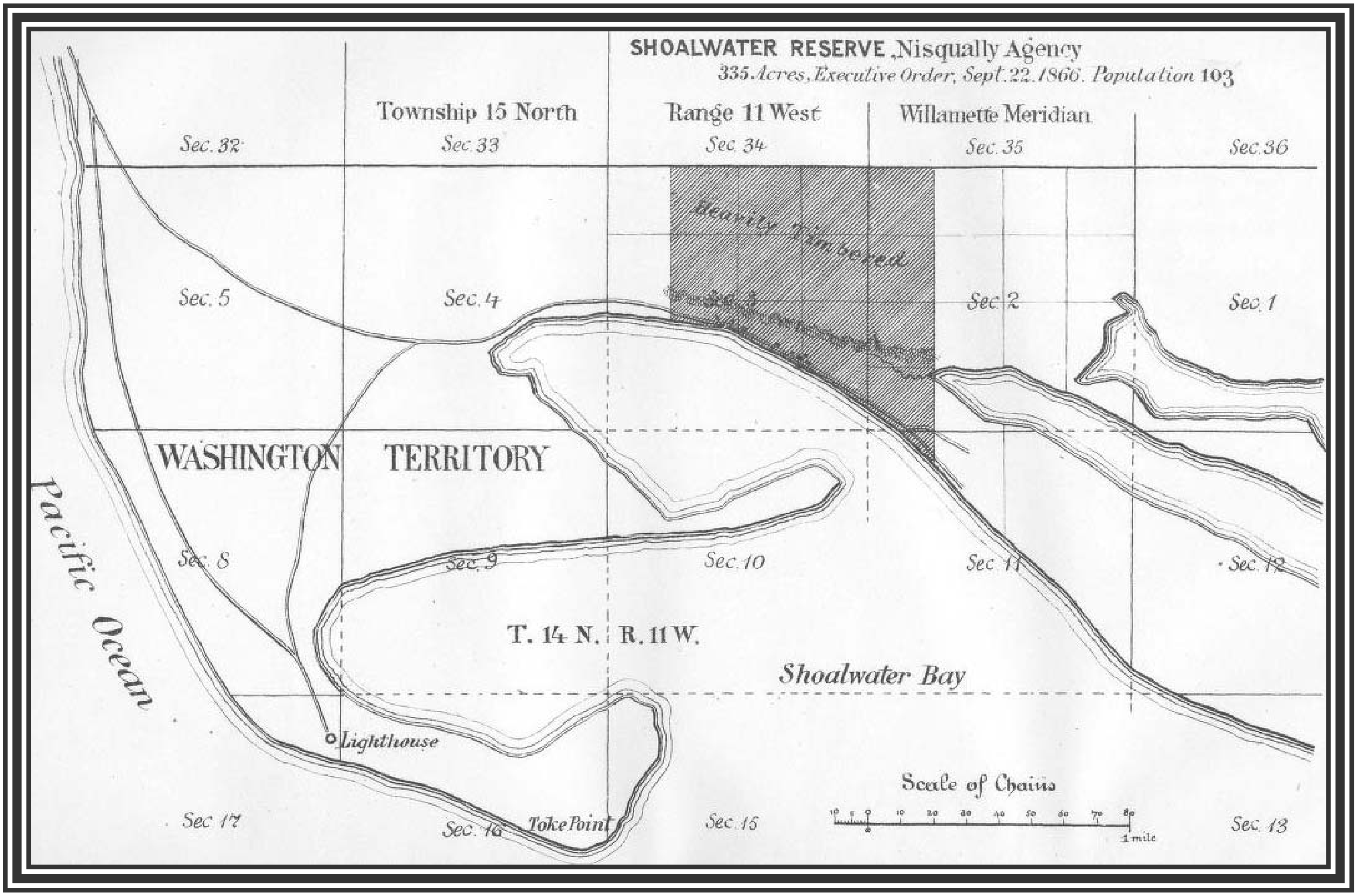
Shoalwater Bay

Indian Tribe

TRIBAL Hazard Mitigation Plan

Spring 2008



Shoalwater Reserve, Nisqually Agency, 1879
Courtesy of University of Washington Libraries

Shoalwater Bay Tribal Hazard Mitigation Plan

Prepared for
The Shoalwater Bay Indian Tribe

Funded by
Federal Emergency Management Agency
Pre-Disaster Mitigation Program
Application #: PDMC-10-WAIT003-2005
&
The Shoalwater Bay Indian Tribe

Prepared by
Shoalwater Bay Tribal Council
&
Shoalwater Bay Tribe Office of Emergency Management

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Spring 2008

Cover photo:
Shoalwater Bay Indian Reservation looking northeast from Graveyard Spit
By Glenn B. Coil, August 17th, 2007

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List of Acronyms

BFE	Base Flood Elevation
BMP	Best Management Practices
BNSF	Burlington Northern/Santa Fe Railroad
CEMP	Comprehensive Emergency Management Plan
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
DEM	Digital Elevation Model
DNR	Washington Department of Natural Resources
EMPG	Emergency Management Performance Grant
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GIS	Geographic Information Services
HIVA	Hazard Identification and Vulnerability Analysis
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
MM	Modified Mercalli Scale
NEHRP	National Earthquake Hazard Reduction Program
NFIP	National Flood Insurance Program
NIMS	National incident Management System
NOAA	National Oceanic & Atmospheric Administration
NWTEMC	Northwest Tribal Emergency Management Council
OEM	Office of Emergency Management
OFM	Washington State Office of Financial Management
PDM	Pre-Disaster Mitigation
PGA	Peak Ground Acceleration
PSCV	Puget Sound Convergence Zone
SFEIS	Supplemental Final Environmental Impact Statement

SFHA	Special Flood Hazard Area
SMPG	Shoreline Master Program Guidelines
TERO	Tribal Employment Rights Office
U&A	Usual and Accustom Fishing Areas
UBC	Uniform Building Code
URM	Unreinforced Masonry
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WA EMD	Washington Emergency Management Department
WRIA	Water Resource Inventory Area

1. Introduction

The purpose of this Shoalwater Bay Tribal-level Hazard Mitigation Plan (THMP) is to guide current and future efforts to effectively and efficiently mitigate natural hazards on the Shoalwater Bay Indian Reservation and other areas of Tribal interest. The plan will also guide mitigation and response to natural hazards that are generated off the Reservation or that cross the Reservation boundaries, in coordination with other agencies and jurisdictions as appropriate. This Shoalwater Bay Tribal HMP establishes goals, lists objectives necessary to achieve the goals, and identifies policies, tools, and actions that will help meet the objectives. These short- and long-term actions will reduce the potential for losses on the Reservation due to natural hazards.

In short, this plan is intended to help create a disaster-resistant community by reducing the threat of natural hazards to life, property, emergency response capabilities, economic stability, and infrastructure, while encouraging the protection and restoration of natural and cultural resources.

The natural hazards that have affected the Shoalwater Bay Indian Tribe in the past and will affect the Tribe in the future include earthquakes, tsunamis, coastal erosion, severe winter storms, coastal flooding and wildfires.

To protect the political integrity, economic security, health, and welfare of the Shoalwater Bay Indian Tribe, its members, and all persons present on the Reservation, it is important for the Tribe to minimize threats to public health and safety and damage to property from future hazard events. In developing a policy response, it is important to recognize that severe winter storms, coastal erosion, earthquakes and other such events are naturally occurring processes that will present occasional disruption to the lives of Reservation residents. Any policy must also recognize that many private and public structures and facilities have been constructed through time without regard to potential natural hazards. Fortunately, many things can be done to reduce future risk and loss through on-the-ground structural and non-structural projects as well as regulatory actions.

This THMP is one such action to reduce future risk and losses since it evaluates risks and identifies mitigation actions and also will qualify the Shoalwater Bay Indian Tribe for funding under the Pre-Disaster Mitigation Program (PDM) that is administered by the Federal Emergency Management Agency (FEMA). This program provides funding for hazard mitigation planning and for mitigation projects that are implemented before a disaster. This plan may also help the Shoalwater Bay Indian Tribe acquire funding under other programs, including the following:

- **Hazard Mitigation Grant Program (HMGP)**, which provides post-disaster funds for hazard reduction projects (e.g., elevation, relocation, or buyout of structures),

- **Flood Control Assistance Account Program**, which provides funds for developing flood hazard management plans, for flood damage reduction projects and studies, and for emergency flood-related projects (e.g., repair of levees); administered by the Washington State Department of Ecology (Ecology);

- **Flood Mitigation Assistance Program**, which provides funds for flood mitigation on buildings that carry flood insurance and have been damaged by floods, administered by FEMA;

- **Repetitive Flood Claims Program,** which provides funds to reduce damages, primarily through acquisition and demolition or relocation, to insured properties that have had one or more claims to the National Flood Insurance Program (NFIP);

- **Severe Repetitive Loss Program,** which provides funds to reduce or eliminate the long-term risk of flood damage to severe repetitive loss (SRL) structures under the NFIP. SRL structures are residential properties that:
    - Have at least four NFIP claim payments over $5,000 each, when at least two such claims have occurred within any ten-year period, and the cumulative amount of such claims payments exceeds $20,000; or
    - For which at least two separate claims payments have been made with the cumulative amount of the building portion of such claims exceeding the value of the property, when two such claims have occurred within any ten-year period; and

- **Emergency Management Preparedness Assistance Grant Program (EMPAG),** which provides funds to local and tribal governments, regional agencies, regional incident management teams, and private organizations to enhance statewide emergency preparedness through short term, high impact, projects. Administered by WEMD.

With this eligibility for grant programs, there is an opportunity to look to the future and work cooperatively and creatively to mitigate future damages and threats to public health and safety. This Tribal Hazard Mitigation Plan addresses the primary natural hazards that threaten the Reservation. Although many of the specific recommendations in the plan are directed at the Reservation, many will be most effective if implemented on a regional basis. It is therefore intended that this plan provides solutions that other local jurisdictions can use and benefit from and that can be cooperatively implemented.

Purpose/Goals

The goals and objectives of the Shoalwater Bay Tribal HMP are to:

1. Protect people, property and the natural environment
    - Regulate and/or Purchase hazard-prone areas for conservation and risk reduction
    - Retrofit and/or Relocate structures located in high-risk hazard areas
    - Reduce human-caused Coastal Erosion and its effects
2. Ensure continuity of critical economic and public facilities and infrastructure
    - Support redundancy of critical government functions
    - Retrofit or build to highest standards, critical facilities and infrastructure
3. Promote and protect Tribal sovereignty and identity
    - Protect culturally and historically significant Tribal sites, places and materials
    - Increase mitigation and emergency management capabilities for the Shoalwater Bay Indian Tribe
    - Enable the Shoalwater Bay Tribe to be self-sufficient for at least 14 days after a disaster
4. Increase public awareness of natural hazards and involvement in hazards planning
    - Encourage organizations, businesses, and local governmental agencies within the North Cove/ Tokeland area community to develop partnerships
    - Implement hazard awareness, preparedness and reduction programs

This THMP provides detailed recommendations and an action plan designed to meet each objective and, ultimately, the goals of the plan.

The Shoalwater Bay Tribal HMP is divided into seven sections plus appendices:

- Section 1 is this introduction.
- Section 2 describes how the THMP was prepared.
- Section 3 describes the land use, socioeconomic conditions, and physical characteristics of the Shoalwater Bay Indian Reservation and surrounding area.
- Section 4 presents an assessment of hazard risks on the Reservation and surrounding area.
- Section 5 presents the Shoalwater Bay Tribe’s mitigation strategy.
- Section 6 describes the THMP maintenance process.

The references cited in this plan are footnoted and any additional references are listed in Section 7.

Adoption

The Shoalwater Bay Tribal Hazard Mitigation Plan was formally adopted by the Shoalwater Bay Tribal Council on June 11th, 2008 as Resolution # 06-11-08-17.

The Resolution adopting the plan can be found in Appendix A

Assurances

The Shoalwater Bay Indian Tribe assures that it will continue to comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, in compliance with 44 CFR 13.11(c). The Tribe will amend its plan whenever necessary to reflect changes in Tribal or Federal laws and statutes as required in 44 CFR 13.11(d).

2. Planning Process

This section will discuss the planning process used to develop the Shoalwater Bay Tribal Hazard Mitigation Plan.

The planning process is an extremely important aspect in the development of a hazard mitigation plan. It is crucial for the success of the plan to have the public ask questions and comment on the plan. In addition, by involving the public in the planning process, it increases the public's awareness of the hazards affecting the Shoalwater Bay Reservation and informs them about the importance of hazard mitigation planning. Having public involvement in the planning process also allows the plan to reflect the public's views and opinions. The Shoalwater Bay Tribe defines "public" as its Tribal Membership, Tribal Government and employees, the surrounding local communities and districts as well as County, State and Federal agencies and relevant non-government organizations. The Tribe maintains final authority on decision making related to this Plan.

The following sections will detail who was responsible for developing and producing the plan, and other associated activities such as coordinating the planning process; a listing of participating departments and agencies; and a timeline of the plan development process, dating back to 2005 and ending with the adoption of the Tribal HMP by the Shoalwater Bay Tribal Council.

To the best extent possible, this planning process was integrated into other Tribal planning processes and FEMA programs and initiatives. These include the Shoalwater Bay Tribe's emergency response planning and training and the Hazard Mitigation Grant Program as well as the Public Assistance Program related to DR-1734.

2.1. Preparation of the Plan

In order to comply with the Disaster Mitigation Act of 2000 and be eligible for federal grant funding, the Shoalwater Bay Indian Tribe, with the Natural Resources Department as lead, submitted a Pre-Disaster Mitigation planning grant application to the Federal Emergency Management Agency (FEMA) in March 2005 in order to develop a Tribal-level Hazard Mitigation Plan for the Tribe. This grant was awarded in the Fall of 2005 as PDMC-10-WAIT003-2005. Throughout 2006, the Natural Resources Dept worked on the Risk Assessment part of the Plan, as well as submitted progress reports the Emergency Management Planning Committee (which was tasked with overseeing completion of the Plan). It was decided in early 2007 that a consultant with previous planning experience in developing Tribal Hazard Mitigations Plans would be contracted to assist with the planning process and facilitate completion of the plan, including approval by FEMA. During the summer of 2007, the Shoalwater Bay Tribal resolved to hire Glenn B. Coil, an environmental planning consultant with experience in tribal hazard mitigation plans, to complete the Plan for the Tribe. It was agreed that the Plan would be completed and approved by FEMA by about the Spring of 2008.

During a community meeting in mid-January 2008 as part of the Planning Process, a first draft was submitted to the Tribe. In April of 2008 , a second draft was submitted for tribal review and FEMA pre-approval.

The 2008 Shoalwater Bay Tribal Hazard Mitigation Plan was approved and adopted by the Shoalwater Bay Tribal Council as **Resolution 06-11-08-17** on June 11th, 2008. More detail on the planning process is shown in the timeline in Section 2.3.

2.2. Plan Participants

Every effort was made to include all of the Shoalwater Bay Tribe's departments, employees, tribal members and residents of the Reservation as well as the local community in the planning process. Community meetings were set-up as well as meeting individually with Tribal departments and staff as was necessary. Surveys were prepared to allow individual feedback. It should be noted that the Shoalwater Bay Indian Tribe is very small, and many of the tribal members who live on the Reservation also work for the Tribe.

Some of the participating departments and groups include:

Shoalwater Bay Tribal Council
Shoalwater Bay Office of Emergency Management
Tribal Casino
Shoalwater Bay Office of Legal Counsel
Shoalwater Bay Natural Resources Department
Shoalwater Bay Housing Department
Shoalwater Bay Health and Human Services Department
Shoalwater Bay Education Department
Shoalwater Bay Tribal Library

Other agencies involved include the Federal Emergency Management Agency (FEMA), the Indian Health Service, the Army Corps of Engineers, WA State Emergency Mgmt. Division, Pacific County, Pacific County Emergency Management, the Town of Tokeland, the Community of North Cove, and Pacific County Fire District #5.

2.3. Literature Review

Washington State and the Puget Sound region's tribes, counties and local communities are among the leaders nationally in emergency management planning. This includes the development of risk assessments and mitigation plans at the local and tribal level. A wealth of readily available hazards knowledge and information was reviewed and referenced for the development of this plan.

The purpose of the literature review is to synthesize and tailor this collective knowledge to the specific Shoalwater Bay Indian community. In turn, this plan will fit into an integrated and regional approach to disaster planning that leverages the capabilities of all the tribal, state and local partners. The plans and documents reviewed include:

Federal

Army Corps of Engineers EIS

http://www.nws.usace.army.mil/ers/reposit/ShoalwaterBAy%20EA%20draft.pdf

State

Washington State Hazard Identification & Vulnerability Assessment

http://emd.wa.gov/plans/documents/hazard_identification_vulnerability_analysis.doc

Washington State Hazard Mitigation Plan

http://emd.wa.gov/plans/washington_state_hazard_mitigation_plan.shtml

Local

Grays Harbor County Natural Hazards Mitigation Plan

http://www.co.grays-harbor.wa.us/info/DEM/HazMitPlan/documents.htm

Pacific County Hazard Identification & Vulnerability Assessment

www.aasa.dshs.wa.gov/professional/EmergencyPlanning/documents/Pacific%20County%20HIVA.doc

Wahkiakum County Hazard Identification & Vulnerability Assessment

www.adsa.dshs.wa.gov/professional/EmergencyPlanning/documents/Wahkiakum%20County%20HIVA.doc

Tribal

Shoalwater Bay tribal Hazard Inventory and Vulnerability Assessment

Sauk-Suiattle Tribal Hazard Mitigation Plan

http://www.nwtemc.org/documents/Sauk_HMP/sauk_suiattle_thmp_FINAL_2.29.08.pdf

Swinomish Tribe Annex, Skagit Hazard Mitigation Plan

http://www.skagitcounty.net/Common/Asp/Default.asp?d=EmergencyManagement&c=General&p=2003NHMPFinaltoc.htm

Upper Skagit Tribe Annex, Skagit County Hazard Mitigation Plan

http://www.skagitcounty.net/Common/Asp/Default.asp?d=EmergencyManagement&c=General&p=2003NHMPFinaltoc.htm

Tulalip Tribes Hazard Mitigation Plan

http://www.tulaliptribes-nsn.gov/department/emergency_management/index.asp

Quil Ceda Village local Hazard Mitigation Plan (in development)

Lummi Nation Hazards Mitigation Plan

Puyallup Tribe Natural Hazard Mitigation Plan

http://www.co.pierce.wa.us/pc/abtus/ourorg/dem/EMDiv/MitPTIP.htm

2.4. Plan Preparation Timeline

This section documents how the plan was developed and who was involved in the effort, dating back to 2005. Dates shown are the occurrence of key events and meetings relating to the plan and the planning process.

