reports.htm>. Approximately 20% of this effort applied to the Dungeness would be \$160,000 (\$32,000 per year). Similar costs have been estimated for land use monitoring and flood hazard/emergency preparedness education for Clallam County. Recommended annual mailings to 300 Sequim-Dungeness property owners are estimated to cost \$3,000 per year for staff time, layout, printing and postage (x 5 years = \$15,000). Workshops at the Dungeness River Audubon Center related to land management (e.g. Septics 101) have been successful educational events for reaching property owners. A cost of \$3,000 per year (x 5 years) is also included for facility costs and advertising. Total estimated cost for education and technical assistance is \$350,000 for a 5-year period.

Table 5-4: Estimated Dungeness River Riparian Land Values

Estimated Values for Dungeness River Riparian Land -- Potential Purchases Identified from 2003 Land Protection Strategy (Hals/DRRWG)					
(Estimates for land acquisition are approximate and were based on the data available without in-depth GIS analysis.)	Mouth to Woodcock	Woodcock to Hwy 101	Hwy 101 to Powerlines	Powerlines to Hatchery	Total
# of riparian parcels	66	69	42	29	206
# acres riparian parcels	565	357	516	50	1488
# parcels in protected status	34	17	5	0	56
# acres protected status	289	41	375	0	705
# additional parcels recommended for acquisition or easement in Land Protection Strategy for HABITAT protection or restoration (and flood hazard abatement)	26	35	15	3	79
Assessed value of these parcels for HABITAT protection and restoration	\$2,753,400	\$7,814,783	\$2,870,015	\$430,875	\$13,869,073
# additional parcels recommended for acquisition primarily for FLOOD HAZARD abatement	3	17	none listed specifically in 2003 plan	12	32
Assessed value of parcels primarily for FLOOD ABATEMENT	\$100,710	\$4,290,665	0	\$830,515	\$5,221,890
TOTAL of assessed value for Habitat and Flood Hazard Abatement	\$2,854,110	\$12,105,984	\$2,870,015	\$1,261,390	\$19,091,499
TOTAL estimated market value at 150% of assessed value	\$4,281,165	\$18,158,976	\$4,305,023	\$1,892,085	\$28,637,249
Notes:					
Approximate estimate based on assessed values obtained on-line in January 2009 compared to tables of recommended actions in the 2003 Land Protection Strategy. Several parcel numbers from 2003 were no longer listed in on-line records. Estimate is based only on the records available via on-line parcel search. Estimates used full assessed value whether acquisition or easement was prescribed, or whether it was high, med, or low priority.					
Protected status means that parcel is owned by Clallam County, Washington State (WDFW or DNR), Jamestown S'Klallam Tribe, has a protected easement (e.g. North Olympic Land Trust), or is identified as having a high level of protection by the private property owner in the 2003 report.					
River mouth to Woodcock: Land acquisition in process at this time (Jan 2009)					
Woodcock to Old Olympic Hwy: Most of the riparian land area in this section is already protected via easement.					
Old Olympic to Hwy 101: Significant portion of the area recommended for habitat acquisition on west bank is in one ownership with high value habitat. Most of the flood abatement parcels are located by bridges, especially 101 (Kaiser Road area).					
Powerline to Hatchery: Most of the flood abatement parcels are located at Kinkade Island area.					

Table 5-5: Additional breakout of land value estimates for selected portions of the Dungeness River riparian area

Selected breakout areas	Reach 1 without Rivers End	Rivers End	Reach 1 Total	Woodcock to Old Oly	Old Olympic to Hwy 101	Reach 2 total
# of riparian parcels	34	32	66	13	56	69
# acres riparian parcels	494	71	565	32	325	357
# parcels in protected status	14	20	34	10	7	17
# acres protected status	226	63	289	22	19	41
# additional parcels recommended for acquisition or easement in Land Protection Strategy for HABITAT protection or restoration (and flood hazard abatement)	14	12	26	2	33	35
Assessed value of these parcels for HABITAT protection and restoration	\$2,341,445	\$411,955	\$2,753,400	\$387,175	\$7,427,608	\$7,814,783
# additional parcels recommended for acquisition primarily for FLOOD HAZARD abatement	3	na	3	0	17	17
Assessed value of parcels primarily for FLOOD ABATEMENT	\$100,710	na	\$100,710	0	\$4,290,665	\$4,290,665
TOTAL of assessed value for Habitat and Flood Hazard Abatement	\$2,442,155	411,955	\$2,854,110	\$387,175	\$11,718,273	\$12,105,448
TOTAL estimated market value at 150% of assessed value	\$3,663,233	617,933	\$4,281,165	\$580,763	\$17,577,410	\$18,158,172

Estimates for land values are approximate and were based on the data available without in-depth GIS analysis.

6. RELATIONSHIP TO REGULATORY AND SPECIES RECOVERY PROGRAMS

The Dungeness River and associated floodplains are governed by numerous federal, state, and local regulations. Table 6-1 provides a broad overview of the regulations affecting flood plain and riparian management in the Dungeness watershed. The discussion in Chapter 6 does not cover all regulatory programs for the Dungeness watershed, but focuses on those programs most relevant to flood hazard management, particularly those within the regulatory jurisdiction of Clallam County or programs relevant to threatened and endangered species in the Dungeness area.

Table 6-1: Regulations affecting flood plain and riparian management in the Dungeness River area

Category	Statute/Regulation	Relationship to Flood Plain Management	Jurisdiction
General land use	WA Growth Management Act	Established guidelines and requirements for preparation of comprehensive plans and development regulations, including flood hazard planning	State
	Clallam County Comprehensive Plan, Title 31 CCC	Clallam County coordinated land use plan adopted under the state Growth Management Act. Guidelines for development activities county-wide.	County
	Clallam County Zoning Code Title 33 CCC	Directs growth and development consistent with the Clallam County Comprehensive Plan. Establishes allowed, conditional, and prohibited land uses.	County
	Clallam County Subdivision Code Title 29 CCC	Establishes how land is divided consistent with the County's comprehensive plan and development regulations. Creation of new lots within the 100-year floodplain is prohibited, unless each lot designated for development contains at least one building site (one acre or larger), including access and utilities.	County
	Clallam County Building Code Title 21 CCC	Requires flood proofing for new construction in a flood hazard area	County
Shoreline and Critical Areas	Hydraulic Code: Hydraulic Project Approval	Regulates development that can potentially impact shorelines and habitat and fisheries.	State
	WA Shorelines Management Act	Provides state-wide values for shoreline protection	State
	Shoreline Master Program	Clallam County goals, policies, regulations, and permit review criteria to guide and regulate development within 200 feet of the ordinary high water mark, includes associated floodplains adopted under the state Shorelines Management Act.	County