March 2005
FEMA PDM grant submitted

Fall 2005
FEMA Grant PDMC-10-WAIT003-2005 awarded to the Shoalwater Bay Tribe to develop a Tribal Hazard Mitigation Plan

February 2, 2006
Emergency Mgt Council Meeting

May 4, 2006
Emergency Mgt Council Meeting

June 1, 2006
Emergency Mgt Council Meeting

July 6, 2006
Emergency Mgt Council Meeting

August 3, 2006
Emergency Mgt Council Meeting

October 19, 2006
Emergency Mgt Council Meeting

November 9, 2006
Emergency Mgt Council Meeting

December 7, 2006
Emergency Mgt Council Meeting

August 21, 2007
Community Meeting, hosted by Emergency Management Planning Committee. At this meeting, the Plan was discussed and the Consultant hired to finish the plan was introduced. Surveys that were mailed out previously were submitted and the Consultant was on hand to answer any questions about the survey and to help community and committee members answer it.

In order to get wide participation, a raffle was held for those submitting surveys and attending the meeting. Prizes were items and supplies useful for Emergency Preparedness and response, such as flashlights, NOAA radios, first aid kits etc.

September 6, 2007
Emergency Mgt Council Meeting

October 4, 2007
Emergency Mgt Council Meeting
November 1, 2007
Emergency Mgt Council Meeting

January 18th, 2008
Second community meeting held which included members and partners outside of the Tribal community.

The meeting had three purposes:

1) for FEMA officials to explain and clarify planning process related to applying for grant monies for DR-1734 and how it relates to the hazard mitigation Plan

2) allow Emergency Management Office and consultant to present early draft of plan including draft Goals and Objectives and Mitigation Actions.

3) present draft Mitigation Actions to the Tribal government and membership, the local community and agencies, FEMA and the State EMD for discussion and preliminary prioritization. Pacific County Fire District #5 suggested mitigation actions which were included into the plan.

February 14th, 2008
Emergency Management Council meeting to approve and prioritize mitigation actions.

April 2008: Final Draft submitted to Sholawater Bay Tribe for review and adoption. Plan submitted to FEMA for pre-approval.

May 1st, 2008: Emergency Management Council meeting for plan presentation and final comments. It was decided to distribute the plan electronically to Tribal community for final review and comments prior to Board Adoption.

June 11th, 2008: Final presentation to Tribal Council. Plan adopted by Shoalwater Bay Tribal Council as **Resolution 06-11-08-17**. Re submitted to FEMA for Final approval.

3. Community Profile

The Shoalwater Bay Tribal Hazard Mitigation Plan covers all the people, property, infrastructure and natural environment within the exterior boundaries of the Shoalwater Bay Reservation as well as any property owned by the Shoalwater Bay Indian Tribe outside of this area. Furthermore the Plan covers any other sacred, ancestral or historic sites and areas of the Tribe's interest. This planning scope does not limit in any way the Shoalwater Bay Indian Tribe's hazard mitigation and emergency management planning concerns or influence nor its sovereignty as a Tribal Nation.

This section will provide detailed information on the history, geography, climate, land use, population and economy of the Shoalwater Bay Indian Tribe and its Reservation. An understanding of these characteristics is essential to understanding and mitigating natural and human-caused hazards.

A few quick facts about the Shoalwater Bay Indian Tribe and Reservation:

- Reservation established 1866
- Reservation located at 46°43'20" North latitude and -124°01'13" West longitude
- Address: 2373 Old Tokeland Rd. Tokeland, WA 98590
- Reservation Land Area: approx. 1 sq. mile, 440 acres of uplands and 700 acres of marine salt marsh and tidal flat habitats
- Tribal enrollment of 311 people, including about 110 who live on Reservation

3.1. Geography

The Shoalwater Reservation is located on the north shore of Willapa Bay in Pacific County, Washington. At one-mile square, the reservation is relatively small, with 2/3 lying at or below the intertidal zone. The Shoalwater Reservation is mostly in a flat area along the shore, with lands extending north toward a Pleistocene rock ridge, which generally runs east to west, and comes within 200 feet of the shore at Washaway Beach.

Washington SR 105 runs east west though the Shoalwater Reservation, with Toke Point Road running southeast off SR 105. Within the tidal portion of the Shoalwater Reservation (behind Graveyard Spit and including parts of North Cove) there are small bays, and extensive intertidal marsh communities. The marsh is a mix of native plants and invasive smooth cordgrass (*Spartina alterniflora*). None of the marsh adjacent to and within the reservation is listed by the Washington Department of Natural Resources as high quality natural heritage wetland.

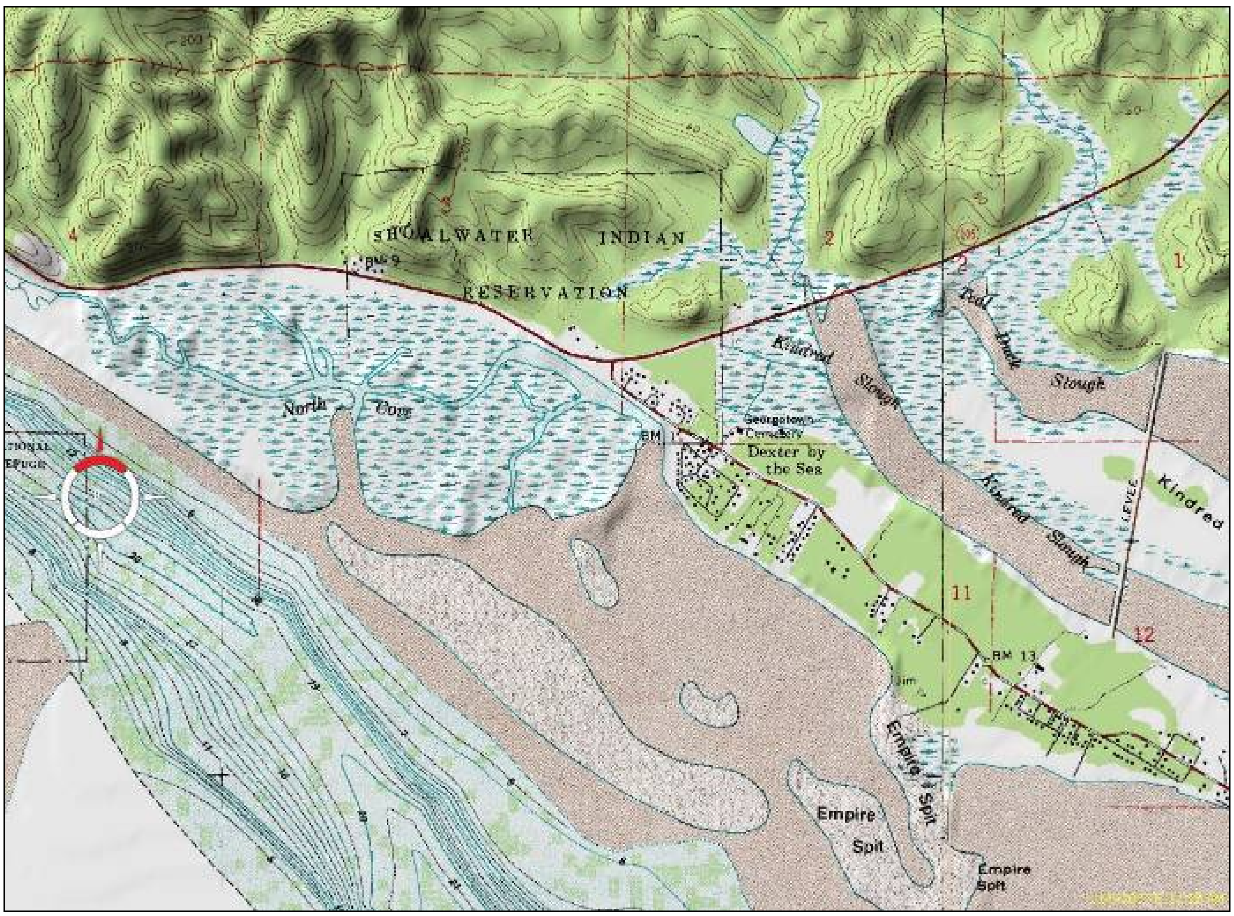
Figure 3-1: Location of Shoalwater Bay Indian Reservation

Today, the Shoalwater Reservation is slightly greater than one-square mile in area and consists of 440 acres of uplands and 700 acres of marine salt marsh and tidal flat habitats. The original Reservation encompassed only 335 acres of uplands. In January 1977, the Office of the Solicitor, U.S. Department of the Interior, issued a favorable Opinion declaring that the Shoalwater Reservation includes the tidelands to the south of the Reservation within its present east and west boundaries and that the southern boundary of the Reservation is located at the low water mark of the bay. The 1977 Opinion reversed a 1962 Opinion of the Regional Solicitor in Portland, Oregon to the contrary. The new Opinion resulted in adding some 700 acres to the Reservation, and made it possible for the Shoalwater Tribe to pursue aqua-culture projects as part of their overall economic development strategy. In recent years, the

Tribe has acquired an additional 105 acres of uplands which are to be held in trust, thus increasing the size of their tribal uplands to approximately 440 acres.

The uplands portion of the Reservation is primarily a steep cliff along the northeast edge of the Reservation boundary, with only a narrow strip of developable land extending along the shoreline. State Route 105 traverses this narrow strip of land, parallel to the shoreline and below the cliff. Due to the topography of the narrow strip of tribal uplands, virtually all tribal development is at very serious and increasing risk of coastal flooding and shoreline erosion associated with extreme high tide storm events. If this problem is not solved soon, the Tribe risks increasing levels of storm-related erosion and flooding, and will be forced to relocate entirely.

Figure 3-2: USGS Topographic Map of Reservation Area



Vegetation

Marsh plants dominate the intertidal areas of North Cove. Species present include beach grass, sedges, rushes, Salicornia sp., and Spartina alternaflora. Upland areas are composed of coastal woodlands and residential ornamental plants and grasses.

Soils

The area along the shore of northern Willapa Bay which contains the Shoalwater Reservation is classified generally as Ocosta Soils (NRCS, 2000). Three soil types dominate: Newskah Loam, Ocosta Silty Clay Loam, and Westport Fine Sand. The adjacent Dexter-By-the-Sea community is underlain with Yaquina loamy fine sand. Graveyard Spit has been described as Dunelands and Fluvaquents, with Ocosta Silty Clay Loam and Westport Fine Sands in the North Cove area.

Geology

Southwest Washington, the Willapa Region: The Geologic Story[1]:

The present unique geomorphology (land form) of the Willapa area is the result of the interaction of geologic processes over a vast amount of time. In general, the earths crustal movements (tectonic processes) and the erosional and depositional modifications by water (fluvial processes) play the major roles. Southwest Washington provides dramatic observable evidence of these geological events which are made even more interesting by their duration and magnitude.

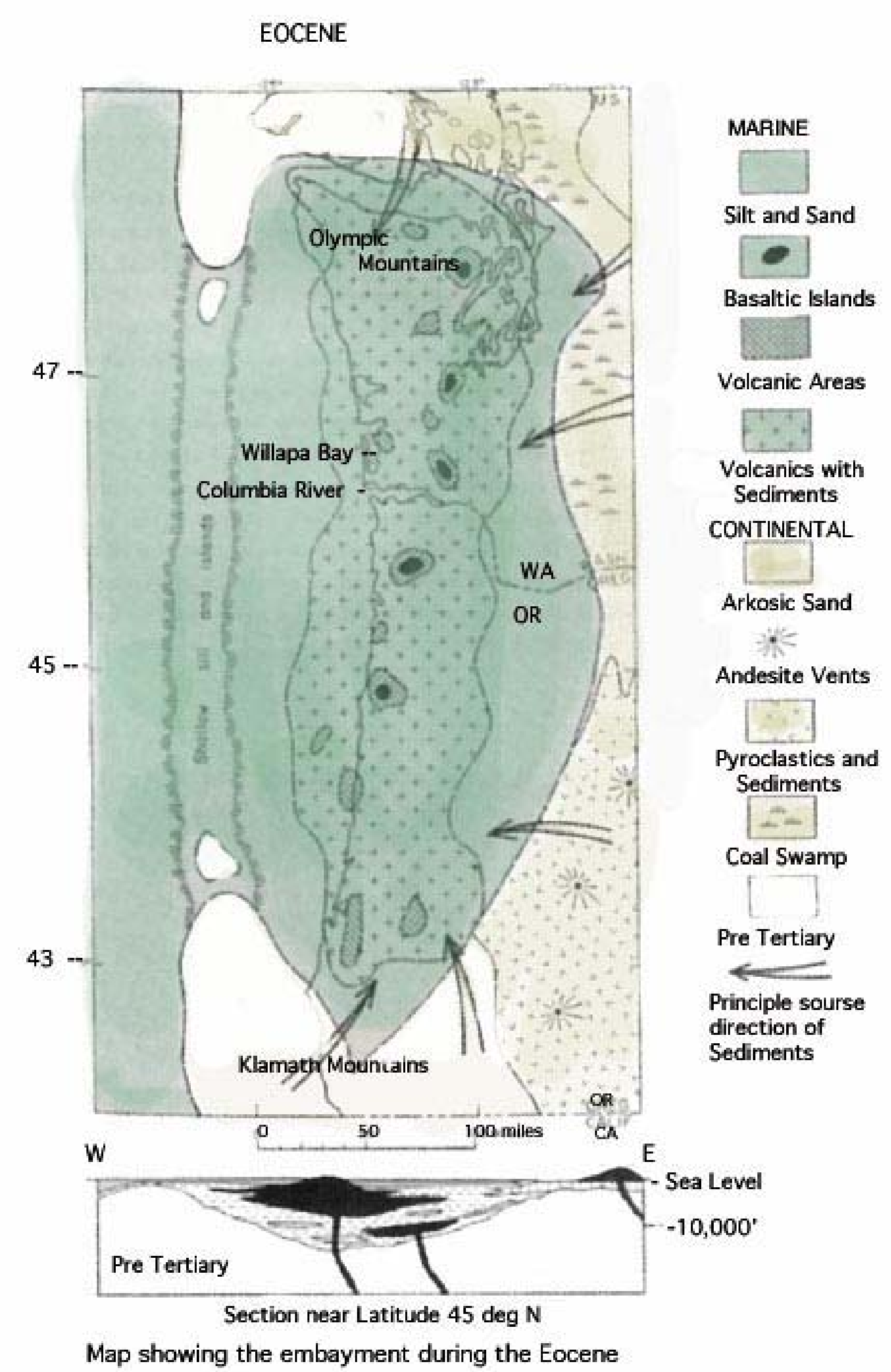
We would need to start back in time about 50 million years to observe the geological events where portions of our present day land forms had their origin. This was called the Eocene Epoch which was part of the Tertiary period. At this time, around 50 million years ago, the landscape would hold no resemblance to the present. Instead of standing in the temperate forest of the Willapa Hills, far above sea level you are, if lucky, on a low tropical volcanic island surrounded by a warm shallow sea. A marine embayment during the Eocene time with an areal extent ranging from the present day Kalamath Mts. (Lat. 43 deg.) north to Vancouver Island. The east margin of this marine basin varied over the next 30 or so million years but generally was located inland where the western slopes of the present day Cascades are located. There were no Cascade mountains at this time. This marine embayment was a large subsiding (sinking) basin called a geosyncline in which volcanic materials, sediments and often mixtures of both were being deposited. As the crust was drawn down it would fracture thus allowing igneous materials to intrude into the sediments. If we had been able to fly over what will be western Washington about where Interstate 5 now runs we would see vast flat lying coal swamps (centered around Centralia) which extended north into Canada (previous geologic map). These marked the eastern margin along the marine embayment. Further east a low lying tropical landscape would be observed. The recently reported banana fossil and other tropical plants from the Clarno area in north central Oregon date back 43 million years. Also from this same time period fossils of many other unfamiliar mammals such as

[1] http://www.willapahillsaudubon.org/earthhistory.html

Brontotheres and small dog sized horses (Orohippus) with four toes have been recovered.

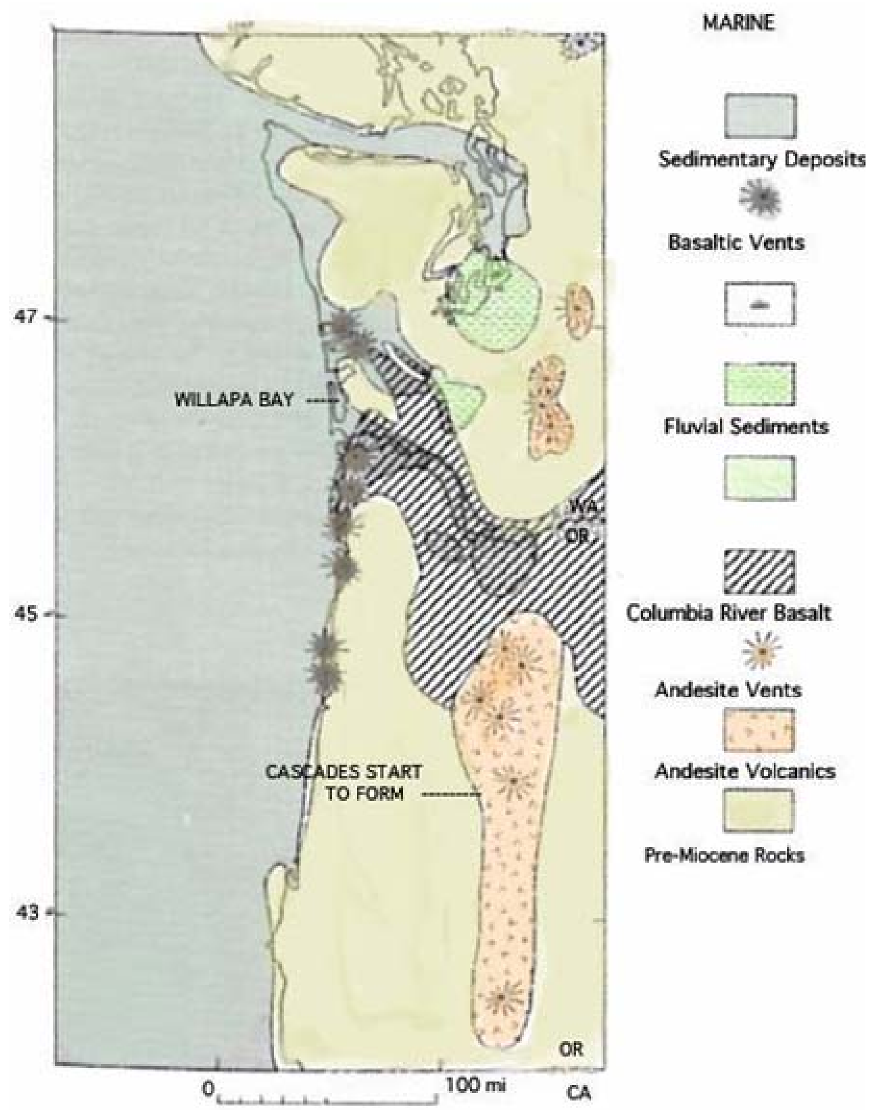
The subsidence of this marine embayment would continue for over 30 million years and in areas of maximum crustal down warping (future site of the present coastal range in Oregon and Willapa Hills) over 20,000 feet of deposits would accumulate below the ocean water level. Moving ahead in time to the Miocene epoch when the widespread deposits of the flood basalts in the Columbia River downwarp spread south into the Willamette Valley and North toward Grays Harbor. These can be can be seen very well in the Columbia River canyon. They covered hundreds of square miles over eastern Washington and Oregon. It is known as the Columbia River Basalt.

Figure 3-3: Willapa Bay during Eocene Times[2]



[2] http://www.willapahillsaudubon.org/embay.html, Map modified from: Snavely, Parke D., Jr. and Holly C. Wagner. 1963. *Tertiary Geologic History of Western Oregon and Washington*, Rept. of Investig. No. 22. Div. of Mines and Geology, Dept of Conservation, State of Washington. pp 1-25.

Figure 3-4: Western WA and OR during the Miocene[3]



Paleogeographic Map of western Washington and Oregon during the Miocene time.

Around 6 million years ago the subsidence stopped and uplift began. As these older deposits lifted above sea level they were constantly eroded down thus exposing older and older rocks over time. This process continues at present. The older rocks which were being deposited during the Eocene (50-40 million years ago) and buried ten to twenty thousand feet below sea level during the next 30 or so million years, are now exposed at various places throughout the Willapa Hills. For example, the upper forks of the Palix River carves through this age rock, Cape Disappointment is a

[3] Ibid.

large remnant and if you miss the turn traveling north at the end of the Astoria (Megler) bridge you would be in direct contact with these Eocene rocks.

As this uplift was in progress the ocean was also shaping the ancient coastline from these older rock formations. The next major event that would contribute to the land forms of the present was the late stage of the ice age (termed the Pleistocene which started 1.5 million years ago). Although our area did not experience direct glacial effects the secondary results of the sea level fluctuation are obvious today. The large continental glaciers, often over a mile thick, would advance and retreat by flowing from central and eastern Canada to the mid portion of the United States. Fluctuations in the glacial volumes caused the sea level to vary widely, often by as much as 300 feet above and below the sea level today. Many geological deposits during the later stages of the Pleistocene remain obvious around Willapa Bay today.

During the last 200,000 years of the Pleistocene at least three major sea level rises and corresponding lowering (relative to the present elevation) occurred. Evidence suggests these fluctuations would have been 40 feet above and below the level today. Sediments were being deposited, as they are today in Willapa Bay and as the sea level lowered (or the land raises) they would be left perched on the older rocks. Today the remnants of those marine and fresh water sedimentary deposits (terraces) are obvious features around Willapa Bay. They lap onto the older uplifted and eroded rocks which form the Willapa Hills and basically make up the eastern margin of the bay. For example, Long Island, Lynn Point, Bay Center, and Wilson Point are comprised of these deposits. The nearly horizontal terrace deposits often contain fossil layers such as the one at Goose Point in Bay Center (which has been dated at around 120,000 years old).

The various processes thus far still did not form the Willapa estuary that we see today. What was necessary was the formation of the Long Beach peninsula. This structure was the result of sand, much of which was carried to the ocean margin by the Columbia River. As the energy of this large river is decreased at its mouth some sediment transport is taken over by ocean wave (long shore) currents and transported mainly northward along the shore. The beach is like a river of sand. As a wind driven wave strikes the beach at a southerly angle the sand grains are driven to the north east. When the wave recedes gravity moves the water and sand directly down the beach slope but there has been a net movement north along the beach. These deposits that form the Long Beach peninsula remain in place because of the hard older (Eocene) rock on the north side of the Columbia River near the mouth including Cape Disappointment. This flow of sand is also interrupted when rivers draining the Willapa watershed combine to breach the sand barrier and thus form, in our case, the entrance to Willapa Bay. This interplay of flowing sand and tidal flows results in the ever changing patterns and channel characteristics at the Willapa Bay mouth.

Today the geological processes continue. The deposition of eroded materials (sand, silt and clay) from the Willapa watershed form the characteristic productive mud flats which floor Willapa Bay. These remain as deposits because of the protection from strong ocean waves and currents by the Long Beach peninsula. We can observe a brief episode in the geologic process. Willapa Bay is a very transitory occurrence in terms of geologic time and most likely would never be duplicated. The interplay of geologic forces will largely determine what form the land will take in the future. However, it is our privilege to coincide in time and space (geography) to this unique dynamic natural occurrence.

Land Use

The steep topography of a significant portion of tribal uplands severely limits the land upon which tribal facilities and housing can be built. Developable land is relatively low-lying and immediately adjacent to the shoreline. Well-maintained tribal facilities and housing have been constructed by the Shoalwater Tribe on this narrow strip of shoreline, to support the growing needs of the tribal community. The Tribe has made significant investments in infrastructure and public facilities to serve the needs of current and future generations of tribal members. Despite its very small land base, the Tribe has a modern Tribal Center, a Wellness Center which opened in 2005 (tribal health clinic and programs, dental services, massage therapy, and office space for a doctor and nurse), a Learning Resources Center which opened in 2003 (library, education administrative offices, computer lab, and activity room), and a gymnasium which opening in 2002. The Shoalwater Tribe has one business enterprise, a small casino. The tribal cemetery is located across the road from the Tribal Center. The U.S. Post Office branch which serves the Reservation and the adjacent non-Indian community is located nearby. Modern housing has been constructed, and streets, walkways and parking areas have been improved. Tribal facilities are open to, and extensively utilized by, non-Indian residents of the adjacent Dexter community and other Tokeland Peninsula residents. There is a strong sense of community between the Shoalwater Tribe and their Pacific County neighbors.

Future development trends

The Shoalwater Bay Indian Tribe is currently building 15 new homes. Three are part of an existing development and the other 12 are part of a new development in Tokeland. In order to mitigate potential flooding damage, all the new homes will be built 3-4 feet above Base Flood Elevation (BSE).

A tsunami evacuation road has been built along the top of the ridge at the north end of the Reservation as well as an alternative tsunami evacuation area on the hill near the Natural Resources offices. Future plans include improving the road and adjacent areas to meet emergency shelter and operational needs.

3.2. Climate

Average water temperature of the Pacific Ocean adjacent to Willapa Bay is 48° to 58°F, and water temperature in the Bay is likely similar to and influenced by ocean exchange. Average temperature ranges from 34.9° to 72.4 °F, and there is an annual total average of 86.9 inches of precipitation[4]

3.3. Tribal History

The Shoalwater Reservation was established by Executive Order of President Andrew Johnson on September 22, 1866. Note that the State of Washington was not admitted into the Union until 1889, whereas the Shoalwater Reservation was established in 1866. The complete text of the Executive Order reads as follows:

Shoalwater Reserve

[In Puyallup Agency; area, one-half square mile; occupied by Shoalwater and Chehalis.]

Executive Mansion, *September 22, 1866.*

Let the tract of land as indicated on the within diagram be reserved from sale and set apart for Indian purposes, as recommended by the Secretary of the Interior in his letter of the 18th instant, said tract embracing portions of sections 2 and 3 in township 14 north, range 11 west, Washington Territory.

Andrew Johnson.

It was not until 1971 that the Shoalwater Tribe became federally recognized. The Shoalwater Tribe rejected the Indian Reorganization Act in 1934, but their descendents gained Federal recognition on March 10, 1971. Shortly thereafter, the tribe adopted a constitution and elected a tribal council. In 1999, they became a self-governance tribe. A five-member elected Tribal Council governs the Tribe. All land is tribally owned; there have been no individual allotments of reservation land to tribal members.

Shoalwater Tribe members are the offspring of peoples who inhabited the Willapa Bay and Grays Harbor areas (Note that at the turn of the 20th century, what is now called Willapa Bay was known as Shoalwater Bay). Those peoples subsisted on fish, clams, oysters and sea animals since time immemorial. After the Shoalwater Reservation was established in 1866, the non-treaty Indians of Shoalwater Bay continued to make their living by fishing, crabbing and oystering, selling their surplus to canneries much the same as non-Indians. Today's tribal members consist of persons (and their descendents) whose names appeared on the official eligible voters list which was prepared for the purpose of the Indian Reorganization Act.

[4] NRCS, 2000

Leslie Sapir[5] cites Curtis[6] in stating that the villages on the north side of Willapa Bay were Salish or Shoalwater Salish, and included: Hlímŭmi near North Cove, Mónĭlŭmsh at Georgetown, and Númoïĥa'nhl at Tokeland. Verne Ray[7] lists village Number 30 as: **na· 'mst'cat's** which was located between Tokeland and North Cove and was a village occupied principally during the winter and that at that time (in 1938) it was called Georgetown. Hajda [8] places the Reservation within the traditional territory of the Lower Chehalis, a subdivision of the Southwestern Coast Salish speaking people. Hajda states that in the early 1830s, a malaria epidemic (as cited by Boyd[9]) devastated the Lower Columbia River and adjacent area populations and resulted in changes of group compositions. The surviving Chinook and Lower Chehalis in Willapa Bay became a bilingual population (as cited by Swan[10]) that were known as Shoalwater Bay Indians. The Lower Chinook were eventually totally replaced by Lower Chehalis (as cited by Ray[11]). A small reservation was established in 1866 for the Lower Chehalis, Chinooks, and others living in the area that came to be called the Georgetown Reservation and then later the Shoalwater Bay Indian Reservation.

Today, the Shoalwater Reservation is slightly greater than one-square mile in area and consists of 440 acres of uplands and 700 acres of marine salt marsh and tidal flat habitats. The original Reservation encompassed only 335 acres of uplands. In January 1977, the Office of the Solicitor, U.S. Department of the Interior, issued a favorable Opinion declaring that the Shoalwater Reservation includes the tidelands to the south of the Reservation within its present east and west boundaries and that the southern boundary of the Reservation is located at the low water mark of the bay. The 1977 Opinion reversed a 1962 Opinion of the Regional Solicitor in Portland, Oregon to the contrary. The new Opinion resulted in adding some 700 acres to the Reservation, and made it possible for the Shoalwater Tribe to pursue aqua-culture projects as part of their overall economic development strategy. In recent years, the Tribe has acquired an additional 105 acres of uplands which are to be held in trust, thus increasing the size of their tribal uplands to approximately 440 acres.

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[5] Leslie Spier, "Tribal Distribution in Washington," General Series in Anthropology 3 (Menasha, Wisconsin, 1936), 30.
[6] Edward S. Curtis, The North American Indian, ed. Frederic W. Hodge, Volume IX (Norwood, MA : Plimpton Press, 1930), 6-7, 173. Reprinted: New York: Johnson Reprint, 1970.
[7] Verne F. Ray, Lower Chinook Ethnographic Notes (Seattle: University of Washington, 1938), 41.
[8] Yvonne P. Hajda, "Southwestern Coast Salish," Northwest Coast Handbook of North American Indians, eds. William C. Sturtevant and Wayne Suttles, Smithsonian Institution, Volume 7 (Washington, D.C.: GPO, 1990), 514.
[9] R. T. Boyd, "The Introduction of Infectious Diseases Among the Indians of the Pacific Northwest." (Seattle: Unpublished Ph.D. dissertation, Department of Anthropology, University of Washington, 1985).
[10] James G. Swan, The Northwest Coast; or Three Years Residence in Washington Territory, (New York, 1857), 211. Reprinted: Fairfield, WA: Ye Galleon Press, 1989.
[11] Ray, 30

3.4. Population and Economics

The Shoalwater Bay Indian Tribe is small, but increasing in population. The Tribe currently has 311 enrolled members and a resident service population of 1,148, with an annual tribal budget of approximately $2.5 million. About 110 members live on the Shoalwater Bay Indian Reservation. Many tribal members work at the Tribal casino or in the Tribal Government. Tribal members are also commercial fishermen within Willapa Bay, and make use of local native plant species for Tribal crafts and ceremonial use.

The Shoalwater Tribe relied heavily, both historically and in recent times, on the diversity and productivity of the 700 acres of intertidal habitat and tide flats in the North Cove embayment. The barrier dune on Graveyard Spit afforded protection to the Cove from winter storm wave attack. The Shoalwater Tribe grew and harvested shellfish in North Cove, on which, along with ocean fisheries, they relied heavily for subsistence food supply. In addition, tribal members harvested local native plant species from the North Cove embayment for tribal crafts and ceremonial use.

3.5. Services and Special Districts

Pacific Co. Fire District #5

Ocosta School District #172

Representation:

19th Legislative District: Rep. Dean Takko, Rep. Brian Blake, Sen. Brian Hatfield

3rd Congressional District: Rep. Brian Baird

U.S. Senators Patty Murray, Maria Cantwell

3.6. Buildings and Critical Facilities

Interviews with Tribal officials, site visits and review of the Tribe's GIS buildings database, it was determined that the Tribe has about 55 buildings on its Reservation and Trust lands. Housing consists of twenty-two structures maintained by the Housing Authority and another 20 privately owned homes. Other tribal buildings include:

Critical facilities
Tribal Center

Shoalwater Bay Casino
Wellness Center
Tribal Police Station
Shoalwater Bay Learning Center (library)
Gymnasium (also used as Emergency Shelter)

<u>Other facilities</u>
Natural Resources offices
Smoke Shop
Fireworks Stand

The Tribe also operates a RV park adjacent to the Casino.

3.7. Infrastructure

- The Shoalwater Bay Tribal water system consists of two wells and a 57,000 gallon storage reservoir.
- Main Tribal Municipal Sewer Treatment Plant. Located near Gym. Built by Indian Health Service. Designed for a capacity of 30 homes, currently serves 9 homes.
- Tribal roads: Eagle Hill Road, Tsunami Evacuation Rd.
- Non-tribal roads: SR 105, Tokeland Rd, misc Residential Streets
- power grid
- 1700 ft protective berm, built by US Army Corps of Engineers in 2001. Run along coast parallel to Tokeland Rd from the RV Park to behind the Tribal Center.
- AHAB Warning Siren

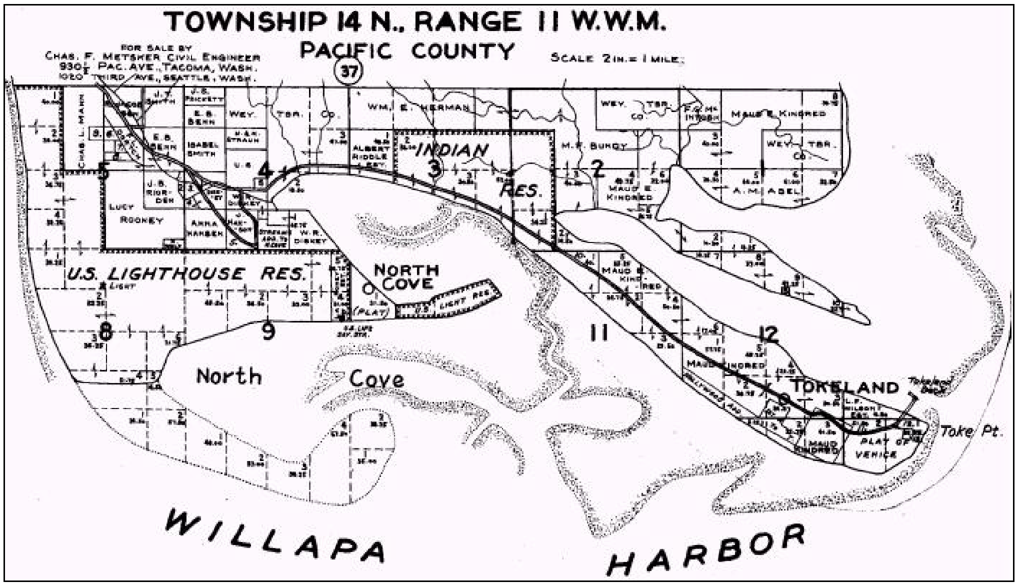
3.8. Cultural/Sacred

Georgetown Graveyard

Chief Charlie's House

Other historic homes

Figure 3-5: 1927 Metsker Map of North Cove area



4. Risk & Vulnerability Assessment

4.1. Introduction

This chapter will look at the potential hazards that could affect the Shoalwater Bay Reservation, and then determine the vulnerabilities of people, property and the environment. An inventory and assessment of Tribally-owned property and critical facilities and infrastructure will be made to determine loss estimations. The geographic focus will be on the area of the Shoalwater Bay Reservation. The format of the chapter will be as follows:

Section 4.1: Introduction and overview, including methodology and summary of findings
Sections 4.2-4.8: Detailed profiles of natural hazards affecting the Shoalwater Bay Tribe, including loss estimations
Section 4.9: Hazardous Materials profile
Section 4.10: Critical Facilities and Infrastructure assessments

Hazards Profiled

The first step in preparing a risk assessment for the Shoalwater Bay Reservation is to identify which natural hazards affect the Reservation. Numerous documents including the Washington State Hazard Mitigation Plan were analyzed as well as interviews of Tribal, State, Federal and County officials. Furthermore, Tribal Elders were consulted about hazards and past events. The hazards that could potentially affect the Reservation are:

- Coastal Erosion
- Earthquakes
- Floods
- Landslides
- Severe Weather
- Tsunamis
- Wildfires

Summary of Vulnerability and Losses

Generally speaking, the Shoalwater Bay Indian Tribe, its Reservation, properties and Areas of Interest are extremely vulnerable from natural hazards.
This section will discuss the Presidential Declared Disasters that impacted the Shoalwater Bay Indian Tribe and the region in the past and then will give a summary

of the potential losses to Tribal property estimated for each of the hazards profiled later in this chapter.

Presidential Declared Disasters

Presidential Declared Disasters are typically events that cause more damage than state, tribal and local governments/resources can handle without the assistance of the federal government. Generally there is not a specific dollar loss threshold that must be met, but for the Shoalwater Bay Indian Tribe to qualify for Disaster Assistance, the Pacific County as a whole must meet certain damage loss thresholds. Thus there could have been hazard events that particularly hit hard the Reservation, but limited damages elsewhere in the County prevented the Tribe from receiving assistance.

A Presidential Major Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, and designed to help disaster victims, businesses, and public entities.[12]

Historically, Pacific County has had 17 confirmed Federally Declared Disasters with the frequency increasing over the past twenty years. Since December 2006, there have been four declarations for Pacific County. The most recent declaration occurred December 2007 for the December 3rd Windstorm These are listed in **Table 4-1**. It is not known at this time how much damage the Shoalwater Bay Reservation received from these disasters, nor how much financial assistance was given to Tribal members and residents of the Reservation.

Table 4-1: Presidential Declared Disasters for Pacific Co.