Dungeness River Comprehensive Flood Hazard Management Plan 2009

Category	Statute/Regulation	Relationship to Flood Plain Management	Jurisdiction
	Clallam County Critical Areas Code, Chapter 27.12 CCC	Development regulations for wetlands, fish and wildlife habitat conservation areas, geologically hazardous areas, frequently flooded areas, and for areas with a critical recharging effect on aquifers adopted under the state Growth Management Act.	County
	Clallam County Open Space Code, Chapter 27.08 CCC	Tax incentive program to promote open space lands that meet certain public benefit criteria. Enrollment is voluntary.	County
Watershed Planning	The Watershed Planning Act (HB2514)	Establishes guidelines for local planning related to setting in-stream flows, as well as habitat, water quality, and supply.	State
Environmental Impacts	National Environmental Policy Act (NEPA)	Requires documentation and review of federal agency sponsored actions.	Federal
	Washington State Environmental Policy Act (SEPA)	Requires documentation and review of state/local agency sponsored development and agency permissions for private development.	State
	Clallam County Environmental Policy Code, Chapter 27.01 CCC	Establishes County processes and requirements for local administration of SEPA. Requires review of projects and activities in order to assess the potential impact to the environment.	County
Wildlife Protection	Endangered Species Act	Establishes requirements related to the declaration and protection of threatened and endangered species and the preparation of recovery plans.	Federal
	Salmon Recovery Planning Act (ESSB 2496)	Establishes procedures and funding mechanisms for local salmon recovery planning and project implementation.	State
Water Management	Clean Water Act Section 404 Section 401	Regulates pollution of waters Regulates filling of wetlands or waters Regulates pollutant release	Federal
	Rivers and Harbors Act – Section 10	Regulates obstruction or alteration of navigable waters	Federal
	Water Supply Facilities – Referendum 38	Created to fund water facility improvements	State
Flood Hazard Management	National Flood Insurance Program	Administered by Federal Emergency Management Agency	Federal
	Clallam County floodplain elevation determination, Critical Areas Ordinance, Shoreline Master Program, and Building Codes	Establishes policies, standards, and permitting requirements to guide, limit and regulate new development within floodplains and floodways as required by the state Growth Management Act, state Shoreline Management Act, and National Flood Insurance Program.	County

6.1 Clallam County Critical Areas Code

6.1.1 Goals of the Critical Areas Code

The Clallam County Critical Areas Code (Chapter 27.12) has been adopted and amended to comply with the Washington Growth Management Act (RCW 36.70A) to identify and protect critical areas and regulate their use. Four of the major goals of the Critical Areas Code relate directly to flood hazard planning:

Goal #3: Avoid potential loss of life and damage of property due to landslide, subsidence, erosion or flooding.

Goal # 4: Protect the general public against avoidable losses from maintenance and replacement of public or private facilities, property damage, subsidy cost of public mitigation of avoidable impacts, and costs to the public for emergency rescue and relief operations.

Goal #8: Preserve, protect, manage, or regulate critical areas that have either a direct or indirect effect on conserving fish, wildlife, other natural resources, and values.

Goal #17: Maintain and enhance local control of resources in Clallam County in order to effectively respond to the challenges of Federal Endangered Species Act listings.

6.1.2 Categories of Critical Areas: Five categories of critical areas are identified and defined by the code: wetlands, aquatic and wildlife habitat conservation areas, geologically hazardous areas, frequently flooded areas, and critical aquifer recharge areas. These categories are not mutually exclusive, and several may apply to any given parcel; protection requirements for each category are applicable where more than one category occurs (see table 6-2 for a summary).

Table 6-2: Regulation of Dungeness River flood hazard areas in the Clallam County Critical Areas Ordinance (as of January, 2009). Note that more than one category may apply to a given parcel, and that most development and changes in land use within CAO jurisdiction requires County permits and approval.

Critical Areas Category:	Definition and applicability to Dungeness River	CAO jurisdiction	What are some of the protection standards for development?
Frequently flooded areas	Includes the floodway, floodplain, and special flood hazard areas (any area with \geq 1% chance of flooding in any given year.)	Floodway and 100-Year Floodplain mapped by FEMA	<ul style="list-style-type: none"> • Structures are subject to special construction codes and elevation requirements. • Land disturbing activities require engineering certification to ensure they do not increase flood levels. • Repairs and improvements to existing structures are limited in size and value. • Recreational vehicle sites are allowed subject to some conditions, but are prohibited in critical area buffers. • Land divisions require a minimum of 1 acre buildable area outside of the flood plain.
Geologically Hazardous Areas	Includes the Channel Meander Hazard Area.	200 feet from edge of landslide hazard areas, included channel meander hazard areas.	<ul style="list-style-type: none"> • Requires a buffer of 50 feet from the Channel Meander Hazard Area. • Creation of new lots must show at least one building site outside of buffers, and that such sites will be stable under normal geologic or hydrologic conditions.

Critical Areas Category:	Definition and applicability to Dungeness River	CAO jurisdiction	What are some of the protection standards for development?
Aquatic and Wildlife Habitat Conservation Areas	Aquatic and Wildlife Habitat Conservation Areas include streams and designated critical habitat for threatened and endangered species. All of the lower 11 miles of the Dungeness River are designated critical habitat and are regulated as Class I wildlife habitat conservation areas.	200 feet from the Ordinary High Water Mark (OHWM) or Known Locations of Class I Wildlife Habitat of endangered, threatened and sensitive species.	<ul style="list-style-type: none"> • Aquatic Habitat Buffers measured from OHWM: <ul style="list-style-type: none"> -150 ft (new land divisions & major development) -75 ft (minor development, includes most single-family development) -May increase to 300 feet to protect endangered and threatened species where a habitat management plan (HMP) indicates a larger buffer is necessary to protect habitat values, or where development is located within landslide and erosion hazard areas. -Buffer averaging may be permitted where protection criteria met. • Creation of new lots must show at least one building site outside of buffers. • Clallam County requires new development within 200 feet of all Class I Wildlife Habitat Areas to have prepared a habitat management plan by a qualified professional. Applicants can use County's pre-approved, HMP guidelines for threatened species of salmonids.
Wetlands	See CCC 27.12 Part 2	200 feet of regulated wetlands	Varies by type of development and wetland classification. See CCC 27.12 Part 2
Crit. Aquifer Recharge Areas	See CCC 27.12 Part 6	Delineated on maps at Clallam County DCD	See CCC27.12.615 for performance standards for certain development activities.

6.1.3 Aquatic and Wildlife Habitat Conservation Areas

The entire lower 11 mile reach of the Dungeness River is within the designated critical habitat area for threatened species of salmonids, and is regulated by the County as Class I Wildlife Habitat Conservation Area as well as Aquatic Habitat Conservation Area. Aquatic habitat Conservation Area Protection standards related to flood hazard reduction and habitat conservation include, but are not limited to, establishment of protective shoreline buffers, standards for shoreline modifications, livestock restrictions, and standards for road, bridges, and utility placement (CCC 27.12.315).

Regulated development activities that occur within 200 feet landward from the Ordinary High Water Mark (OHWM) in a Class I Wildlife Habitat Management Area require the preparation of a Habitat Management Plan (HMP). The HMP can be prepared by a qualified professional, or applicants can use the pre-approved, Clallam County HMP guidelines (Clallam County, 2004) for threatened species of salmonids. For the Dungeness River, these guidelines promote protection and/or restoration of native vegetation within one potential tree height.