Disaster #	Type of Event	Date Declared
137	Flood, Wind	October-62
185	Flood	December-64
322	Severe Storms, Flooding	February 1972
492	Flood	December-75
545	Flood, Landslide	December-77
784	Flood	November-86
883	Flood	November-90
981	Wind	January-93
1037	El Nino Effects	August 1994
1079	Flood	Nov-Dec 1995

[12] FEMA, http://www.fema.gov/library/dproc.shtm

Disaster #	Type of Event	Date Declared
1159	Ice, Wind, Snow, Landslide, Flood	Dec 1996-Feb 1997
1172	Flood, Landslide	March-97
1361	Earthquake	February-01
1641	Severe Storms, Flooding, Tidal Surge, Landslides, and Mudslides	May 17th, 2006 (for storm Jan. 27- Feb 4th, 2006)
1671	Severe Storms, Flooding, Landslides, and Mudslides	Dec 12, 2006 (for November 2nd-11th 2006 Flood)
1682	Severe Winter Storm, Landslides, and Mudslides	February 14th, 2007 (for Dec 14-15th, 2007 "Chanukah Eve" Storm)
1734	Severe Storms, Flooding, Landslides, and Mudslides	December 8th 2007, for storm beginning Dec. 1, 2007

Summary of Loss Estimations for each Hazard

As stated above, this part will summarize the total estimated losses for each natural hazard that could affect the Shoalwater Bay Indian Tribe. More detail on how these estimates based on FEMA methodology were derived can be found in each hazard profile. It should be noted though that these estimates are based on worse-case scenarios and on preliminary, incomplete data. It is generally impossible to predict exactly what damage an event will incur, but nonetheless general estimates can be made to guide planning, preparedness, response and better decision making. Furthermore it can also help increase awareness of the potential effects of natural disasters. These loss estimates also do not take into account potential economic losses, which in many cases may be worse than structural and content losses.

Assumptions:

Total value of Tribal structures and infrastructure (including Casino and Housing): $22,110,000. This breaks down to:

- Total Structure value: $15,500,00
- Total Content value: $6,610,000

Additionally there are another 20 privately owned homes, with a total structural value of $4,200,000 and a content value of $2,100,000.

Property value information was obtained from Tribal Insurance Schedules and discussions with Tribal officials. Property values are summarized in **Table 4-2**.

Table 4-2: Summary of Shoalwater Bay Tribe's Property Values

Structure & Content Values for SBIT (in millions of $)			
	Structure	Contents	Total
Tribal Facilities & Infrastructure	$12.20	$5.46	$17.66
Tribal Housing	$3.30	$1.15	$4.45
Private Housing	$4.20	$2.10	$6.30
Total	$19.70	$8.71	**$28.41**

Coastal Erosion: (Direct losses not estimated, see Flood loss estimates for Erosion caused flooding losses)

Earthquakes:

Estimated loss to earthquake-prone structures is **$7,249,600**

Estimated loss to contents is **$1,602,640**

Floods:

Estimated loss to structures from flood is **$4,334,000**

Estimated loss to contents from flood is **$2,874,300**

Landslides:

Estimated loss from landslides (water system): $700,000

Severe Weather (wind damage):

Estimated losses to structures: **$394,000**

Estimated loss to contents: **$174,200**

Tsunami:

Estimated loss to tsunami-prone structures: **$19,700,000**

Estimated loss to contents for all structures: **$8,710,000**

Total estimated loss from a tsunami event: **$28,410,000**

Wildfires:

Estimated losses to structures is: **$84,000**

Estimated losses to contents is $**42,000**

Methodology of Hazard Profiles

Each hazard profile is generally broken down into the following sections:

Definitions: a primer of some of the key terms used in the study of the hazard.

General Background: a general overview of the causes and effects of the hazard, focusing on the geological and climatological conditions needed to create the hazard.

Hazard Profile: a detailed profile of the hazard as it affects the Tribe. It is broken down into the following headings:

- ***Past Events*:** a review of past hazard events in the study area
- ***Location*:** where in the study area the hazard could impact people, property and the natural environment
- ***Frequency:*** How often a severe event can occur
- ***Severity:*** How destructive the event could be
- ***Warning Time:*** How much warning time people would have to prepare against an impending event

Exposure: from this hazard profile, it can be determined what Tribal interests (people, property etc) are exposed to the hazard.

Vulnerability: Now that the hazard is profiled and exposure is determined, vulnerability can be assessed. Vulnerability can be determined in many ways; for example Tribal capabilities can be looked at and building structural information can be used. The Tribe’s vulnerability to a hazard will guide and focus future mitigation efforts.

Loss Estimation: this section is included for a future loss estimation (damage assessment) from the hazard. This is a requirement of FEMA Hazard Mitigation Plans.

Please Note: Keep in mind that these hazard profiles are a constant work in progress using best available science. Information found here has been edited for a non-technical audience should only be used for guidance.. If there are any questions or inaccuracies on the validity of the scientific statements and/or assumptions of this risk assessment, please refer to the source studies from which this information was culled.

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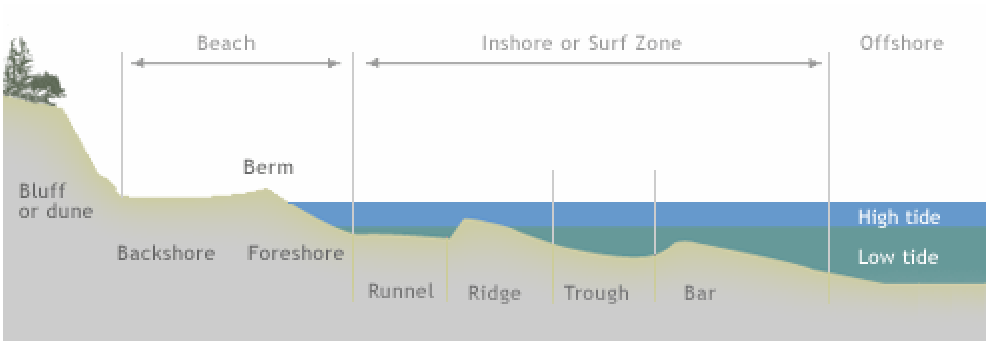
4.2. Coastal Erosion

Definitions[13]

Beach: A beach is an area of loose sediment (sand, gravel, silt, or cobbles) controlled by coastal processes. Waves, currents, and weather are always shaping the shore. Sediment may be added, causing the beach to grow or accrete -- or sediment may be taken away, causing the beach to erode.

Figure 4-1: Beach Cross-section



Accretion: Beach growth -- or the accumulation of beach sediment.

Backshore: The part of the beach reached only by the highest tides and storm waves.

Bar: A ridge of sand formed by waves and currents.

Berm: A low or nearly horizontal plateau on the beach or backshore, formed by waves. The berm marks the limit of ordinary high tide.

Berm crest: The seaward edge of the berm, delineating the the foreshore from the backshore.

Bluff: A steep headland, promontory, or sea-cliff.

Dune: A hill or ridge of sand shaped by wind, either bare or topped with vegetation.

Erosion: The wearing away of the land by natural forces. On a beach, the carrying away of beach material by waves, tides, or deflation.

Foreshore: The seaward sloping section on the beach between high and low tides.

Inshore: The section of the beach profile that reaches from the foreshore to beyond the surf zone.

Offshore: The section of the coastal profile that spans seaward from the breaker zone to the edge of the continental shelf.

Ridge: A rise in elevation seaward of a runnel.

[13] http://www.ecy.wa.gov/programs/sea/coast/beaches/basics.html

Runnel: A trough that runs parallel to the beach. Ebb tides move out the runnel between ridges, feeding a rip channel.

Rip channel: A trough, channel, or break in between nearshore bars, allowing the flow of a rip current.

Sand: Loose grains of sediment. Often quartz or feldspar measuring between 1/16 and 2 millimeters in diameter.

Sediment: Loose material deposited by currents, waves, wind, rivers, or glaciers.

Shoal: A sandbank or a sandbar.

Shoreface: The narrow zone seaward from the low tide shoreline covered by water, over which beach sand and gravel move with changing wave conditions.

Shoreline: Where the exposed beach meets the water.

Tide: The periodic change in the water level of the ocean, inlets, bays, and estuaries due to the gravitational attraction of the moon and sun.

Trough: A linear depression running parallel to the shore, hollowed out by wave action and currents. A trough can also be a the lowest point between wave crests.

General Background

Erosion is carving into Southwest Washington beaches. Erosion rates at Cape Shoalwater have averaged over 100 feet per year for a century. In recent decades, new erosion hot spots have developed. Storm waves near the Grays Harbor South Jetty threatened City of Westport facilities and a state park. Another erosion hot spot is at Ocean Shores, north of the Grays Harbor North Jetty. This beach had been growing since the jetty was built in the 1900's, but has recently begun to erode, threatening development. Erosion is also cutting into Fort Canby State Park; up to 90 camp sites could be lost to erosion by the year 2009, scientists with the Southwest Washington Coastal Erosion Study predict.

What's happening on Washington's southwest coast?

To understand the erosion problems on southwest Washington's coast, the Washington State Department of Ecology and the U.S. Geological Survey began a study in 1996. The Southwest Washington Coastal Erosion Study[14] has been investigating coastal change and processes. Findings from the study will help coastal communities plan and prepare for coastal hazards.

[14] http://www.ecy.wa.gov/programs/sea/swces/index.htm

How the coast works

Erosion along Washington's southwest coast is affected by: jetties, dams, sediment supply, geologic history, wave action, and weather.

- **Jetties caused beaches to grow and possibly erode**
  Jetties have influenced accretion and possibly erosion patterns on the beaches over distances of 12 miles (20 kilometers) or more.
- **Dams on the Columbia River have reduced the sand supply**
  Dams on the Columbia River have reduced the sand supply to coastal beaches by two thirds.
- **Beach growth has slowed**
  Accretion rates along the coast have slowed dramatically over the past few decades.
- **Beaches that once grew rapidly are now eroding**
  High rates of erosion are occurring along sections of beach that previously grew most rapidly.
- **El Niño impacts the shoreline**
  El Niño, a recurring atmospheric phenomenon, can bring higher sea levels, intense storms, and extreme high waves from the southwest.
- **Earthquakes hit Washington's coast**
  Large earthquakes in the past caused the coast to sink 3 to 6 feet suddenly (1 to 2 meters).
- **Columbia River sand built beaches and barriers**
  Supplied by sand from the Columbia River, beaches on the Long Beach Peninsula grew for 4,000 to 5,000 years.

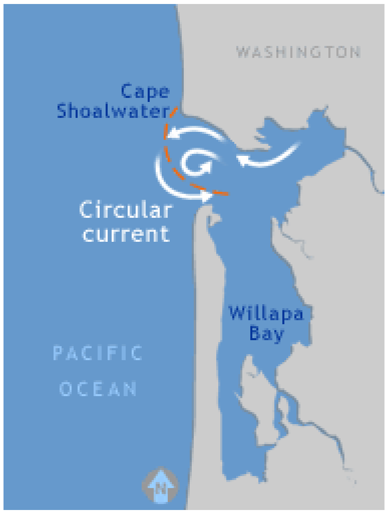
Hazard Profile

Washaway Beach, Cape Shoalwater, is the most rapidly eroding beach on the United States Pacific Coast. The Cape has been eroding an average of 100 feet year for the last century. At one time Cape Shoalwater provided protection to shallow North Cove and its excellent clamming and the Shoalwater Bay Reservation on the landward side from the full onslaught on winter storms and waves. Today Cape Shoalwater Spit is gone, North Cove has filled-in with invasive spartina grass and serves as the only barrier for the Reservation from the ocean. This section will profile the hazard coastal erosion poses to the Shoalwater Bay Tribe and the surrounding North Cove/Tokeland area, but first we will begin with a discussion of the causes of erosion in this area.

Causes of Erosion at Cape Shoalwater

A tidal channel is deepening and migrating northward (an 8 to 12 year cycle.) As the channel migrates, it cuts into the shore. As the channel migrates northward, an underwater sand bar forms near the entrance of Willapa Bay. Waves push sand south, into Willapa Bay, forcing the northern channel to bend south. In time, the tidal channel breaks through the sand bar. The cycle begins again, as the separated sand bar moves to the center of Willapa Bay's entrance.

Figure 4-2: Erosion Cycle



The Army Corps of Engineers has found in their Erosion Mitigation Study that the Shoalwater Bay Reservation is no longer threatened by direct coastal erosion of developed Tribal lands. The northward migration of the Willapa channel has stopped. Since the mid-1980s, the slope of the north bank of the main channel has been constant and has remained in a fixed position. This strongly indicates that the channel encountered hard strata that are resistant to erosion, sparing the last of the severely damaged dunes fronting the Shoalwater Bay Reservation shoreline. Nonetheless erosion to the remaining sand dunes and increased flooding associated with this erosion remains a major concern that needs to be mitigated.

Past Events

During the early 1900s, Cape Shoalwater, a massive spit, began eroding rapidly. Between 1890 and 1965, the cape eroded 12,303 feet (3750 meters) at about 124 feet per year (37 meters).

During the 1920s, over 30 homes were claimed by erosion or relocated. In the years that followed, erosion destroyed a lighthouse, a life-saving station, a clam cannery, a school, and a Grange Hall. Erosion also forced the relocation of a cemetery and State

Highway 105. In recent decades, erosion has destroyed 20 homes, private property, and part of the Willapa National Wildlife Refuge.

Transportation concerns

In 1995, erosion threatened to undermine State Highway 105. There were also concerns that sea water could invade and damage cranberry bogs worth millions of dollars. To protect State Highway 105, the Washington State Department of Transportation constructed a $27 million submerged groin and beach fill area.

Location

The sand spits and barrier islands just offshore of the Shoalwater Bay Reservation are the areas being affected by Coastal Erosion. This had led to the in-filling of North Cove, once an area for clam and oyster digging, but now composed of tidal marsh and mud.

Frequency

Coastal Erosion has been occurring every winter for the last 100 years

Severity

Coastal Erosion has been claiming at least 100 feet of shoreline per year. One major storm event can undermine the foundations of homes and structures adjacent to the coast and send them into to ocean.

Warning Time

Coastal erosion is a gradual process, so structures threatened by coastal erosion can be identified months to weeks before the structures are undermined and washed into the ocean. Severe storms, which can bring periods of increased erosion, can be predicted days in advance.

Secondary Hazards

Coastal Flooding is the secondary hazard most intensified by coastal erosion. This hazard will be discussed further in Section

Exposure Inventory

All of the Shoalwater Bay Tribe's people and property is exposed to the effects of coastal erosion.

Vulnerability[15]

The entire Shoalwater Reservation is at increasing risk of shoreline erosion and coastal flooding associated with storm events at extreme high tide. The flooding is the direct result of the gradual erosion and breaching of the barrier dune on Graveyard Spit that fronts the Reservation and the Tokeland Peninsula. As a result, the narrow shoreline strip of developable lands upon which tribal facilities and housing are located is at increasing risk of serious shoreline erosion and flood damage. Likewise, the productivity of the North Cove tide flats and salt marsh upon which tribal members have relied for subsistence shellfish and harvesting of local native plant species for tribal crafts and ceremonial use will continue to decline due to its infilling with sand from storm wave overwash and erosion of the eroded barrier dune. Winter storms in 1998-1999 caused two breaches to form in the barrier dune, resulting in storm wave run-up and flooding of shoreline areas where tribal development is concentrated. Storm wave overwash has eroded the barrier dune, resulting in infilling of the North Cove tidal flats with sand. This has diminished the Cove's ability to sustain Tribal subsistence shellfish beds and native plant populations. To protect the Tribal Center, a 1,700-foot-long shoreline flood berm was constructed in 2001 by the Corps of Engineers. In February 2006, another storm at extreme high tide caused significant flooding and damage, with debris blocking the State highway that traverses the Reservation. Five of the eleven extreme high tides recorded since 1970 have occurred since 1999.

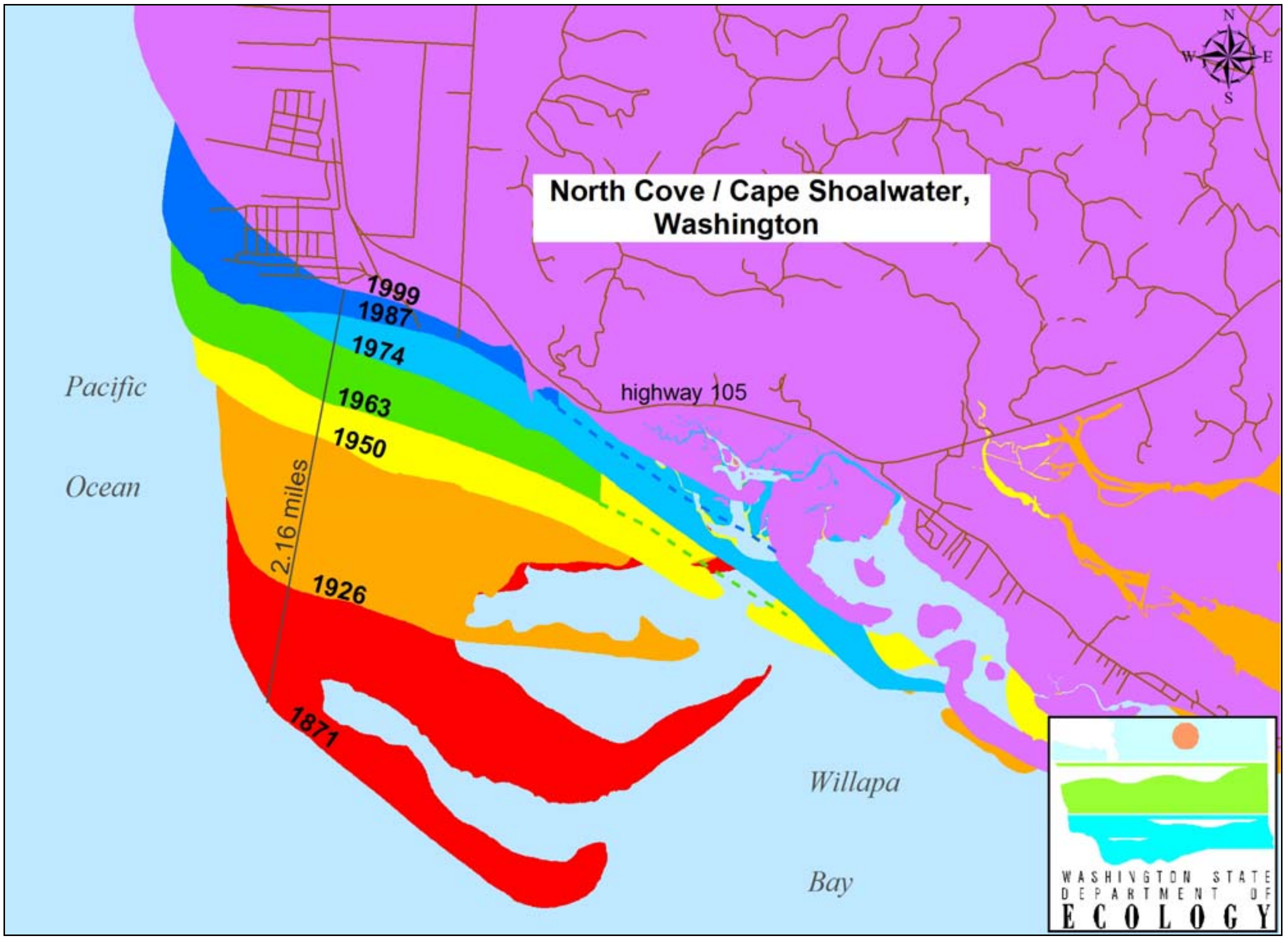
Loss Estimate

As mentioned previously, The Army Corps of Engineers no longer believes that Tribal structures are directly exposed to coastal erosion, although flooding from erosion of the remaining barrier dunes fronting the Reservation will continue to be a major and increasingly frequent vulnerability.

Based on these conclusions, it was determined to not prepare a loss estimate for Coastal Erosion. Losses to the Tribe from coastal erosion will be from floodwaters and will be discussed accordingly in the Flood Hazard profile.

[15] *Shoalwater Bay Shoreline Erosion, Washington Post-Authorization Decision Document Shoalwater Bay Indian Reservation March 2007* 1

Figure 4-3: Erosion at Cape Shoalwater 1871-1999



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4.3. Earthquakes

Definitions

Benioff Earthquake: Sometimes called "deep quakes," these occur in the Pacific Northwest when the Juan de Fuca plate breaks up underneath the continental plate, approximately 30 miles beneath the earth's surface.

Crustal Earthquake: Crustal quakes occur at a depth of 5 to 10 miles beneath the earth's surface and are associated with fault movement within a surface plate.

Earthquake: An earthquake is the shaking of the ground caused by an abrupt shift of rock along a fracture in the earth such as a fault or a contact zone between tectonic plates. Earthquakes are measured in both magnitude and intensity.

Intensity: Intensity is a measure of the effects of an earthquake. It is measured by the Modified Mercalli scale and is expressed in Roman numerals.

Liquefaction: Liquefaction is the complete failure of soils, occurring when soils lose shear strength and flow horizontally. It is most likely to occur in fine grain sands and silts, which behave like viscous fluids when liquefaction occurs. This situation is extremely hazardous to development on the soils that liquefy, and generally results in extreme property damage and threats to life and safety.

Magnitude: Magnitude is the measure of the strength of an earthquake, and is typically measured by the Richter scale. As an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Peak Ground Acceleration: Peak Ground Acceleration (PGA) is a measure of the highest amplitude of ground shaking that accompanies an earthquake, based on a percentage of the force of gravity.

Subduction Zone Earthquake: This type of quake occurs along two converging plates, attached to one another along their interface. When the interfaces between these two plates slips, a sudden, dramatic release of energy results, propagated along the entire fault line.

General Background

The Western Washington region is seismically active, with hundreds of earthquakes occurring each year. Most of these earthquakes are so small only sensitive instruments can detect them. However, at least 20 damaging earthquakes have occurred in Western Washington during the past 125 years. Large quakes in 1946, 1949, 1965 and 2001 killed 16 people and caused more than $3.59 billion (2004 dollars) in property damage. In fact, recent seismic studies have increased concern among the scientific and engineering communities regarding both magnitude and frequency of damaging earthquakes in the Pacific Northwest.

More than 90% of all Pacific Northwest earthquakes occur along the crustal plate boundary between the Juan de Fuca plate and the North American plate. Seismicity catalogs are the fundamental tool used to determine where, how often, and how big earthquakes are likely to be. However, because of the short time (from a geological perspective) that written records have been kept and the relative infrequency (from a human perspective) of such events, seismicity statistics are necessarily based on historically short catalogs.

The results from examining the historical record, monitoring seismic and geodetic changes, and study of the geologic record are combined to characterize seismic sources. This data is used to identify seismic source zones, the regions of the earth's crust where earthquakes occur. Although there are large uncertainties associated with source characterization (we have not yet figured out how to place instruments in the crust at the depths where earthquakes are generated), the Pacific Northwest has been studied extensively in recent years and some valuable new insights have been developed as a result of this attention. It is now generally agreed that three source zones exist for Puget Sound quakes: a shallow (crustal) zone; the Cascadia Subduction zone; and a deep or intraplate ("Benioff") zone.

Estimating the expected ground motion at a given distance from an earthquake of a certain magnitude is the second element of earthquake hazard assessment. The parameters that must be identified in order to estimate ground motions at any location are:

earthquake magnitude,

type of faulting,

distance of the site from the epicenter,

and local site conditions (hard rock, soft rock, stiff soil, soft soil, etc).

Hazard values calculated for rock/stiff soil (the most common classifications) are lower than hazard values calculated for unconsolidated or soft soil sites typically found along river valleys. The type of faulting is also important because high angle reverse thrust displacements (most common in Puget Sound shallow fault zones) are far more damaging than, for example, strike-slip faults.

The third element of earthquake hazard assessment, the actual calculation of expected ground motion values, involves determining the annual probability that certain ground motion accelerations will be exceeded, then summing over the time period of interest. The most commonly mapped ground motion parameters are the horizontal and vertical **peak ground accelerations** (**PGA**) for a given site classification (soil or rock type). Maps of PGA values now form the basis of seismic zone maps that are included in building codes, including the U.S. Uniform Building Code (UBC). Building codes that include seismic provisions specify the horizontal force due to lateral acceleration that a building should be able to withstand during an earthquake. PGA values are directly related to these lateral forces that could damage "short period structures" (i.e. single-family dwellings, the most common structures in the county). Maps of longer period spectral response components may also need to be developed to determine the lateral forces that damage larger structures with longer natural periods (apartment buildings, factories, high-rises, bridges).

Earthquakes are caused by the fracture and sliding of rock within the Earth's crust. The Earth's crust is divided into eight major pieces (or plates) and many minor plates. These plates are constantly moving, very slowly, over the surface of the globe. As these plates move, stresses are built up in areas where the plates come into contact with each other. Within seconds, an earthquake releases stress that has slowly accumulated within the rock, in some instances over hundreds of years. Sometimes the release occurs near the surface, and sometimes it comes from deep within the crust.[16]

The impact of any earthquake event is largely a function of ground shaking, liquefaction and distance from the source of the quake. Liquefaction results generally in softer, unconsolidated soils. A program called the National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics so that locations potentially subject to liquefaction may be identified. **Table 4-3** provides a description of the NEHRP soil classification.

Table 4-3: NEHRP Soil Classification System

NEHRP Soil Type	Description	Mean Shear Velocity to 30 m (m/s)
A	Hard Rock	1500
B	Firm to Hard Rock	760-1500
C	Dense soil, soft rock	360-760
D	Stiff Soil	180-360
E	Soft clays	<180

16 http://www.metrokc.gov/prepare/hiva/earthquakes.htm

F	Special study soils (liquefiable soils, sensitive clays, organic soils, soft clays > 36 m thick)	

The degree of ground shaking (or damage) caused by an earthquake is often assigned a numerical value from Roman Numeral I to XII on the Modified Mercalli (MM) Scale and is referred to as intensity. This helps to assess and understand the physical affects of the earthquake. **Table 4-4** provides a comparison of Peak Ground Acceleration to the MM Intensity scale.[17]

Table 4-4: Mercalli Scale and Peak Ground Acceleration Comparison

MMI	Potential Damage	Est. PGA	Source
I	None	< .017	USGS
II – III	None	.017	USGS
IV	None	.014 - .039	USGS
V	Very Light	.039 - .092	USGS
VI	None to Slight USGS – Light	.02-05	Munich Re-ins
	URM[18] – stair-step cracks	.04-.08	Goettle
		.06 - .07	Bolt 1988
	Damage to chimneys	.06 - .13	Table 3.2 Seismic Provisions
	Threshold of damage	.092 - .18	USGS
VII	Slight – Moderate USGS - Moderate	.05.-10	Munich Re-ins
	URM – Significant cracking of parapets; masonry may fall	.08-.16	Goettle
		.10 - .15	Bolt
		.1	Trifunac 1976
	Threshold of structural damage	.18 - .34	USGS

[17] Cascadia Region Earthquake Workgroup, Professor Anthony Qamar, University of Washington
[18] URM: Unreinforced Masonry

MMI	Potential Damage	Est. PGA	Source
VIII	Moderate – Extensive USGS – Moderate to Heavy	.10 - .20	Munich Re-ins
	URM – extensive cracking; fall of parapets and gable ends	.16 - .32	Goettle
		.25 - .30	Bolt 1988
		.13 - .26	Table 3.2 NEHRP
		.2	Trifunac 1976
		.35 - .65	USGS
IX	Extensive – Complete USGS - Heavy	.20 - .50	Munich Re-ins
	Structural collapse of some URM buildings; walls out of plane Damage to seismically designed structures	.32 - .55	Goettle
		.50 - .55	Bolt 1988
		.26 - .44	Table 3.2
		.3	Trifunac 1976
		.65 – 1.24	USGS
X	Complete Ground Failures USGS- Very Heavy (X+)	.50 – 1.00	Munich Reins
	Structural collapse of most URM buildings Notable damage to seismically designed structure Ground Failures	.55 - .80	Goettle
		>.6	Bolt 1988
		.44 - .64	bldgs w T >.5
		> 1.24	USGS

Richter Scale[19]

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The magnitude of an earthquake is determined from the logarithm of the amplitude of waves recorded by seismographs. Adjustments are included for the

[19] http://vulcan.wr.usgs.gov/Glossary/Seismicity/description_earthquakes.html

variation in the distance between the various seismographs and the epicenter of the earthquakes. On the Richter Scale, magnitude is expressed in whole numbers and decimal fractions. For example, a magnitude 5.3 might be computed for a moderate earthquake, and a strong earthquake might be rated as magnitude 6.3. Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude; as an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

At first, the Richter Scale could be applied only to the records from instruments of identical manufacture. Now, instruments are carefully calibrated with respect to each other. Thus, magnitude can be computed from the record of any calibrated seismograph.

Earthquakes with magnitude of about 2.0 or less are usually call micro-earthquakes; they are not commonly felt by people and are generally recorded only on local seismographs. Events with magnitudes of about 4.5 or greater - there are several thousand such shocks annually - are strong enough to be recorded by sensitive seismographs all over the world. Great earthquakes, such as the 1964 Good Friday earthquake in Alaska, have magnitudes of 8.0 or higher. On the average, one earthquake of such size occurs somewhere in the world each year. Although the Richter Scale has no upper limit, the largest known shocks have had magnitudes in the 8.8 to 8.9 range. Recently, another scale called the moment magnitude scale has been devised for more precise study of great earthquakes. The Richter Scale is not used to express damage. An earthquake in a densely populated area which results in many deaths and considerable damage may have the same magnitude as a shock in a remote area that does nothing more than frighten the wildlife. Large-magnitude earthquakes that occur beneath the oceans may not even be felt by humans. **Table 4-5** shows a description of Richter scale magnitudes.

Table 4-5: Richter Scale

Descriptor	Richter magnitudes	Earthquake Effects	Frequency of Occurrence (worldwide)
Micro	Less than 2.0	Micro-earthquakes, not felt.	About 8,000 per day
Very minor	2.0-2.9	Generally not felt, but recorded.	About 1,000 per day
Minor	3.0-3.9	Often felt, but rarely causes damage.	49,000 per year (est.)
Light	4.0-4.9	Noticeable shaking of indoor items, rattling noises. Significant damage	6,200 per year (est.)

Descriptor	Richter magnitudes	Earthquake Effects	Frequency of Occurrence (worldwide)
		unlikely.	
Moderate	5.0-5.9	Can cause major damage to poorly constructed buildings over small regions. At most slight damage to well-designed buildings.	800 per year
Strong	6.0-6.9	Can be destructive in areas up to about 100 miles across in populated areas.	120 per year
Major	7.0-7.9	Can cause serious damage over larger areas.	18 per year
Great	8.0-8.9	Can cause serious damage in areas several hundred miles across.	1 per year
Rare great	9.0 or greater	Devastating in areas several thousand miles across.	

Table 4-6: Magnitude / Intensity Comparison

Magnitude	Typical Maximum Modified Mercalli Intensity
1.0 - 3.0	I
3.0 - 3.9	II - III
4.0 - 4.9	IV - V
5.0 - 5.9	VI - VII
6.0 - 6.9	VII - IX
7.0 and higher	VIII or higher

Hazard Profile

Earthquakes were profiled for the Shoalwater Bay Indian Tribe by reviewing best available science about earthquakes in Western Washington as well as by studying NEHRP soils maps of the Tribal Reservation and other properties. Damage estimates were made using the FEMA damage methodology for earthquakes.

Past Events

There have been numerous earthquakes experienced in the Willapa Bay area for hundreds of generations of people. This section will recount some of the past events felt here, but is by no means exhaustive.

- 1700 Cascadia Subduction Earthquake
  Between 9:00 PM and 10:00 PM, local time, on January 26th 1700, a great earthquake shook the Pacific Northwest. This quake, with magnitude estimated at 9.0, rocked the region with strong shaking for several long minutes while coastal Washington plummeted as much as 5 feet relative to coastal waters. This earthquake generated a massive tsunami that affected many of the Indian Tribes living on the coast and adjacent bays and creeks and was recorded in their folklore and histories. The tsunami generated also affected Japan.
  This erathquake is used as teh absis to help predict and prepare for future events.

The Pacific Northwest Seismic Network[20] published a compilation of past earthquake events in Southwest Washington that was produced by Pacific County Historical Society and Museum "Columbia River Chronology Historical Dates" www.pacificcohistory.org/columbia.htm

Note: Citations are given for each entry but bibliography is not available at this time per discussion with Pacific County Historical Society.

SW WASHINGTON EARTHQUAKES

- December 2, 1841 earthquake near Ft Vancouver Washington (Wong and Bott p 128)
- December 23, 1854 tsunami recorded at Astoria (Lander p 121)
- December 24, 1854 tsunami recorded at Astoria (Lander p 121)
- April 3, 1868 tsunami recorded at Astoria (Lander p 122)
- August 14, 1868 tsunami recorded at Astoria (Lander p 123)
- August 23, 1872 teletsunami recorded at Astoria (Lander p 24, 47)

[20] http://www.pnsn.org/

- October 12, 1877 earthquake tremors felt in Astoria oscillating from east to west (Daily Astorian October 13, 1877 p 1)

- December 12, 1880 2 earthquakes shocks felt (Daily Astorian [Dec?] 14, 1880 p 3; Algermissen and Harding)

- April 30, 1882 Severe tremors (Daily Astorian May 2, 1882 p 3) Daily Astorian

- May 3, 1882 p 3 mentions that earthquake was felt in Westport and Ft Canby about 10:30 pm [on] April 30. Daily Astorian May 4, 1882 tells that 3 shocks vibrated from SW to NE on April 30.

- March 27, 1884 earthquake felt in Hoquiam (Workman p 38)

- November 30, 1891 slight earthquake on Grays Harbor (Workman p 49)

- February 2, 1892 earthquake in Astoria (Bott and Wong p 118)

- February 26, 1895 earthquake hits Astoria (Daily Morning Astorian p 4)

- August 6, 1899 earthquake hits Astoria (Astoria Daily Budget August 8, 1899 p 4)

- November 20, 1899 tidal wave at Shoalwater Bay (Astoria Daily Budget November 20, 1899 p 4)

- September 12, 1903 quake hits city (Astoria Daily Budget p 4)

- March 16, 1904 Earthquake felt along Washington Coast and in Aberdeen, Hoquiam (Lander p 59, 127 not mentioned in Astoria newspapers)

- March 30, 1904 possible tsunami off Washington coast caused flooding (Lander p 19 not mentioned in Astoria newspapers)

- January 11, 1909 Grays Harbor Earthquake (Workman p 68)

- November 9, 1920 earthquake hits Astoria (Astoria Budget p 1)

- November 29, 1920 slight earthquake hits Astoria (Astoria Budget p 1)

There have been numerous other earthquakes felt in the Shoalwater Bay area over the years. The most severe of these can be attributed to the numerous faults found in Western Washington. The most severe crustal earthquake ever felt in Washington occurred in the North Cascades area in 1872. **Table 4-7** is a summary of large earthquakes that have occurred in Western Wa.[21]

Table 4-7: Large Earthquakes in the Western WA Region

1872	Entiat or North Cascades	6.8 or 7.4	Crustal Zone
1882	Olympic Area	6.0	Benioff Zone
1909	Puget Sound	6.0	Benioff Zone
1915	North Cascades	5.6	--
1918	Vancouver Island	7.0	--
1920	Puget Sound	5.5	--
1932	Central Cascades	5.2	Crustal Zone
1939	Puget Sound	5.8	Benioff Zone
1945	North Bend	5.5	Crustal Zone
1946	Puget Sound	6.3	Benioff Zone
1946	Vancouver Island	7.3	Benioff Zone
1949	Olympia	7.1	Benioff Zone
1965	Puget Sound	6.5	Benioff Zone
1981	Mt. St. Helens	5.5	Crustal Zone
1990	NW Cascades	5.0	Crustal Zone
1995	Robinson Point	5.0	Crustal Zone
1996	Duvall	5.6	--
2001	Nisqually\Puget Sound	6.8	Benioff Zone

1872, Entiat, WA (Chelan Co.)[22] On the evening of December 14, 1872, severe earthquake shaking was widely felt in Washington, Oregon, British Columbia, Idaho, Montana, and Alberta. Dozens of communities reported severe shaking, but no surface faulting was found. The 1872 earthquake was thought to have originated in the North Cascades, a rugged area inaccessible for most of the year. Reports of shaking came from more populous areas some distance away, making the location

[21] Hazard Identification and Vulnerability Analysis, King County Office of Emergency Management. September 1998

[22] http://www.ess.washington.edu/SEIS/PNSN/CATDAT/northcascades.html

and size of the earthquake very hard to determine. Magnitude estimates have ranged as high as 7.4, and location estimates have spanned a wide area of the North Cascades.

The new magnitude and location were determined from reports of shaking intensities from communities throughout the northwest and an improved model of how shaking intensities fall off with distance. Hundreds of trial magnitude/location combinations were modeled and compared to the observed shaking intensities. The best fit was a magnitude 6.8 crustal earthquake near the southern end of Lake Chelan.