6.1.4 Geologically Hazardous Areas

The Geologically Hazardous Areas are designated within the Critical Areas Code to provide standards to protect human life and property, control erosion and siltation, protect water quality, protect habitat,

and allow for the natural movement of rivers and streams within a flood plain. Channel meander hazard areas are classified as landslide hazard areas in the Critical Areas Code. The meander hazard does not include areas that are blocked from channel movement by the existence of permanent levees. Clallam County has mapped the area considered a channel meander hazard. However, newer information has been incorporated into the analysis of the channel meander hazard boundaries and mapped by the Jamestown S'Klallam Tribe (Rot and Edens, 2008). (See Section 6.5.1 of this plan for further discussion.) Critical area protection standards for Channel Meander Hazard Areas include, but are not limited to:

- 1) Buffer of 50 feet from the edge of the channel meander hazard area for all major and minor development.
- 2) Buffers that are in their natural state should not be altered.
- 3) Specific guidance provided for buffer reduction and hazard tree removal.
- 4) For land divisions – no lot or parcel shall be created within landslide hazard areas unless a Geotechnical report certifies that it will be stable. Land divisions containing landslide hazard areas are prohibited unless each lot contains at least one building site. The hazard area and buffer shall be noted on final plat with a statement that subsequent development will comply with critical areas standards.
- 5) Notice to the title must be filed when a development proposal is submitted. The statement must contain notice of critical area and buffer, and applicability of the Critical Areas Code.
- 6) Prior to any zoning or comprehensive plan amendment, an environmental assessment shall be approved by Clallam County to determine if the proposal would be consistent with the Critical Areas chapter and if mitigation measures would be necessary if the proposal were approved. The review shall occur before any SEPA threshold determination.
- 7) All forest practices (timber harvesting and associated development activity) shall maintain the 50 foot buffer from the edge of the geologic hazard area.
(CCC 27.12.415)

6.1.5 Frequently Flooded Areas

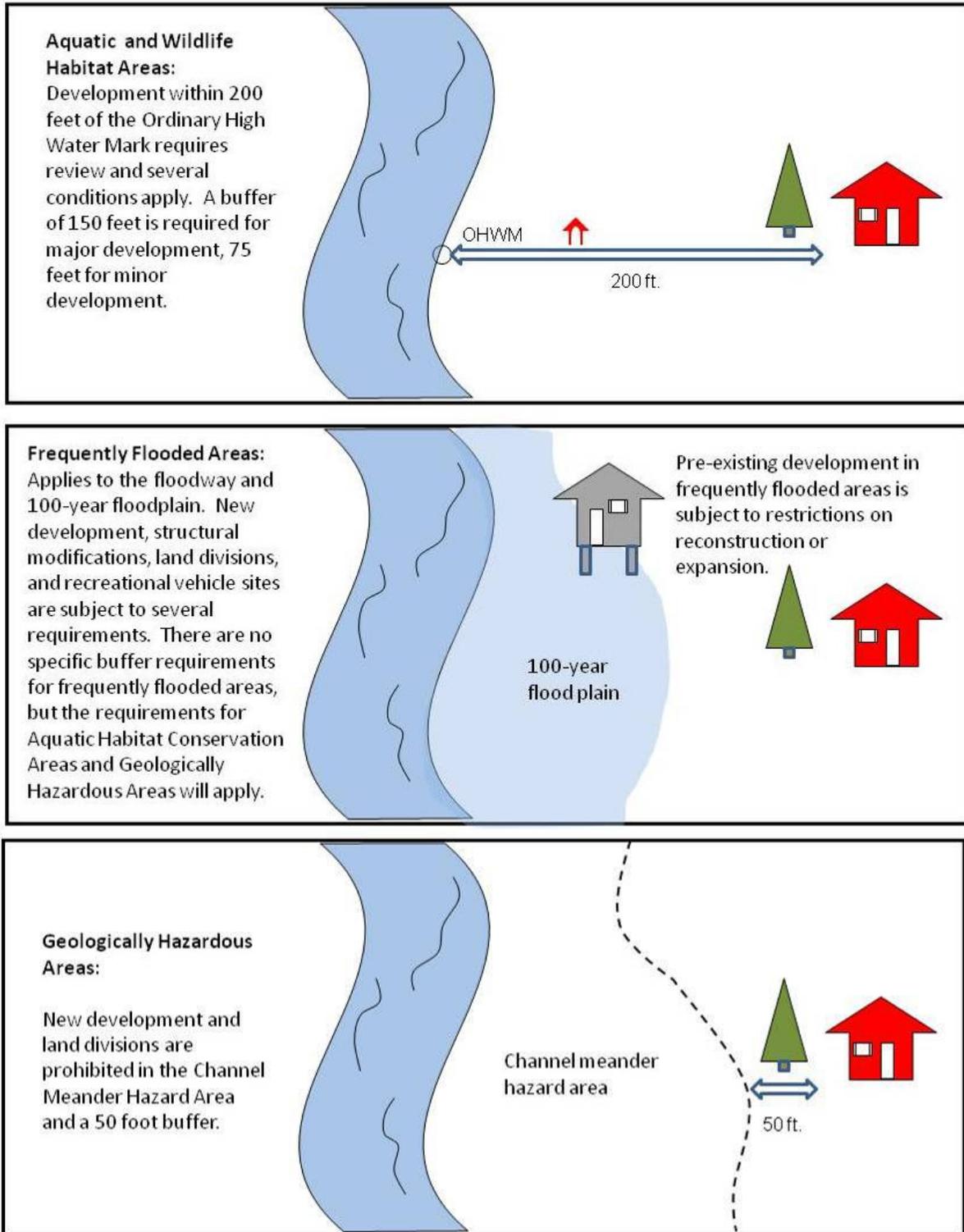
Frequently flooded areas include floodways, floodplains, and special flood areas. The floodway is the channel of the stream plus any adjacent areas that must be kept free of encroachment in order to discharge the base flood without cumulatively increasing water surface elevation by more than one foot. A Special Flood Hazard Area is defined as the floodway and adjoining land which has a one percent chance or better of flooding during a given year, as determined by engineering studies which have been accepted by Clallam County. A floodplain is the floodway and special flood hazard areas. Critical area protection standards for Frequently Flooded Areas include, but are not limited to:

- 1) Critical facilities, such as schools and hospitals, are prohibited in frequently flooded areas.
- 2) Land divisions within frequently flooded areas are not allowed unless the applicant can show that each lot has at least one building site that is not within the frequently flooded area, and is at least one acre in size.
- 3) In frequently flooded areas, land disturbing activities--such as construction, clearing or grading, require engineering certification that the activities will not increase flood levels by more than one foot at any point. An engineered stormwater and sediment control plan is required.
- 4) Construction or reconstruction of residential, commercial, and/or industrial structures is prohibited in floodways except for repairs or improvements of existing structures. Repairs and improvements cannot exceed 50 percent of the market value of the existing structure. There are some exceptions for existing buildings.
- 5) Recreational vehicles are allowed in special flood hazard areas but are required to follow several guidelines including limits on the length of stay and readiness to move. Recreational vehicles cannot be located in critical areas buffers.

- 6) Notice to the title must be filed when a development proposal is submitted. The statement must contain notice of the critical area and possible limitations.
- 7) Prior to any zoning or comprehensive plan amendment, an environmental assessment shall be approved by Clallam County to determine if the proposal would be consistent with the Critical Areas chapter and if mitigation measures would be necessary if the proposal were approved. The review shall occur before any SEPA threshold determination.
(CCC 27.12.515)

Figure 6-1: Differences in protection standards among three types of critical areas under the Clallam County Critical Areas Code.

Note that all three categories are likely to apply to any given parcel along the Dungeness River, along with the standards for wetlands and critical aquifer recharge areas.



6.2 Clallam County Shoreline Master Program

Clallam County has established a Shoreline Master Program under the requirements of the Washington State Shorelines Management Act (SMA). Under the SMA, the Dungeness River is considered a “shoreline of the state.” The area covered by the designation includes the river itself, the adjacent lands within 200 feet of the ordinary high water mark, those areas within the 100-year floodplain, and all associated marshes, bogs and swamps. The SMA requires permits for conditional uses, substantial development, and variances within the shorelines of the State.