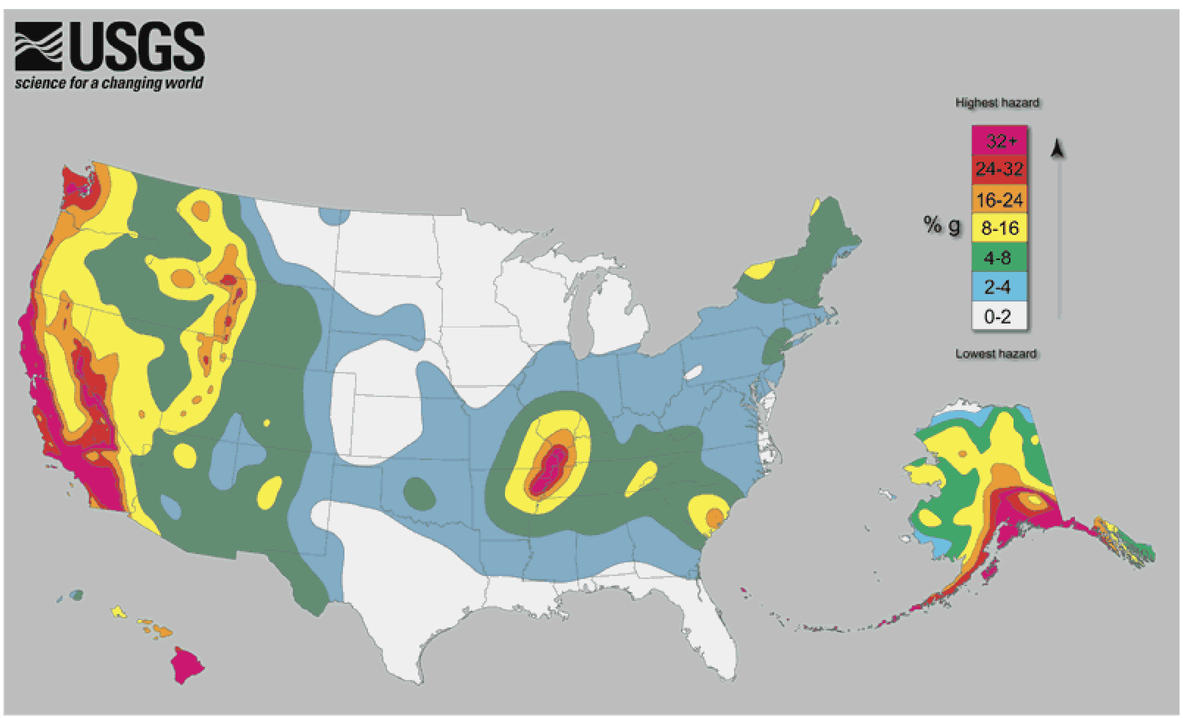
- 1949, Nisqually Delta Area north of Olympia: This earthquake had a magnitude of 7.1 on the Richter scale

- 2001, Nisqually Delta Area North of Olympia: This earthquake had a magnitude 6.8 on the Richter scale

Location

The Shoalwater Bay Indian Tribe is located in one of the most earthquake prone regions of the United States. This section will detail the different types of earthquakes that can affect the Reservation. There will also be a discussion of the soil make-up of the Reservation to identify areas of highest concern. Structures located on softer soils are more vulnerable to the shaking caused by earthquakes.

Figure 4-4: United States Earthquake Risk

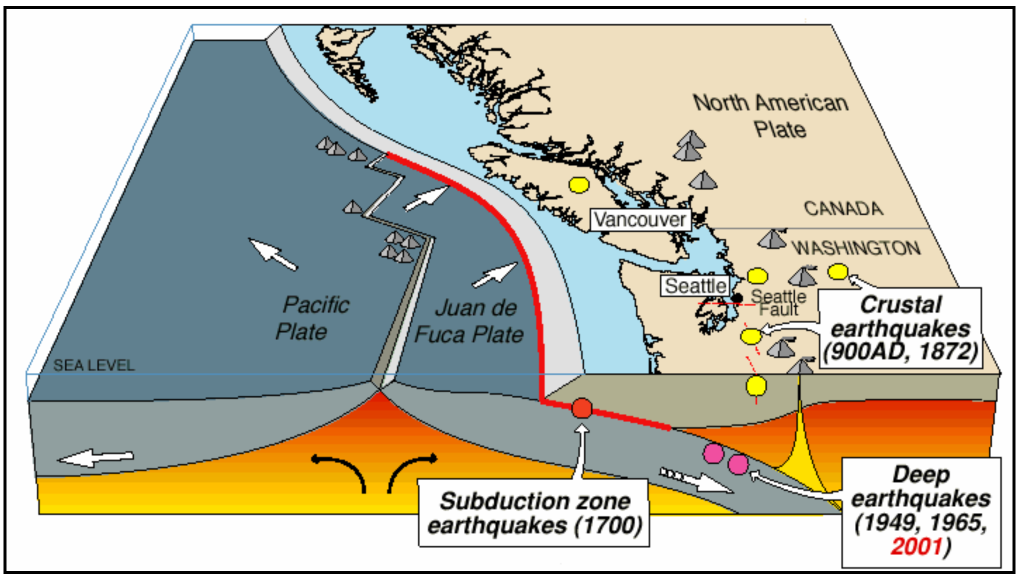


In Western Washington, the primary plates of interest are the Juan De Fuca and North American plates. The Juan De Fuca plate moves northeastward with respect to the North American plate at a rate of about 4cm/yr. The boundary where these two plates converge, the Cascadia Subduction Zone, lies approximately 50 miles offshore of the west coastline and extends from the middle of Vancouver Island in British Columbia to northern California. As it collides with the North American plate, the Juan De Fuca plate slides (or subducts) beneath the continent and sinks into the earth's mantle.

The three source zones that exist for Western WA quakes are a shallow (crustal) zone; the Cascadia Subduction zone; and a deep or intraplate ("Benioff") zone. These are shown in **Figure 4-5**.

A Cascadia Subduction Zone earthquake is the type most likely to cause damage to the Shoalwater Bay Indian Reservation.

Figure 4-5: Earthquake Types in Western Washington



Cascadia Subduction Zone

Subduction Zone earthquakes occur along the Cascadia subduction fault, as a direct result of the convergence of these two plates. These are the world's greatest earthquakes and are observed at subduction zone boundaries. A subduction earthquake would be centered off the coast of Washington or Oregon where the plates converge and would typically have a minute or more of strong ground shaking. These magnitude 8 to 9.5 Richter scale thrust-type subduction earthquakes occur from time to time as two converging plates slide past one another. There are no reports of such earthquakes in the Cascadia Subduction Zone off the Oregon/Washington coast since the first written records of permanent occupation by

Europeans in 1833 when the Hudson Bay Trading Company post was established at Fort Nisqually. However, paleoseismic evidence suggests that there may have been as many as five of these devastating energy releases in the past 2000 years, with a very irregular recurrence interval of 150 to 1100 years. Written tsunami records from Japan, correlated with studies of partially submerged forests in coastal Washington and Oregon, give a probable date for the most recent of these huge quakes as January 26, 1700.

Since the installation in 1969 of a multi-station seismograph network in Washington, there has been no evidence of even small subduction-type earthquakes in the Cascadia region, indicating the plates are locked. However, parts of subduction zones in Japan and Chile also appear to have had very low levels of seismicity prior to experiencing great earthquakes. Therefore the seismic quiescence observed historically along coastal region of Washington and Oregon does not refute the possibility that an earthquake having a magnitude of greater than 8 could occur there. Recent shallow geodetic strain measurements near Seattle indicate that significant compressional strain is accumulating parallel to the direction of convergence between the Juan de Fuca and North America plates, as would be expected prior to a great thrust earthquake off the coast of Oregon, Washington and British Columbia. Usually, these types of earthquakes are immediately followed by damaging tsunamis and numerous large aftershocks.

Benioff (Deep) Zone

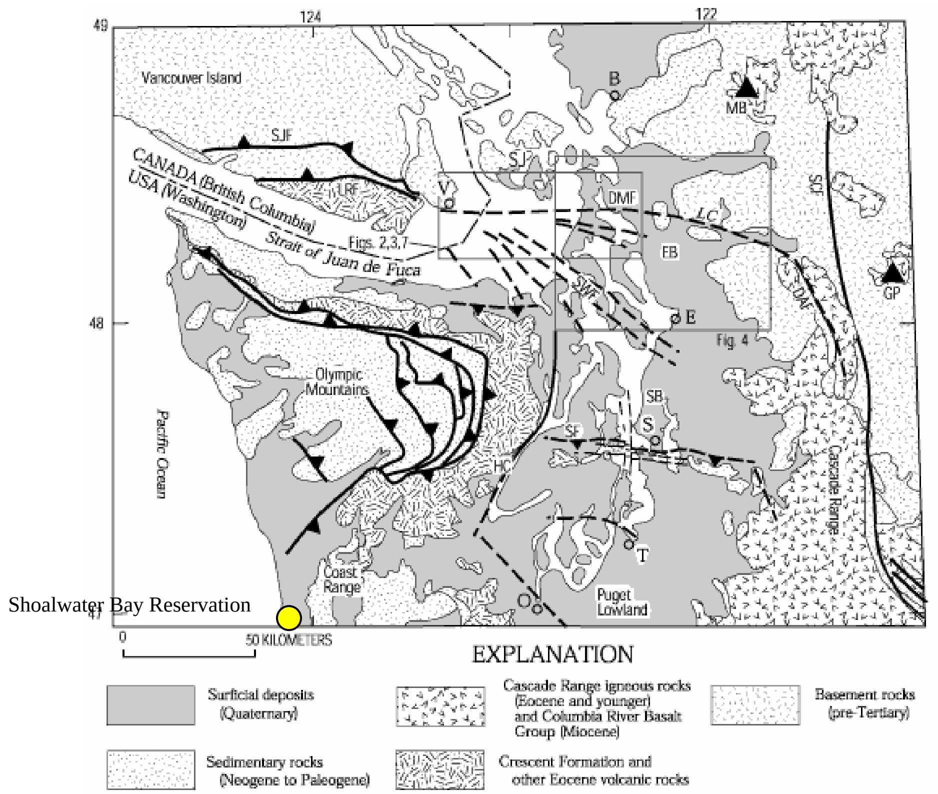
Western Washington is most likely to experience intraplate or "deep" earthquakes of magnitude 6 to 7.4 on the Richter scale. This occurs within the subducting Juan de Fuca plate at depths of 50 -70 km. As the Juan de Fuca plate subducts beneath North America, it becomes denser than the surrounding mantle rocks and breaks apart under its own weight, causing Benioff zone earthquakes. The Juan de Fuca plate begins to bend even more steeply downward, forming a "knee". It is at this knee where the largest Benioff zone earthquakes occur.

The largest of these events recorded in modern times were the 7.1 magnitude Olympia earthquake in 1949 and the 6.8 magnitude Nisqually earthquake in 2001. Strong shaking during the Olympia earthquake lasted about 20 seconds. Since 1870, there have been seven deep earthquakes in the Puget Sound basin with measured or estimated magnitudes of 6.0 or larger. The epicenters of all of these events have been located within about 80 kilometers of each other between Olympia and just north of Tacoma. Scientists estimate the recurrence interval for this type of quake to be 30 - 40 years for magnitude 6.5, and 50 - 70 years for magnitude 7.0. Because of their depth, intraplate earthquakes are least likely to produce significant aftershocks.

Crustal Zone

The third source zone is the crust of the North American plate. These are known as shallow earthquakes. Of the three source zones, this is the least understood. A variety of lines of evidence leads to the conclusion that the Puget Lowland area is currently shortening north-south at a rate of about 0.5 cm (one-fifth of an inch) per year. Shallow earthquakes of magnitude up to 7.0 or more on the Richter scale can happen anywhere in the Puget Sound region. Great crustal quakes do not seem to happen very often; perhaps no more than once every 1000 years.

Figure 4-6: Faults near Shoalwater Bay Reservation[23]



National Earthquake Hazard Reduction Program (NEHRP)

In addition to understanding the different types of earthquakes that can affect the Shoalwater Bay Indian Tribe's Reservation, it is also crucial to have knowledge of the soil make-up of the Reservation. This will narrow down what areas of the Reservation will be more impacted by an earthquake event. The NEHRP classification system is used to accomplish this. In the event of an earthquake, NEHRP soils B and C typically can sustain ground shaking dependent on the magnitude. The areas that

[23] http://earthquake.usgs.gov/regional/pacnw/activefaults/dmf/#mapping

will be most affected by ground shaking are located in NEHRP soils D, E and F. In general these areas will also be most susceptible to liquefaction, a secondary effect of an earthquake where soils lose their shear strength and flow horizontally. The NEHRP Soils Classifications and Liquefaction Risk for the Shoalwater Bay Reservation area are shown in **Figure 4-8**and **Figure 4-9**.

Frequency

Deep: Five magnitude 6earthquakes, plus one magnitude 7 since 1900.

Crustal: Four magnitude 7 or greater known in the last 1,100 years; including two since 1918 on Vancouver Island

Subduction Zone: Every 400-600 years; intervals between events are irregular. The most recent was in 1700.

Severity

As noted earlier the Shoalwater Bay Indian Tribe has the potential to be affected by a subduction, Benioff, or crustal zone earthquake. A subduction zone earthquake could produce an earthquake with a magnitude 9.0 or greater on Richter scale on the Reservation. Benioff zone earthquakes as large as magnitude 7.1 are expected everywhere west of the eastern shores of Puget Sound.[24] A crustal zone earthquake could produce a 7.1 magnitude. **Table 4-8** provides a description of the expected severity of the earthquakes. **Figure 4-7** shows the predicted Peak Ground Acceleration in the Shoalwater Bay Reservation area.

For a 9.0 Cascadia Subduction Zone event, The Shoalwater Bay Reservation will be subjected to strong shaking, landslides, and tsunamis. Buildings, roads, bridges and utility lines will suffer varying amounts of damage. Some will be destroyed. Extensive injuries and fatalities are likely. Within minutes, a tsunami will arrive, making it essential that residents and visitors understand the need to head for higher ground or inland as soon as the shaking stops. Coastal Highways 101 and SR 105will be impassable over large stretches, and landslides through the Coast Range will sever highway travel between the coast and inland areas. Destruction of roads, runways, ports, and rail lines will leave individual cities isolated. Residents and visitors will have to do much of the work of rescuing those trapped in the rubble and will be responsible for the immediate clean-up and organization to distribute relief supplies.[25]

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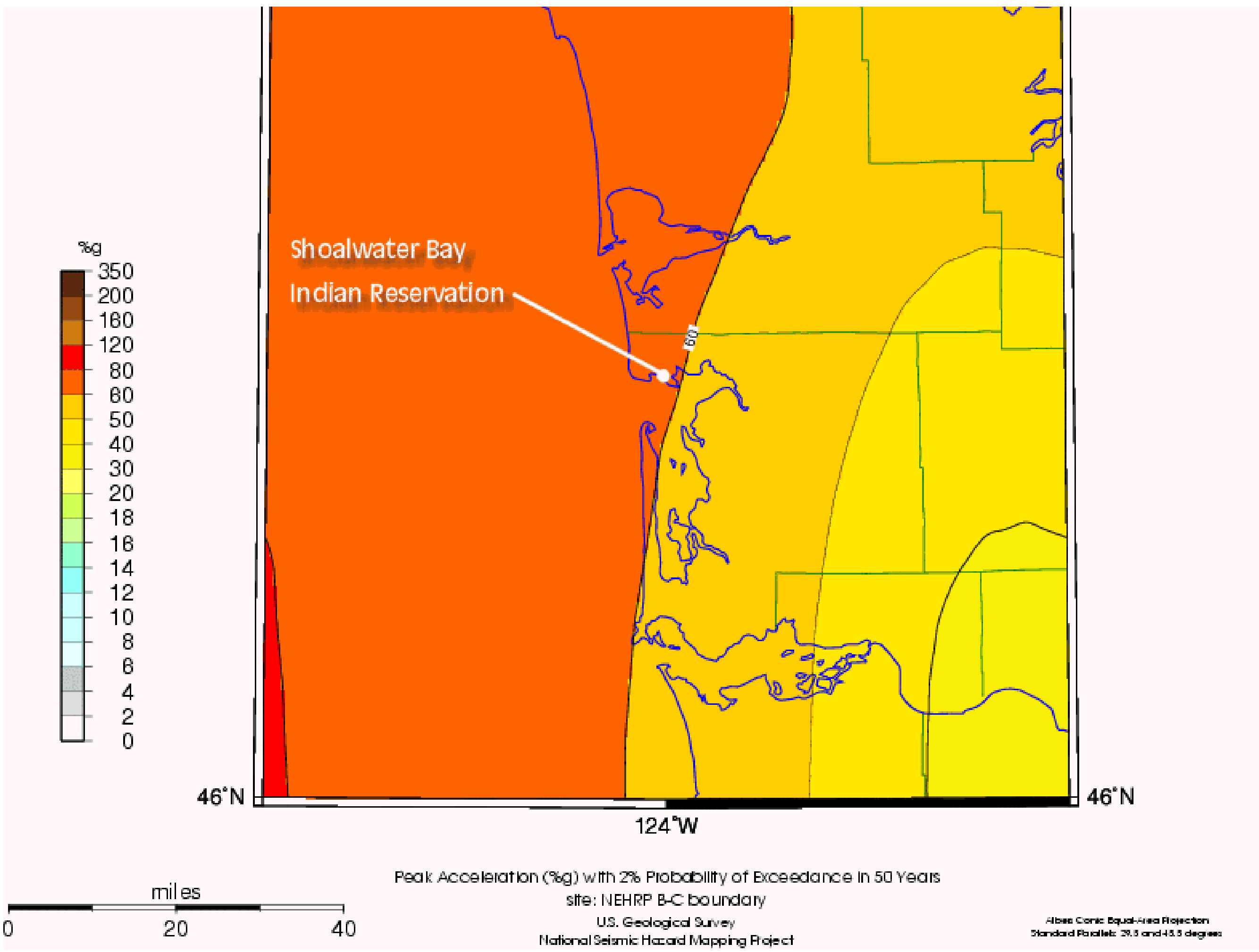
[24] http://wrgis.wr.usgs.gov/docs/wgmt/pacnw/lifeline/eqhazards.html
[25] http://www.crew.org/papers/CREWCascadiaFinal.pdf p.2

Table 4-8: Severity of Western WA Earthquakes

Cascadia Subduction Zone	9.0 for approximately 4 minutes with aftershocks
Benioff	7.1 with no aftershocks
Crustal -	7.5 with some aftershocks

Figure 4-7: Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years



Warning Time

Although, there is a large amount of information that is known about possible earthquake locations, there is no current reliable way to predict what day or month an earthquake will occur at any given location. There is current research that is being conducted with warning systems that use the low energy waves that precede major earthquakes.[26] These potential warning systems give approximately 40 seconds notice that a major earthquake is about to occur. The warning time is very short but it could allow for someone to get under a desk, step away from the hazardous material they are working with or shut down a computer system.

Secondary Hazards

The major secondary hazard is tsunamis. A major Subduction Zone earthquake off the Coast could trigger a tsunami that could reach the Shoalwater Bay Reservation in minutes. This is discussed further in Section 4.7, Tsunamis.

There are other potential secondary effects of earthquakes. Earthquakes can cause large and sometimes disastrous landslides and mudslides. River valley and coastal hydraulic-fill sediment areas are also vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction occurs when water-saturated sands, silts or gravelly soils are shaken so violently that the individual grains lose contact with one another and "float" freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may actually sink quicksand-like into what was previously solid ground. Lastly, unless properly secured, hazardous materials releases can cause significant damage to the surrounding environment and people.

Exposure Inventory

All of the Shoalwater Bay Indian Tribe's people, property and natural resources are exposed to earthquakes, particularly Subduction earthquakes.

Vulnerability

The Shoalwater Bay Indian Tribe is extremely vulnerable to earthquakes, particularly a Cascadia Subduction Zone vent. The Tribe is located in an extremely remote area of Washington State that has limited access. A major earthquake could also cause landslides that destroy bridges and roads leading into the area, cutting of ingress and egress for emergency services and basic supplies. The Shoalwater Bay Indian Reservation and the Tribe's properties are all located on Moderate-to-High Liquefaction Susceptible Soils and NEHRP D (moderate to high amplification) soils.

[26] California Institute of Technology, Caltech 336, "System gets the jump on quakes"

Loss Estimation

FEMA has developed a detailed methodology to estimate damages from earthquakes based on the strength and location of an earthquake and also the characteristics of Shoalwater Bay Tribal structures, such as year built, foundation and building materials, such as wood-frame, tilt-up or steel frame. Unfortunately, at this time it is not possible to conduct a detailed inventory of all structures on the Shoalwater Bay Reservation to come up with an accurate loss estimate. For this estimate, general values were used. The values used in this loss estimation are a hypothetical estimate of all *potential* damage. Its purpose is to come up with a value that can be used to compare with other hazards, in order to prioritize and focus mitigation efforts. Loss estimate accounted for all structures on Shoalwater Bay Reservation.

It has been estimated that the Shoalwater Bay Indian Reservation could endure shaking of Peak Ground Acceleration values of 65-70% of gravity or even higher.

On page 4-17 of the FEMA How-to Guide for Mitigation Planning, the lost estimation table for wood frame structures (all Tribal housing and facilities are wood frame) was used to determine a Building Damage Ratio. Generally, Tribal structures are built to moderate to high seismic design levels. Unfortunately PGA values in the table are lower than predicted PGA values the Reservation may experience. To compensate, we estimated damages based on the highest PGA value available, 55%, and downgraded the seismic design of Tribal structures to Pre-code.

Please note this was only used for a general loss estimate. A seismologist and a structural engineer should be consulted to determine detailed Building Damage Ratios for the Shoalwater Bay Indian Reservation.

Assumptions:

PGA value used for this estimate is **55% of gravity**

The estimated damage to wood frame pre-code structures is **36.8%**

FEMA suggests that damage to content value be estimated as ½ of the damage to improvements, or **18.4%**

Insured value of Tribal buildings: **$19.7 Million**

Insured content value: **$8.71 Million**

Loss estimation:

Estimated loss to earthquake-prone structures is **$7,249,600**

Estimated loss to contents is **$1,602,640**

Table 4-9: Earthquake Loss Estimates

Structure & Content Loss Estimates for SBIT (in millions of $)			
	Structure	Contents	Total
Tribal Facilities & Infrastructure	$4.49	$1.00	$5.49
Tribal Housing	$1.21	$0.21	$1.42
Private Housing	$1.55	$0.39	$1.94
Total	$7.25	$1.60	**$8.85**

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Figure 4-8: Shoalwater Bay Reservation Area NEHRP Soil Classification

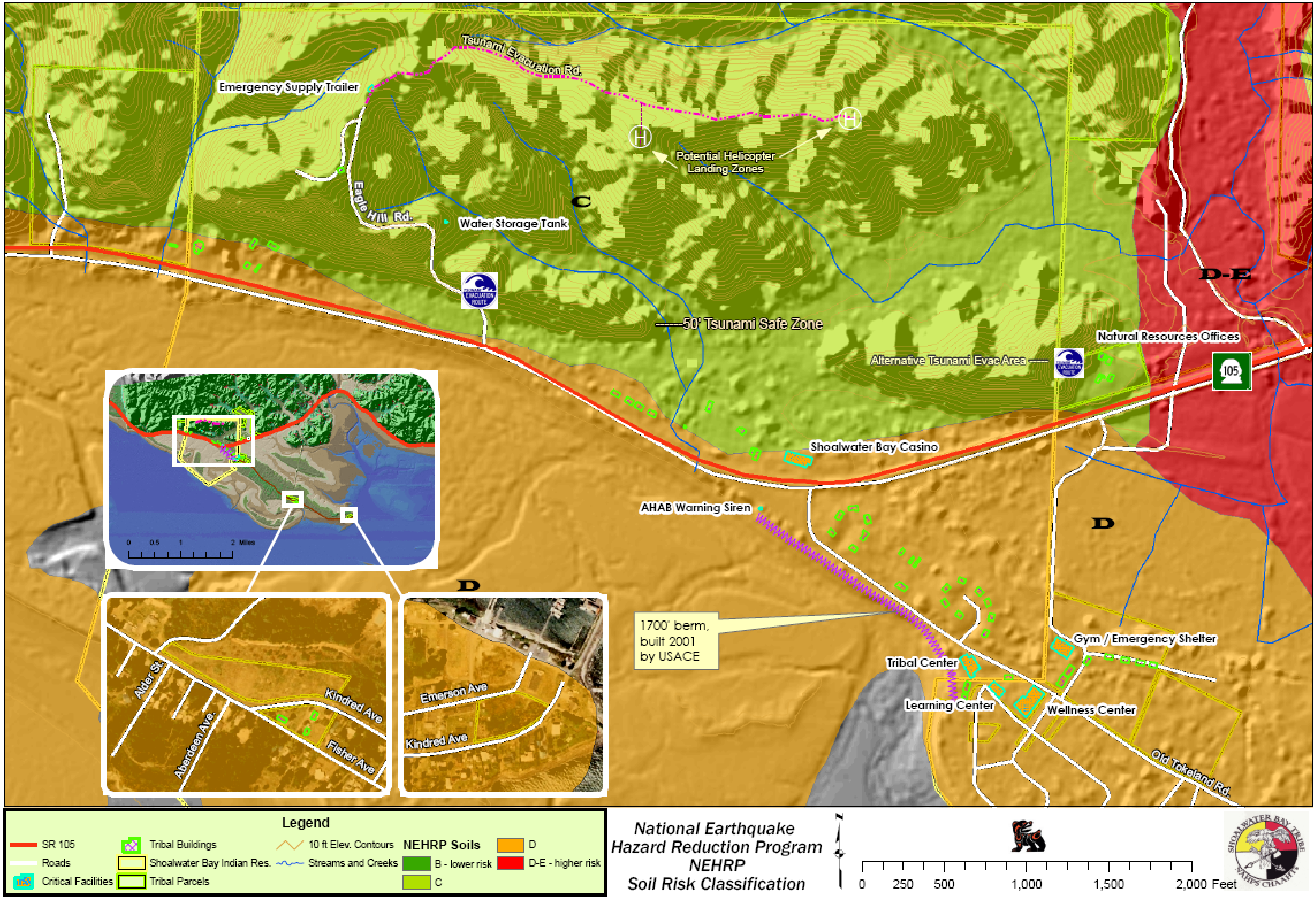

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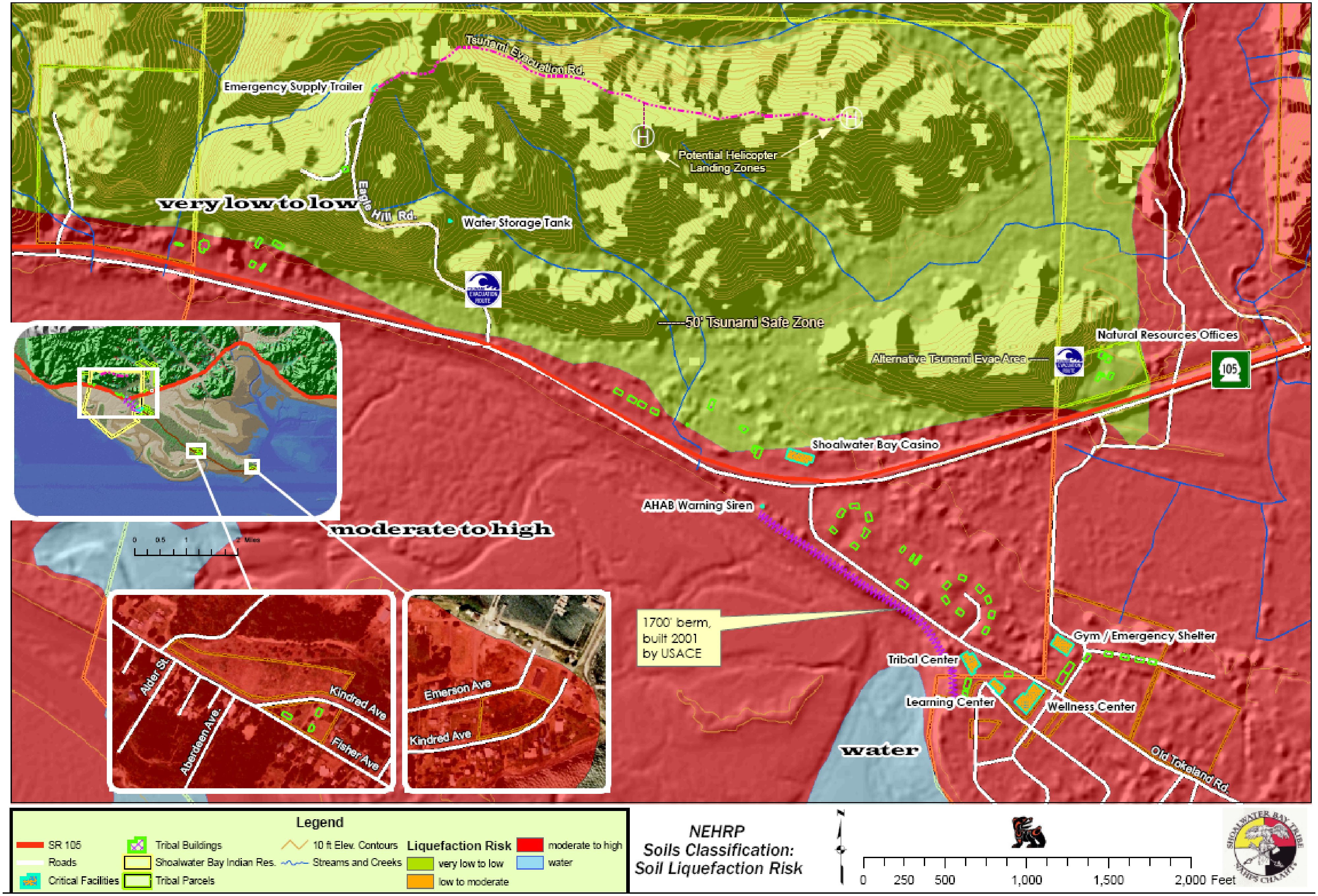
Figure 4-9: Shoalwater Bay Reservation Area Soil Liquefaction Risk



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4.4. Flood

Definitions

Avulsion: In Property law, **avulsion** refers to a sudden loss or addition to land, which results from the action of water. It differs from **accretion**, which describes a gradual loss or addition to land resulting from the action of water.

Base Flood Elevation (BFE): The base flood elevation is the elevation of a 100 year flood event, or a flood, which has a 1% chance of occurring in any given year.

Basin: A basin is the area within which all surface water- whether from rainfall, snowmelt, springs or other sources- flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains and ridges. Basins are also referred to as **Watersheds** or **Drainage Basins**.

Channel Migration Zone (CMZ): The area where the active channel of a stream or river is prone to movement over time.

Coastal Flooding: The inundation of land areas along the coast caused by sea water above normal tidal actions

Cubic Feet per Second (cfs): Discharge or river flow is commonly measured in cfs. One cubic foot is about 7.5 gallons of liquid.

Flood Insurance Rate Map (FIRM): FIRMs are the official maps on which the Federal Emergency Management Agency (FEMA) has delineated the Special Flood Hazard Area (SFHA).

Floodplain: Floodplains are the land area along the sides of rivers that becomes inundated with water during a flood. Floodplain can be defined in different ways, but is commonly defined as the area that is also called the 100 year floodplain. The term 100 year flood is misleading. It is not the flood that will occur once every 100 years. Rather, it is the flood that has a 1% chance of being equaled or exceeded each year. Thus, the 100 year flood could occur more than once in a relatively short period of time. Because this term is misleading, FEMA has properly defined it as the 1% annual chance flood. This 1% annual chance flood is now the standard used by most Federal and State agencies and by the National Flood Insurance Program.[27]

Floodway: Floodways are areas within a floodplain that are reserved for the purpose of conveying flood discharge without increasing the base flood elevation more that one-foot. Generally speaking, no development is allowed in floodways, as any structures located there would block the flow of floodwaters.

Floodway Fringe: Floodway fringe areas are those lands that are in the floodplain but outside of the floodway. Some development is generally allowed in these areas with a variety of different restrictions.

[27] Definition from: FEMA, http://www.fema.gov/fhm/fq_gen23.shtm

Flood Zone Designations: These are the different flood hazard zones FEMA uses for FIRMs. These designations may be found on the flood hazard maps for Whitman County's communities.

Zone A: An area inundated by 100-year flooding, for which no Base Flood Elevations (BFEs) have been determined.

Zone AE: An area inundated by 100-year flooding, but for which BFEs have been determined.

Zone ANI: An area that is located within a community or county that is not mapped on any published FIRM.

Zone X500: An area inundated by 500-year flooding; an area inundated by 100-year flooding with average depths of less than 1 foot or with drainage areas less than 1 square mile; or an area protected by levees from the 100-year flooding.

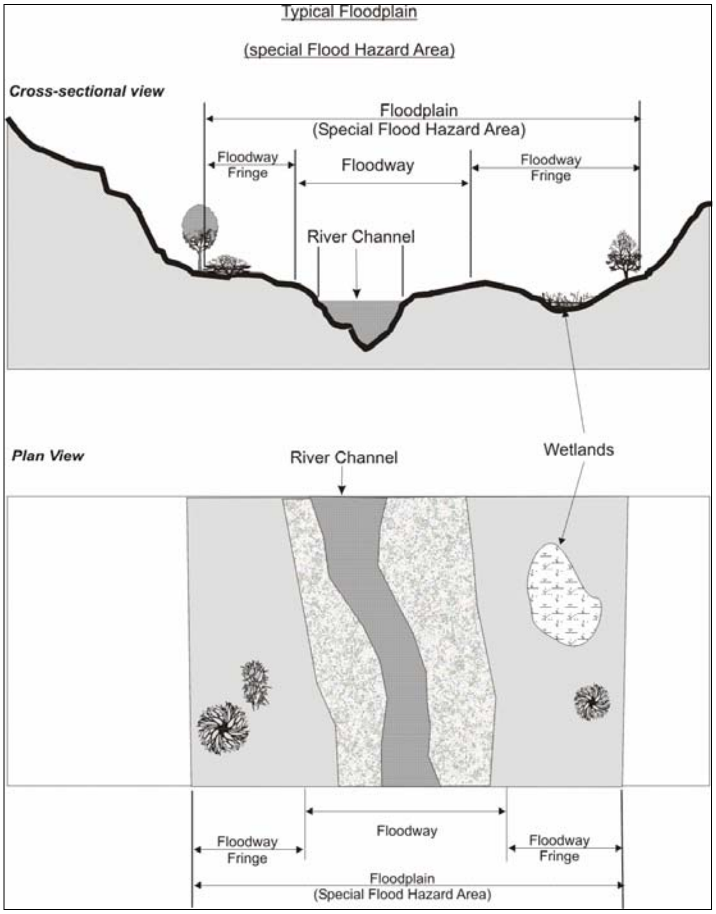
National Flood Insurance Program:[28] In 1968, Congress created the National Flood Insurance Program (NFIP) in response to the rising cost of taxpayer funded disaster relief for flood victims and the increasing amount of damage caused by floods.

The Mitigation Division is a section of the Federal Emergency Management Agency (FEMA) manages the NFIP, and oversees the floodplain management and mapping components of the Program. Nearly 20,000 communities across the United States and its territories participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities.

FEMA contracted the Army Corps of Engineers to map the floodplains, floodways, and floodway fringes. **Figure 4-10** depicts the relationship among the three designations.

[28] Definition from FEMA: http://www.fema.gov/nfip/whonfip.shtm

Figure 4-10: Floodway Schematic



Pre and Post FIRM rates:[29] Category of rates published in the National Flood Insurance Program Manual, applying to buildings located in a community qualifying for the regular flood program. Post-FIRM rates are used on building construction that started after December 31, 1974, or after the community's initial Flood Insurance Rate Map was published, whichever is later. These rates are lower than pre-FIRM rates.

Repetitive Loss Properties:[30] Any NFIP-insured property that, since 1978 and regardless of any change(s) of ownership during that period, has experienced:

a) Four or more paid flood losses in excess of $1000.00; or
b) Two paid flood losses in excess of $1000.00 within any 10-year period since 1978 or
c) Three or more paid losses that equal or exceed the current value of the insured property.

Special Flood Hazard Area: The base floodplain delineated on a Flood Insurance Rate Map. The SFHA is mapped as a Zone A in riverine situations and zone V in coastal

[29] Definition from: http://insurance.cch.com/rupps/post-firm-rates.htm
[30] Definition from FEMA: http://www.fema.gov/nfip/replps.shtm

situations. The SFHA may or may not encompass all of a community's flood problems.

Storm Surge: A rise above the normal water level along a shore caused by strong onshore winds and/or reduced atmospheric pressure. The surge height is the difference of the observed water level minus the predicted tide.

Subbasin: A subbasin is a tributary basin of a larger basin or watershed.

Water Resource Inventory Area (WRIA): WRIAs were formalized under WAC 173-500-040 and authorized under the Water Resources Act of 1971, RCW 90.54. Ecology was given the responsibility for the development and management of these administrative and planning boundaries. These boundaries represent the administrative under pinning of this agency's business activities. The original WRIA boundary agreements and judgments were reached jointly by Washington's natural resource agencies (Ecology, Natural Resources, Fish and Wildlife) in 1970.

Zero-Rise Floodway: A 'zero-rise' floodway is an area reserved to carry the discharge of a flood without raising the base flood elevation. Some communities have chosen to implement zero-rise floodways because they provide greater flood protection than the floodway described above, which allows a one foot rise in the base flood elevation.

General Background

A flood is the inundation of normally dry land resulting from the rising and overflowing of a body of water. A natural geologic process that shapes the landscape, floods provide habitat and create rich agricultural lands. But Floods can cause loss of life and damage to structures, crops, land, flood control structures, transportation infrastructure (roads and bridges) and utilities. Floods also cause erosion and landslides, and can transport debris and toxic products that cause secondary damage. Flood damage in Washington State exceeds damage by all other natural hazards.

There have been 30 Presidential Major Disaster Declarations for floods in Washington State from 1956 through 2006. Every county has received a Presidential Disaster Declaration for flooding since 1970. While not every flood creates enough damage to merit a declaration, most are severe enough to warrant intervention by local, state or federal authorities.