The Clallam County Shoreline Master Program establishes five shoreline environments within Clallam County. The Dungeness River Shoreline from the Olympic National Forest boundary downstream to the mouth at Dungeness Bay is defined as a Rural Environment. Examples of some of the policies and protection requirements of the SMP for Dungeness River shorelines are summarized in table 6-3.

Table 6-3: Examples of policies and requirements of the Clallam County Shoreline Master Program for Dungeness River Shorelines

SMP Section	Policies and Requirements
4.10 Rivers, streams and creeks	<ul style="list-style-type: none"> • Discharge of raw sewage, animal wastes, pesticides, herbicides, and fertilizers into the water is prohibited. • Construction of dikes, levees, and bulkheads should be done in such a way as to preserve the natural channel rather than constrict it into the conformation of a ditch. • Any such modification of the natural channel must be proven necessary for the protection of life and property. • Construction of dams for electrical power, water supply, or flood control must provide the accustomed upstream migration of anadromous fish and for their return to the sea. • Any alteration of the shoreline that would result in erosion of soil or siltation or pollution is prohibited.
4.11 Floodplains	<ul style="list-style-type: none"> • Dikes and levees designed to prevent destruction of property by floods should be set well back from the ordinary channel allowing the stream to meander. • Permits for residential development on unprotected floodplains shall be discouraged. • Removal of timber or other vegetation along the waterway of a floodplain shall be discouraged.
5.01 Agricultural practices	<ul style="list-style-type: none"> • Buffer zone of permanent vegetation or other suitable soil erosion control methods shall be established and/or maintained between tilled or grazed areas and associated water bodies. • Animal feeding operations, retention and storage ponds, feedlot waste, and manure stockpiles must be located so as to prevent contamination of associated water bodies.
5.03 Forest management practices	<ul style="list-style-type: none"> • Forest practices must comply with Forest Practices Chapter 90.58.150 RCW
5.08 Residential Development	<ul style="list-style-type: none"> • Shore setback for dwellings and associated development range from 35 feet to 150 feet from ordinary high water mark at a minimum for single-family units and 50 to 200 feet for multi-family units.

Clallam County will be revising the Shoreline Master Program in 2010-2011. Given the many detailed studies of Dungeness river channels and river processes, the upcoming SMP revision is an opportunity for the County to incorporate the information and implement flood hazard reduction policies, design criteria, and regulations specific to the Dungeness River shoreline.

6.3 Relationship to other County Ordinances

6.3.1 Clallam County Comprehensive Plan

The current Comprehensive Plan (Title 31 CCC), initially adopted in 1995 and amended periodically since, is based on the requirements of the Growth Management Act (GMA). The comprehensive plan includes four regional comprehensive plans. Chapter 31.03, the Sequim-Dungeness Regional Plan, was also adopted in 1995, and has been amended periodically. It is specific to the unique characteristics of the Dungeness area and sets open space and environmental conservation policies in section 31.03.195, including protection of the Dungeness River. The future land use plan adopted with the Sequim-Dungeness Regional Plan, as amended, establishes land uses and densities for the area, including the Dungeness River corridor. The future land use plan is also adopted as the County's zoning map.

6.3.2 Clallam County Zoning Ordinance

The Clallam County Zoning Code was first adopted as part of the Clallam County Code in the 1960s, and has been significantly modified to incorporate GMA-related changes since then. The Zoning Code contains the use and density requirements that guide land uses in the zones near the river. The Zoning Code provides standards and procedures for the granting of variances and conditional uses, and for enforcement actions. Development in any zone must also comply with the Critical Areas Code.

Most of the land along the Dungeness River is zoned for rural residential development. Rural Low designation encompasses most of the land along the river from RM0 to RM0.95 and from RM2.7 to 10.5. Rural Low allows for one dwelling per 4.8 acres. Portions of the east side of the river were zoned Rural Moderate, allowing for a maximum of one dwelling per 2.4 acres, but these areas are currently zoned Interim Rural Low (R5). Future designation of these former Rural Moderate zones is pending the outcome of Clallam County's appeal and/or compliance response to the Western Washington Growth Management Hearings Board [Case No. 07-2-0018c].

Areas on both sides of the river from RM0.95 to 2.7 are zoned Agricultural Retention (AR). One dwelling per 16 acres is allowed in the AR zone. The Agricultural Retention Zone allows for farms that were previously surveyed into five acre tracts to recombine parcels through a cluster/conservation type design to retain most of the former farm in long-term agricultural and other rural open spaces.

Land south of the RM 8.2 to the east and south of RM10.5 is zoned Commercial Forestry (CF). The CF zone allows for one dwelling per 80 acres, and requires a conditional use permit for some new residential development regardless of parcel size.

6.3.3 Clallam County Subdivision Ordinance

The Subdivision Ordinance outlines procedures and conditions for dividing land into smaller parcels. A subdivision is defined as the division of land into five or more lots; a short subdivision is four or fewer lots. The Subdivision Ordinance does not identify specific hazard areas in relation to the Dungeness River, but the topographical hazards section states that land which is unsuitable for building purposes due to flooding, unstable soils, or other adverse natural features likely to be harmful to the health, safety or general welfare of existing and future inhabitants shall not be divided for building sites. New land divisions must also demonstrate consistency with the County's zoning, critical area, and shoreline master program regulations. For example, new lots created for development must demonstrate a suitable building site outside of aquatic areas, wetlands, floodplains, landslide hazards, channel migration zones, and associated required protective buffers.

6.3.4 Clallam County Building Code

Clallam County has adopted the Uniform Building Code (UBC). The Building Code is used in conjunction with other regulations such as the zoning and flood management ordinances to ensure that proper flood proofing is provided for new construction in a flood hazard area.

6.3.5 Clallam County Code Compliance

Clallam County adopted a comprehensive code compliance ordinance in 2007. This ordinance identifies processes and methods to achieve compliance with laws and regulations, including regulation of development within flood hazard and shoreline areas. Clallam County currently (2009) has two full-time, code compliance positions within the Department of Community Development (DCD). The code compliance program also relies on trained volunteers. DCD code compliance staff coordinate some compliance efforts with the Clallam County Sheriff as part of a Community Policing Team approach. In addition, they work with other code compliance/law enforcement staff of other agencies of jurisdiction such as the Washington State Department of Fish and Wildlife.

6.4 Relationship to the Federal Endangered Species Act

Several species of Dungeness salmonids are listed as threatened under the Federal Endangered Species Act including Puget Sound Chinook, Hood Canal/eastern Strait of Juan de Fuca summer chum, bull trout, and steelhead. The “take” of threatened species is prohibited under the law and conservancy of critical habitat is required. Projects with the potential to harm threatened species are subject to several requirements for review and consultation.

6.4.1 Puget Sound Salmon Recovery Plans

Recovery plans for Puget Sound Chinook and Hood Canal/Strait of Juan de Fuca summer chum have been approved by the National Marine Fisheries Service and are in early phases of implementation. The Dungeness chapter of the Puget Sound Salmon Recovery Plan (Shared Strategy, 2005) contains several site-specific projects that would reduce flood hazard as well as improving habitat quality and quantity. Clallam County and the Jamestown S’Klallam Tribe submitted a three-year work plan to the Salmon Recovery Council listing high priority recovery projects. Many of these projects include actions to abate the constrictions of the Dungeness flood plain from levees, reconnect flood plain areas, and restore riparian vegetation.

Relevant actions from the three-year project list are included in Table 6-4. The salmon recovery project list for the Dungeness and the north Olympic Peninsula region is updated regularly, and can be viewed at the Puget Sound Partnership website—salmon recovery section (as of 2009):

http://www.psp.wa.gov/downloads/SALMON_RECOVERY/UPDATE_2008/2008_Elwah_Dungeness_Skokomish_Watershed_Update.pdf

Table 6-4: Excerpts from the three-year salmon recovery list for the Dungeness watershed

Project Name	Likely sponsor	Project ranking (out of 24)	Project Type	Project Summary	Current Status – Jan. 2009
Rivers End Risk Assessment	Jamestown S'Klallam	top 5	Pre-project Study	Study to examine the risks and benefits of the River occupying its 1855 channel. Study was requested by adjacent landowners.	Study completed
Dungeness estuarine saltmarsh recovery Phase I	Clallam County WDFW Jamestown S'Klallam	top 5	Pre-project study	Estuarine dikes have been in place since 1855. The study looked at increasing salt marsh extent through fill removal and dike removal scenarios.	Completed
Dungeness estuarine saltmarsh connectivity project	Dungeness Farms Jamestown S'Klallam Clallam County WDFW	top 5	Restoration	Dikes will be opened or removed and fill removed.	2008-9 in restoration design and permitting phase
Lower Dungeness floodplain acquisition - west	Jamestown S'Klallam/NOLT	1	Acquisition	Purchase property behind Game Farm levee to implement Corps levee setback restoration plan	Inactive
ACOE levee setback Phase I	Clallam County	2 and 3	Restoration	2 mile levee setback on east bank of lower river, upstream of Schoolhouse Bridge	Phase 1 analysis completed by BOR.
Lower Dungeness floodplain acquisition - east	Clallam County	1	Acquisition	Purchase property behind Corps levee to implement levee setback restoration plan.	Appraisals approved. Offers accepted, purchases pending.
LWD placement and channel reconstruction Phase II	Jamestown S'Klallam	10	Restoration	Log jam construction and channel reconstruction in levee setback reach	Dependent on Phase I but will occur at same time
Dungeness corridor protection Hurd Creek - WDFW Hatchery	WDFW JSKT NOLT	5, 6, 7, 9, 11, 13	Acquisition	Tier I parcels identified for acquisition. Contain important main channel, side channel and riparian habitat. Areas identified that are integral to removing levees and recovering floodplain.	Negotiations are underway for some Tier 1 parcels by WDFW
Middle Dungeness River Restoration Plan	JSKT WDFW Clallam Conservation District	5, 6, 7	Pre-project study	Risk/benefit analysis of various restoration alternatives using existing information and developing a hydraulic reach model.	Hydraulic modeling and landowner mtgs planned in 2009-10
Removal or setback of upper Haller dike	JSKT WDFW Clallam County	6	Restoration	Recover lost floodplain on the west bank	Pending acquisition and the Middle Dungeness Restor. Plan
Riparian reforestation	Conservation District JSKT Clallam County	High	Restoration	Reforest unvegetated riparian land with cooperating landowners	

6.4.2 Relationship of the ESA to the National Flood Insurance Program (NFIP)

The National Flood Insurance Program is administered by the Federal Emergency Management Agency as a way to encourage community programs for corrective and preventive land management in flood plains. The NFIP program has three components:

- Flood Insurance: Residences and businesses located in communities that meet NFIP requirements for building standards and floodplain ordinances are eligible for federally-backed flood insurance. Flood insurance is encouraged as an alternative to disaster assistance; the floodplain management and building practices reduce flood damage.
- Floodplain Management: Participating communities voluntarily adopt and enforce floodplain management ordinances, particularly with respect to new construction.
- Flood Hazard Mapping: FEMA identifies and maps floodplains to provide data for floodplain management programs and to rate construction for flood insurance purposes. Floodplain boundaries are primarily based on elevation in relationship to the probability of flood flows.

Clallam County has repealed most of the Floodplain Management Code and replaced it with the Critical Areas Code, and portions of the Zoning Code and Building Code. Together these satisfy current FEMA requirements for participation in the NFIP.

In September, 2008, the National Marine Fisheries Service issued a Biological Opinion under the Federal Endangered Species Act that concludes that development consistent with the National Flood Insurance Program jeopardizes threatened population units of salmon and orcas and adversely modifies critical habitat. FEMA has notified Puget Sound communities that additional guidance related to the NFIP program will be forthcoming, and suggested a moratorium on development in the floodplain as an interim measure. Other suggested measures to be implemented in 2009 include improving map accuracy, changes to levee vegetation maintenance, and implementation of mitigation activities. The studies and projects that have been initiated in the Dungeness River related to mapping the channel migration zone, analyzing floodplain processes, revegetation projects, and levee setback will likely be consistent with the measures suggested by NMFS.

6.5 *Dungeness River Reports*

In addition to Clallam County codes and Federally-approved species recovery plans, a number of specific studies and reports have been conducted along the Dungeness River regarding flood/erosion hazards and fish and wildlife habitat. Three of these reports that have direct relevance to regulatory and species recovery programs and flood hazard management in the Dungeness River corridor are discussed below:

6.5.1 Channel Migration Zone Update

Clallam County maps of channel meander hazard areas were developed in 1999 by County staff prior to the availability of LiDAR (2002, 2008), geomorphic research on the Dungeness by the Bureau of Reclamation and US Geological Survey, and guidance on channel migration zone delineation from the Department of Ecology. The Jamestown S’Klallam Tribe completed a study in 2008 (Rot and Edens) that combines the results of recent studies related to the physical boundaries of floodplains and historic channel movement of the Dungeness. The study updates and delineates the Dungeness River Channel Migration Zone (CMZ), and provides the scientific rationale behind those boundaries. The CMZ includes the outer extent of known historic channels, plus potential future migration over the next 100 years. The updated CMZ maps and related information are intended to assist with making informed decisions in terms of planning for riverside development, protecting the public welfare, and providing for resource protection. Updating current County maps and informing the public of CMZ boundaries are recommendations of this plan (see Chapter 5.1).

6.5.2 Dungeness River Land Protection Strategies

The placement of existing structures and location of “grandfathered” lots within frequently flooded areas and habitat conservation areas remain problematic for flood hazard reduction and critical habitat protection and restoration. A parcel-by-parcel analysis of the Dungeness River shoreline in the lower 11 miles was completed by the Dungeness River Restoration Work Group (Hals and DRRWG, 2003). Parcels with high habitat values were identified. The County, Jamestown S’Klallam Tribe, WDFW, and North Olympic Land Trust have implemented buy-out and conservation easement programs on several parcels along the river. Many of the parcels acquired also contained structures which were at high risk for flood hazard, and several homes and associated infrastructure have been removed. Continuing to implement the recommendations of the 2003 Dungeness River Comprehensive Land Protection Strategy is a general recommendation of this plan.

6.5.3 Review of the Clallam County’s Critical Area Ordinance – A Dungeness River Case Study

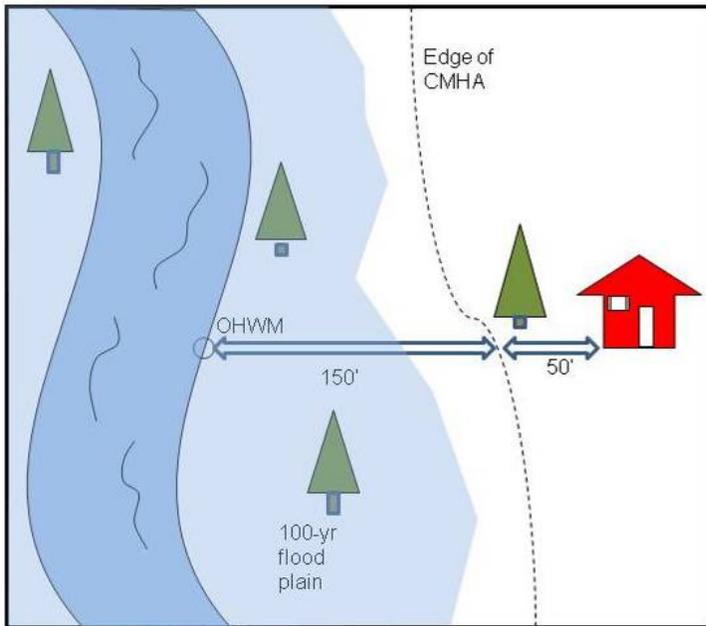
The Jamestown S’Klallam Tribe completed a study by Hals in 2004 of the County’s critical areas ordinance for protecting riparian areas using the Dungeness River as a case study. The report was focused on riparian functions for fish and wildlife habitat rather than flood hazard reduction. The report also analyzed existing land uses along the river corridor for compliance with existing critical area protection standards. The Jamestown S’Klallam Tribe’s study also noted areas where the Tribe felt the code was not effective in protecting riparian functions, and/or identified ownerships along the river corridor that appeared to be out of compliance with the County regulations. Recommendations for improving the effectiveness of the critical areas code were included.

One of the recommendations related to reducing flood hazards, erosion hazards, and conserving important upland shoreline habitats was that the County should require riparian buffers to be measured

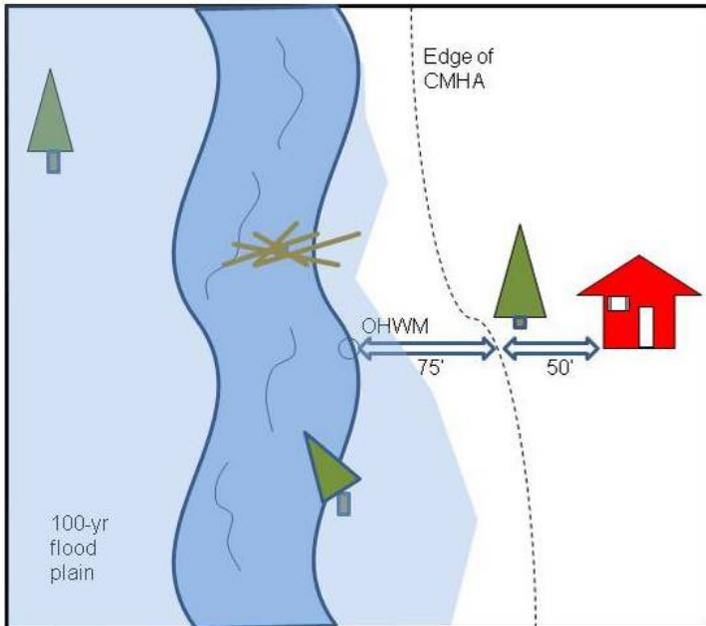
from the delineated channel migration zone rather than the ordinary high water mark (OHWM). The study noted that buffers related to Geologically Hazardous Areas, including the Channel Meander Hazard Area (CMHA), are set back from the edge of the CMHA at 50 feet, while buffers for Aquatic and Wildlife Habitat Conservation Areas are set back 200 feet from the OHWM. The OHWM changes as the channel migrates in the floodplain, thus a structure that is built in compliance with the Critical Areas Code, could become a non-conforming use in the future (Figure 6-2).

The present buffer for Geologically Hazardous Areas that requires a setback of 50 feet from the Channel Meander Hazard Area may not be adequate to account fully for erosion and avulsion hazards. Requiring the habitat conservation setback to be measured from the edge of the Channel Migration Zone rather than OHWM would improve flood hazard risk as well as providing benefits to fish and wildlife values. This is one of the recommendations contained within Chapter 5 of this plan.

Figure 6-2: Example of how a structure may become a non-conforming use under the Critical Areas Code over time



In this diagram the house is built in compliance with Critical Areas requirements, as it is 50 feet from the Channel Meander Hazard Area and 200 feet from the Ordinary high water mark.



Years later, the channel has migrated toward the structure, and the house now encroaches on the Aquatic Habitat Conservation Area, as measured from the Ordinary High Water Mark.

7. EMERGENCY MANAGEMENT

The Clallam County Emergency Management Division operates a Comprehensive Emergency Management Plan jointly with the cities of Port Angeles, Sequim, and Forks using the Incident Command System. The Emergency Management Plan covers numerous types of emergency situations including storms, flooding, tsunamis, earthquakes, and civil defense and has been certified by the Washington State Emergency Management Division. The Clallam Emergency Operations Center is located in the basement of the Clallam County Courthouse, and is activated as needed. Alternative EOC sites are operated at fire stations. A Flood Warning by the National Weather Service for any Clallam County river will trigger EOC activation. Upon EOC activation, an informational message center is staffed, providing specific information to citizens about flood risks, weather forecasts, road closures, and power failures. The message center can also be used to make specific requests for evacuation, sheltering, food and water, or other needs. Medical emergencies or other life threatening emergencies should still use 911 however. The message center at the EOC can be reached at (360) 565-2680 or 2681 only when the center is activated.

Residents of flood hazard management areas are advised that notification or assistance from County or other emergency officials may not always be available during a flood event and they should assume that they are on their own. Residents are advised to be prepared for flood emergencies, monitor flood watches and warnings, and take appropriate action to remove themselves from harm's way in advance.

Information on planning for floods and other hazards is available on the Clallam County website at <http://www.clallam.net/html/emergencies.htm>.

Additional information to assist homeowners and businesses to plan and prepare for emergencies is available from the Washington Emergency Management Division www.emd.wa.gov or the Washington State Department of Health www.doh.wa.gov. The state Emergency Resource Guide publication is available at www.doh.wa.gov/phepr/factsheets as DOH publication #821-001.



River's End Road during flooding, 2002

(Clallam County photo)

7.1 Preparing for a Flood

7.1.1 Preparing households in flood hazard areas: The websites described above have guidelines for preparing homes and businesses. Households in the identified flood hazard areas are advised to keep emergency kits prepared and ready to go with non-perishable food items, flashlight, blanket, first aid kit, water, phone contact list, a battery operated radio and extra batteries, along with special medications if needed. Households should be aware of procedures to monitor flood levels and evacuation routes, and family members should have an out-of-area contact in case of separation.

7.1.2 Neighborhood preparation in high risk areas: The Clallam County Emergency Management Division offers a Map Your Neighborhood program that is recommended all citizens to prepare an effective disaster response. The Map Your Neighborhood program provides training for residents, designates a gathering site, maps evacuation routes, and identifies neighbors who have special skills or limited mobility. Map Your Neighborhood is available from the County upon request. There is no charge for the training; however a designated individual from the neighborhood must be willing to volunteer as the neighborhood coordinator.

7.1.3 People living in flood hazard areas are encouraged to monitor weather and flood warnings through NOAA weather radio, track weather and flood information at the National Weather Service website (<http://www.wrh.noaa.gov/sew/>) and/or listen to local radio stations for weather related warnings. Additionally the County Emergency Management Division, upon request, will add individuals to an email list through which severe weather information, flood forecasts, and situation reports on ongoing emergencies is disseminated. County Emergency Management personnel can also provide information on personal preparation and additional sources of weather and flood information.

7.2 During a Flood

The National Weather Service has several terms used to describe the potential for flooding:

- **Watch:** A watch is issued when the probability of a flood event is high but the occurrence or timing is still uncertain. A watch is issued from 36 to 12 hours before the potential event. The public should set plans in motion to prepare when a watch is issued.
- **Warning (highest level of alert):** A warning is issued when flood events are occurring, are imminent, or have a very high probability of occurrence. A warning is typically issued within 12 hours of a life or property-threatening event. Flood (and other emergency) watches and warnings are available at <http://www.wrh.noaa.gov/sew/> and will be broadcast on NOAA weather radio.

7.2.1 Monitoring flooding and emergency notification systems: During a flood watch or a flood warning, residents along the flood hazard zone of the Dungeness River should monitor the flood stage and heed NWS warnings. Information on flows and emergency notification is available in several ways:

- **The US Geological Survey website** provides real-time data for the Dungeness River from a gaging station at River Mile 12 approximately one mile downstream from the boundary of Olympic National Forest: <http://waterdata.usgs.gov/wa/nwis/current?type=flow>
The gaging station describes the flow in two ways—as the discharge of water flowing past the gaging point measured in cubic feet per second, and as stage measured as the height in feet

above the river bed at the station site. Flood stage occurs when the flow begins to overtop the streambank at the gage site. This occurs at an elevation of 7.0 feet at the USGS gaging station.

- **The Washington Department of Ecology** maintains a telemetered gaging station at the Schoolhouse Bridge at river mile 1 which transmits updates of the discharge every three hours and is loaded to the following internet site:
<https://fortress.wa.gov/ecy/wrx/wrx/flows/regions/state.asp?region=1>
- **Local Radio:**
 - KONP-1450 AM 360.457.1450
 - KBDB -103.9 FM 360.374.6233
 - KAPS-660 AM Mt. Vernon, 800.827.7660
 - KSQM-91.5 Sequim 360-681-0000
- **NOAA Weather Radio** is part of the national Emergency Alert System and issues alerts, watches and warnings from the National Weather Service. These battery powered radios are available at most radio electronic retailers. As noted above, flood (and other emergency) watches and warnings are also available at <http://www.wrh.noaa.gov/sew/>.
- **The 211 system:** Clallam County activates the 211 information referral system during emergency events. Calls to 211 may be made to obtain information on road closures and river stage. Do not call 911 unless there is a life-threatening emergency. The 211 system is intended to provide information and to keep the 911 lines available.
- **Reverse 911:** Clallam County operates a reverse 911 system during emergency events. Reverse 911 enables the county to call blocks of residences to warn them of imminent danger. If you receive a call from Clallam County Emergency Management, follow the instructions in the pre-recorded message. Do not count on a reverse 911 call during flood emergencies as many phones will not be activated due to power loss and other interference.
- **Ham radio and Citizen's Band systems:** The Clallam County Emergency Management Division works closely with the Amateur Radio Emergency Service (ARES) and Registered Amateur Civil Emergency Service (RACES) networks to maintain communication capability when conventional systems are not available due to power failure or other emergency. These are licensed amateurs who have voluntarily registered their qualifications and equipment for communications duty in the public service when disaster strikes. More information is available on the Emergency Management portion of the Clallam County website.
- **Message Centers and Shelters:** Notification systems will provide information about the availability of shelters. However, some residents may not be equipped with functional phones or radios. Message Centers will be activated during an emergency event. The centers are physical sites that will have personnel or written messages about the availability of shelters and other assistance.
- Flood-related problems (e.g. active erosion or high water conditions) may be reported to the Emergency Management Center at (360) 565-2680 or 2681 when the center is activated. Life threatening conditions, emergency rescue requests, and medical emergencies should be reported to 911.

7.2.2 Procedures Following a Flood Warning and During a Flood: Once a flood watch has escalated into a warning, residents are advised to pay close attention to the weather updates and take additional steps including:

- Get emergency supplies ready for evacuation.
- Do not walk or drive through floodwaters. Even water that is 6 inches deep can sweep you off your feet. If you are outside, climb to higher ground and stay there.
- Unplug major appliances, computers, and other items that are potentially affected by a power surge.
- If instructed to do so by local authorities, turn off utilities at the main switch and close the main gas valve as directed.
- If you are instructed to evacuate, listen to a battery operated radio for instructions, and evacuate immediately. Follow recommended evacuation routes to avoid being marooned.

7.3 After a Flood

7.3.1 Staying safe: The Washington State Emergency Resource Guide at www.doh.wa.gov contains several reminders of actions to stay safe during flood events, and stresses the importance of avoiding walking or driving through floodwaters as this has been the cause of many flood-related deaths. Flooded homes should not be re-entered until emergency officials indicate that it is safe to enter and to turn utilities on.

7.3.2 Post-flood procedures

- Health and safety precautions during cleanup: Floodwaters contain many contaminants, and anyone coming into contact should wash hands frequently, and use gloves and boots while cleaning up. County and state health departments and their websites have information on discarding food and purifying water, reactivating septic systems, cleaning mold, and evaluating structural weaknesses.
- Inspecting, documenting, and reporting damage: The Clallam County Emergency Management Division will provide information on documenting flood damage following an event and may be reached at 417-2483, 417-2305 or 417-2525.

7.4 Tsunami Hazard Areas

Several shoreline areas near Sequim are considered tsunami hazard zones (see map). The Clallam County region is susceptible to both distance tsunamis, which occur out under the ocean, and nearby tsunamis which can be generated in the Cascadia subduction zone immediately offshore of Oregon and Washington. Although there may be three or more hours of advance warning of a tsunami generated by a distant source, a Cascadia subduction zone event may reduce response time to less than one hour. Residents who are located in a tsunami hazard zone should respond immediately to quakes, sudden drops in sea level, or emergency warnings. If you feel the ground shaking, drop and cover and then go immediately to higher ground. Other precautions for flood hazard areas are also relevant for tsunami hazard zones. Clallam County has planned the installation of a tsunami warning system near the mouth of the Dungeness River in the vicinity of Jamestown Road in 2010. When installed this system will broadcast and siren followed by an audible message warning of a tsunami.

Figure 7-1: Tsunami Hazard Zones in the Sequim-Dungeness area



7.5 Certification of Comprehensive Emergency Operations Plan

[Plan is required to include a letter from CTED or other designated state agency certifying the County EOP]



STATE OF WASHINGTON
MILITARY DEPARTMENT
EMERGENCY MANAGEMENT DIVISION
MS: TA-20 Building 20
Camp Murray, Washington 98430-5122
Phone: (253) 512-7000 • FAX: (253) 512-7200

October 27, 2004

Mr. Joe Ciarlo, Director
Clallam County Emergency Management
Post Office Box 863
Port Angeles, Washington 98362-0149

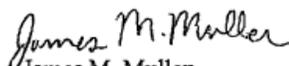
Dear Mr. Ciarlo:

Thank you for submitting the March 2004 *Clallam County Comprehensive Emergency Management Plan*. The plan is an exceptionally complete, well-presented document that is consistent with the *Washington State Comprehensive Emergency Management Plan* and meets the criteria of WAC 118-30-060 and the requirements of RCW 38.52.070. The Terrorism Annex meets the requirements of the FFY02 Supplemental Emergency Operations Plan (EOP) Grant.

To ensure that you remain eligible for the Emergency Management Performance Grant funding program, please submit your plan maintenance schedule each year in accordance with WAC 118-09-030. Additionally, you should update your plan every four years and submit it to the Emergency Management Division for review. For your consideration, we have enclosed comments that may help in the update of your next plan.

I congratulate you on completing this significant endeavor. My point of contact for emergency management plans is Dr. Terry Egan, (253) 512-7041.

Sincerely,


James M. Mullen
Director

JMM
Enclosure



8. GLOSSARY AND ACRONYMS

Acre foot: The volume of water that will cover an area of one acre to a depth of one foot. One acre-foot is equivalent to 325,851 gallons or 43,560 cubic feet.

Aggradation: Increase in the elevation of the river bed, relative to a previous height.

Avulsion: Movement of a river channel to a new location, either by creating a new channel or reoccupying an old channel or low area.

Berm: A natural or man-made embankment flanking a stream. A mound of earth or debris, used to deflect or hold back floodwater deflection.

Channel Meander Hazard Areas: *“Areas subject to the natural movement of stream channel meanders associated with alluvial plains where long-term processes of erosion and accretion of the channel can be expected to occur. Such meander hazards are characterized by abandoned channels, ongoing sediment deposition and erosion, topographic position, and changes in the plant community, age, structure and composition. These areas do not include areas protected from channel movement due to the existence of permanent levees or infrastructure improvements such as roads and bridges constructed and maintained by public agencies. These areas also do not include areas outside the meander hazard which may be subject to rapid movement of the entire stream channel or avulsion.” (Clallam County Critical Areas Code 27.12.410(1)(a)(x))* Channel Meander Hazard Areas are classified as Landslide Hazard Areas in the Critical Areas Code. The use of the term CMHA (rather than CMZ) in this document is generally associated with the Clallam County Critical Areas Code.

Channel Migration Zone (CMZ): *“The geographic area where a stream or river has been and will be susceptible to channel erosion and/or channel occupation.”* (Washington Department of Ecology, A Framework for Delineating Channel Migration Zones) Because river channels are rarely static over time, they naturally migrate within their valleys through erosion, flooding, and deposition. Channel migration is not limited to areas of flood inundation and can advance into landscape features above the 100-year flood water surface elevation. As used in this document, Channel Migration Zones and Channel Meander Hazard Areas are synonymous.

Critical Areas: Areas designated under the Critical Areas Code including: 1) wetlands; 2) aquatic and wildlife habitat conservation areas; 3) geologic hazard areas (including the Channel Meander Hazard Zone); 4) frequently flooded areas; and 5) critical aquifer recharge areas.

Cubic feet per second (cfs): A measure of flow; one cfs is approximately equal to 450 gallons per minute.

Degradation: 1) Decrease in the elevation of the river bed, relative to a previous height. 2) Loss of ecological functions or values for one or more species in terms of area, suitability (temperature, food production, structure), or persistence over time.

Dikes: See levees

Flood: Any relatively high flow that overtops the natural or man-made banks of a river. The FEMA definition of flooding is “a general and temporary condition of partial or complete inundation of normally dry land areas from the overflow of

Flood fringe: On a map of a 100-year floodplain, the portion that is outside of the floodway.

Floodplain: the relatively flat lowland that borders a river, usually dry but subject to flooding; an area susceptible to inundation. In the Clallam County CAO, this term is used synonymously with “Frequently Flooded Area.”

Floodway: The channel of a river or watercourse and the adjacent areas that must be kept free of encroachment in order to discharge the 100-year flood without cumulatively increasing the water surface elevation more than one foot.

100-year Flood: A flood magnitude with a one percent chance of being equaled or exceeded in any given year. Contrary to popular belief, it is not a flood occurring once every 100 years.

100-year Floodplain: The area adjoining a river, stream, or watercourse that is inundated in the event of a 100-year flood.

Levee: A levee is any artificial barrier together with appurtenant works that will divert or restrain the flow of a stream or other body of water for the purpose of protecting an area from inundation by flood waters. The terms dike and levee are used interchangeably in this document. Traditionally, levee referred to restraint of flood water from rivers and lakes while dikes referred to the restraint of tidally-influenced bodies of water.

LiDAR: Light Detection and Ranging; a remote sensing system used to collect topographic data using pulses of light that are beamed to the earth’s surface and measuring the time of the pulse return. This technology is being used by scientists to document topographic changes along the Dungeness River flood plain. The data are collected with aircraft-mounted lasers capable of recording elevation measurements with a vertical precision of 6 inches.

National Flood Insurance Program: Operated by the Federal Emergency Management Agency, the NFIP is a program that offers government-subsidized flood insurance to communities that have adopted ordinances restricting development in the floodway and regulating construction in the 100-year floodplain.

Ordinary High Water Mark (OHWM): A point along a streambank or riverbed where the presence and action of water are so common and usual, and so long continued in ordinary years, that the soil and vegetation is distinct from the abutting upland.

Reach: A section of river divided by designated landmarks.

Special Flood Hazard Areas: The floodway and adjoining land which is subject to a one percent or greater chance of flooding in any given year. Equivalent to the 100-year floodplain.

ACRONYMS:

ACOE	=	US Army Corps of Engineers (also referred to as “Army Corps”)
BOR	=	US Bureau of Reclamation
BPA	=	Bonneville Power Administration
CAO	=	Critical Areas Ordinance
CCC	=	Clallam County Code
CCD	=	Cline-Clallam-Dungeness irrigation group
cfs	=	cubic feet per second
CIDMP	=	Comprehensive Irrigation District Management Program
CMHA	=	Channel Meander Hazard Area
CMZ	=	Channel Migration Zone
DOH	=	Washington Department of Health
DRMT	=	Dungeness River Management Team
DRRWG	=	Dungeness River Restoration Work Group
EOC	=	Emergency Operations Center
FCAAP	=	Flood Control Assistance Account Program
FEMA	=	Federal Emergency Management Agency
GMA	=	Washington State Growth Management Act
HMP	=	Habitat Management Plan
JSKT	=	Jamestown S’Klallam Tribe
NFIP	=	National Flood Insurance Program
NMFS	=	National Marine Fisheries Service
NOAA	=	National Oceanic and Atmospheric Administration
NOLT	=	North Olympic Land Trust
OHWM	=	Ordinary High Water Mark
RCW	=	Revised Code of Washington
RM	=	River Mile (measured from the mouth)
SEPA	=	State Environmental Policy Act
SMA	=	Washington State Shoreline Management Act
SMP	=	Shoreline Master Program
USGS	=	United States Geological Survey
WAC	=	Washington Administrative Code
WDFW	=	Washington Department of Fish and Wildlife
WRIA	=	Water Resources Inventory Area

APPENDICES

- A. Plans and Studies in the Dungeness Watershed 1989-2008
- B. Description of Structural Flood Control Options
(Tetra-Tech 2003 Draft Dungeness River Flood Hazard Management Plan)
- C. Delineation of the Dungeness Channel Migration Zone
(Rot & Edens, 2008) (electronic)
- D. Recommended Land Protection Strategies for the Dungeness River Riparian Area
(Hals and Dungeness River Restoration Work Group, 2003) (electronic)
- E. State Environmental Policy Act (SEPA) Checklist
- F. Public Outreach & Newspaper Articles
- G. Public Hearing Process
- H. Clallam County Resolution for Plan Adoption & WA Department of Ecology Letter of Approval