Since 1980, federal, state and local governments have invested more than $522 million to repair public facilities, help individuals recover from flood disasters, and pay for measures to prevent future flood damage. This is nearly 40 percent of the more than $1.37 billion amount spent on disaster relief and hazard mitigation during this time. The built environment creates often localize flooding problems outside natural floodplains by altering or confining drainage channels. This increases flood potential in two ways: 1) it reduces the stream's capacity to contain flows; and 2) increases flow rates downstream. Floods also cause erosion and landslides, and can transport debris and toxic substances that can cause secondary hazards.

Hazard Profile

The Shoalwater Bay Indian Reservation is affected by Storm or tidal surge. Tidal surge is an offshore rise of water associated with a **low pressure** weather system, typically a **tropical cyclone**. Storm surge is caused primarily by high **winds** pushing on the **ocean**'s surface. The wind causes the water to pile up higher than the ordinary **sea level**. Low pressure at the center of a weather system also has a small secondary effect, as can the **bathymetry** of the body of water. It is this combined effect of low pressure and persistent wind over a shallow water body which is the most common cause of storm surge flooding problems. The term "storm surge" in casual (non-scientific) use is storm tide; that is, it refers to the rise of water associated with the storm, plus tide, wave run-up, and freshwater flooding.

Past Events

The Pacific Co Flood insurance Study (written in 1985) identified past flooding events:

“Major coastal and tidal floods, in order of highest water, have occurred in 1934, 1933, 1973, 1969, 1972 and 1960.”[31]

More recent events include:

- **1999 storm surge**
  On March 3, 1999, a storm surge of 4.6 feet, accompanied by 49.7 mile an hour winds, caused widespread coastal flooding. Wave heights exceeded 29.5 feet for over 5 hours, peaking at 34.8 feet. At Ocean Shores, several houses were damaged and a public restroom was destroyed. This combined storm and high tide caused severe flooding of the Shoalwater Bay Reservation shoreline and the surrounding community. The flooding prompted the initiation of a Corps of Engineers emergency flood protection planning process. As a consequence, in March 2001, the Corps of Engineers constructed a riprap flood berm along a small portion (1,700 feet) of the Shoalwater Reservation shoreline. This flood berm provides protection from direct wave attack and further shoreline erosion during combined storm and high tide events only to this portion of the Reservation shoreline, including the Tribal headquarters building.

November 2007 Flooding

December 2007 Flooding: Disaster Declaration

[31] Pacific Co FIS, p. 6

Location

The Shoalwater Bay Indian Reservation is affected by Coastal flooding caused by tidal and storm surge. The Reservation is generally not affected by riverine or surface flooding.

Portions of the shoreline that is not protected by the flood berm – and the tribal infrastructure located on these lands – will continue to be overtopped by storm waves at extreme high tide, causing flooding of all the low lying backshore areas of the Shoalwater Reservation with elevations lower than approximately **+15 feet mean lower low water (MLLW)[32]. This is about 6 feet above mean higher high tide.**

Frequency

The Washington State Hazard Mitigation Plan identified Pacific County's frequency of major flooding to be at least once every five years. The Shoalwater Bay Indian Reservation experiences at least minor flooding every year from storm and tidal surge.

Severity

Coastal flooding, especially those occurring during high tide, on the Shoalwater Bay Indian Reservation can be quite severe, inundation homes and structures and washing debris onto shore which can block roads and damage property. With the erosion of Cape Shoalwater and the barrier islands protecting the Reservation, the severity may increase. Furthermore sea-level rise caused by human-induced rapid global warming may increase the severity of coastal flooding.

Warning Time

Major storms with strong tidal surges can be predicted days in advance, although the severity may not be as predictable. High tides can also be predicted well in advanced.If a major event is predicted or underway, the Tribe may call the National Guard, Army Corps of Engineers and/or the Wa State EMD to pre-position flood control assets such as temporary berms.

Secondary Hazards

The major secondary hazards caused by flooding are landslides and erosion. Severe weather and flooding can saturate the soil, making it more susceptible to landslides. Debris from flooding, such as driftwood, can also cause damage. Hazardous materials can also be transported by floodwaters.

[32] Appendix 1, Engineering Analysis and Design, Shoalwater Bay Shoreline Erosion Study, p.9

Exposure Inventory

The whole Shoalwater Bay Indian Reservation as well as Trust lands in Tokeland are exposed to Coastal flooding.

Further analysis was conducted using GIS mapping software using two methods to determine exposure. The first method used digital Flood Insurance Rate Maps (D-FIRMS) of 100 and 500 year flood zones to identify Tribal Properties and Structures within these zones.

The second method utilized high-resolution LIDAR elevation data. Using the Army Corps of Engineer's flood elevation height of 15 feet above Mean Low Low Water, (about 6 feet above mean High High Tide), structures and properties below 15 ft. MLLW were identified.

Results:

FEMA Floodplain Maps:

Structures: At least 41 homes and Tribal facilities, including the Casino, Tribal Center, Wellness Center and Gymnasium were located in the 100 or 500 year floodplain. The Wellness Center was mostly located in the 500 year floodplain and the gym was completely located in the 500 year floodplain.

Properties: The tribal properties at the "Y location" (intersection of Fisher and Kindred Avenues), Tokeland as well as the Property at Toke Pt are located in the 100 year floodplain.

LIDAR data using 15' above MLLW for storm flood height:

Structures: At least 16 structures, including the Casino were located in areas below 15' feet above MLLW. Many other structures, such as the gym/evacuation shelter were surrounded by areas lower than the predicted flood height, or were only 1 or 2 feet above 15' elevation height.

Properties: The tribal properties at the "Y location" (intersection of Fisher and Kindred Avenues), Tokeland as well as the Property at Toke Pt are located in areas lower than 15' above MLLW

Vulnerability

As mentioned, the whole of the Shoalwater Bay Indian Reservation is exposed to flooding. Most Tribal structures are located in the 100-year floodplain, although some housing is located in the 500-year floodplain or just outside of it. Many structures are located below 15' elevation above Mean Low low Water, the Army Corps of Engineer's predicted storm surge height for flooding. Tokeland Rd is below 15' elevation and could be blocked. Most tribal structures are not elevated above floodplain levels.

National Flood Insurance Policies and Claims

The Shoalwater Bay Indian Tribe is in the National Flood Insurance Program.[33]
The Tribe (CID #530341) joined the NFIP January 4th, 2002, adopting Pacific County's (CID # 530126) FIRM Panel No. 0016, the effective date of which was 9/27/1985. Coastal erosion and sea level change has affected the accuracy of the map and should be updated. The Shoalwater Bay Indian Tribe affirms continued compliance with the requirements of the National Flood Insurance Program.

The Tribe currently does not carry flood insurance on its structures located in the 100 or 500 floodplains and thus has not filed any claims since joining the NFIP.

Repetitive Loss Structures

The Tribe identifies all of its structures as Repetitive Loss Structures.

Loss Estimation

Flood loss estimates are based on damage curves developed by FEMA. These numbers do not represent the total estimated value a flood may cost, but rather a hypothetical estimate of all *potential* damage. Its purpose is to come up with a value that can be used to compare with other hazards, in order to prioritize and focus mitigation efforts. Flood damage estimation percentages come from the Flood Loss Estimation Tables found in the FEMA How-to Guide.[34] It should also be noted that these damage estimates were not calculated for the type of coastal flooding that can occur in SW Washington State, although methodologies are being developed by FEMA. .

Assumptions:

Due to the differing results of the flood exposure analysis, as well as the effects of other factors, including Climate Change, El Niño effects, continued Coastal Erosion and Sea level Rise, it was determined to use Damage Estimates for a flood depth of 2 feet for all Tribal Structures.

For a storm surge occurring during Mean high-high tide, it is assumed that:

[33] Tribal information from The NFIP Community Status Book, WA State http://www.fema.gov/cis/WA.pdf
[34] Understanding Your Risk, Estimate Losses, p. 4-13

Flooding can reach depths of **2 feet**

Buildings: One story, no basement

Building damage estimate: **22%**

Building content damage (damage to TVs, furnaces, furniture) estimates are of insured content value: **33%**

Loss estimate:

Estimated loss to structures from flood is **$4,334,000**

Estimated loss to contents from flood is **$2,874,300**

Table 4-10: Flood Damage Estimates

Structure & Content Values for SBIT (in millions of $)			
	Structure	Contents	Total
Tribal Facilities & Infrastructure	$2.68	$1.80	$4.48
Tribal Housing	$0.73	$0.38	$1.11
Private Housing	$0.92	$0.69	$1.61
Total	$4.33	$2.87	**$7.20**

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Figure 4-11: FEMA Floodplains

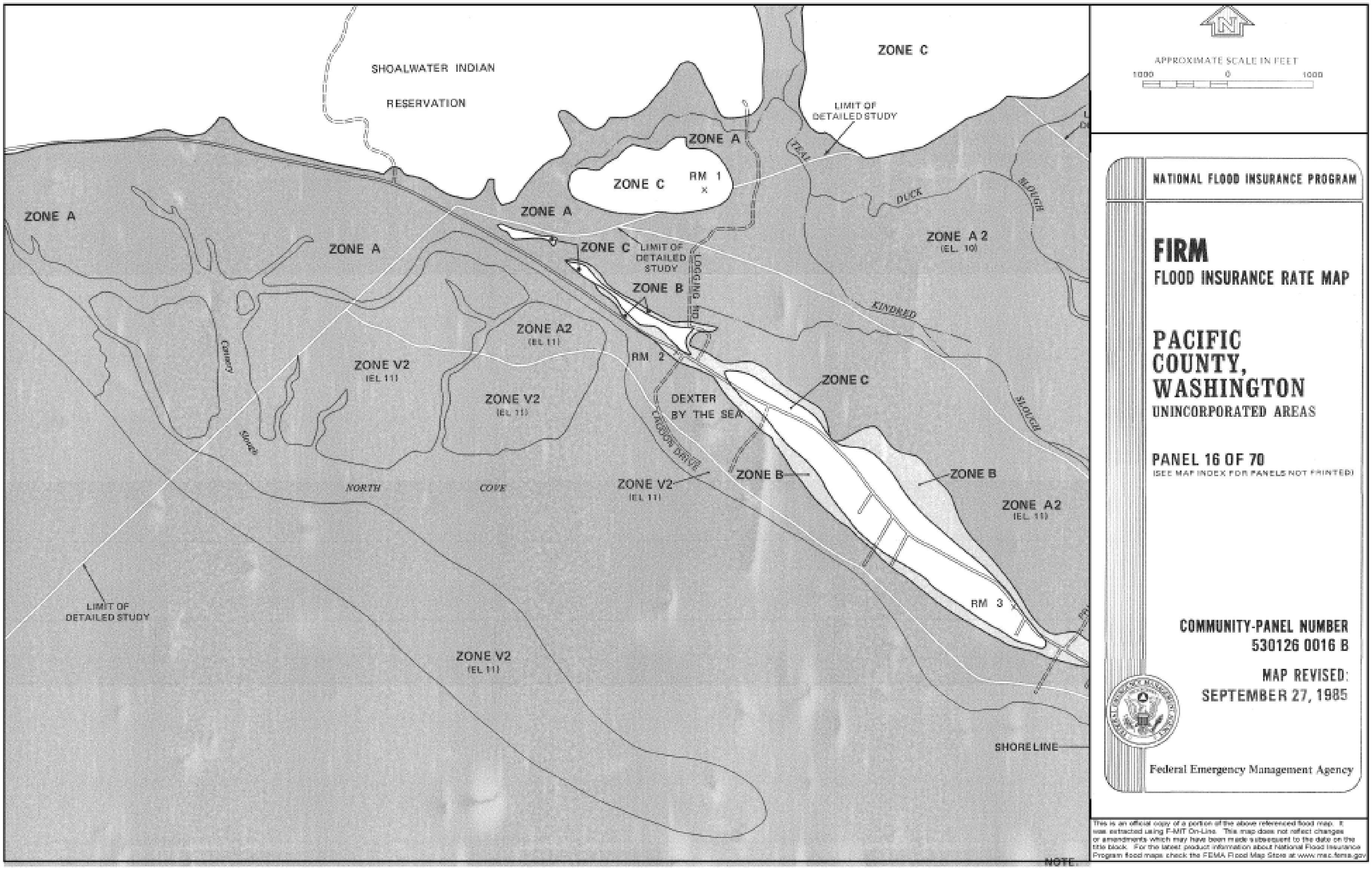

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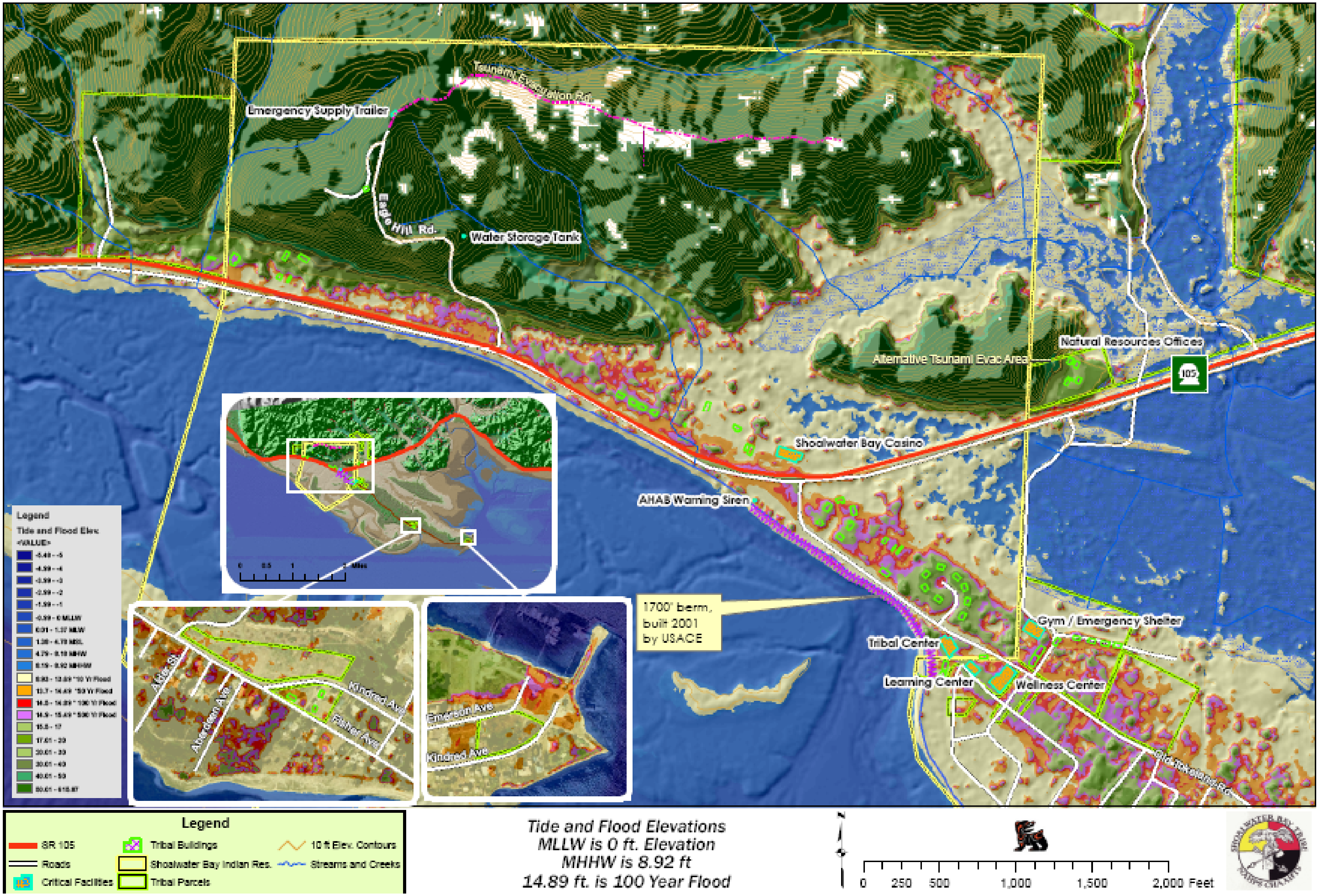
Figure 4-12: Floodplain Using LiDAR Elevations



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4.5. Landslides

Definitions

Debris Slides: Debris slides consist of unconsolidated rock or soil that have moved rapidly down slope. They occur on slopes greater than 65%.

Earthflows: Earthflows are slow to rapid down slope movements of saturated clay-rich soils. This type of landslide typically occurs on gentle to moderate slopes but can occur on steeper slopes especially after vegetation removal.

Landslide: Landslides can be described as the sliding movement of masses of loosened rock and soil down a hillside or slope. Fundamentally, slope failures occur when the strength of the soils forming the slope exceeds the pressure, such as weight or saturation, acting upon them.

Mass movements: A collective term for landslides, mudflows, debris flows, sinkholes and lahars.

Rock falls: A type of landslide that typically occurs on rock slopes greater than 40% near ridge crests, artificially cut slopes and slopes undercut by active erosion.

Rotational-Translational slides: A type of landslide characterized by the deep failure of slopes, resulting in the flow of large amounts of soil and rock. In general, they occur in cohesive slides masses and are usually saturated clayey soils.

Sinkholes: A collapse depression in the ground with no visible outlet. Its drainage is subterranean, its size typically measured in meters or tens of meters, and it is commonly vertical-sided or funnel-shaped.

Steep Slope: Different communities and agencies define it differently, depending on what it is being applied to, but generally a steep slope is a slope in which the percent slope equals or exceeds 25%.

General Background[35]

Landslide is the movement of rock, soil and debris down a hillside or slope. Landslides take lives, destroy homes, businesses, and public buildings, interrupt transportation, undermine bridges, derail train cars, cover marine habitat, and damage utilities. The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Ground failures that result in landslides occur when gravity overcomes the strength of a slope. While gravity is the primary reason for a landslide, there can be other contributing factors, including:

[35] from WA HIVA http://emd.wa.gov/plans/documents/Tab_7.1.5_Landslide_final.pdf

- Saturation, by snowmelt or heavy rains, that weaken rock or soils on slopes.
- Erosion by rivers, glaciers, or ocean waves that create over-steepened slopes.
- Topography of a slope – its shape, size, degree of slope and drainage.
- Stress from earthquakes magnitude 4.0 and greater can cause weak slopes to fail.
- Volcanic eruptions that produce loose ash deposits and debris flows.
- Excess weight, from accumulation of rain or snow, from stockpiling of rock or ore, from waste piles, or from manmade structures, may stress weak slopes to failure.
- Human action, such as construction, logging or road building that disturbs soils and slopes.

Landslides occur where certain combinations of geologic formations are present. For example, groundwater can accumulate and zones of weakness can develop when layers of sand and gravel lay above less permeable silt and clay layers. In the Puget Sound region, for example, this combination is common and widespread; glacial outwash, often Esperance Sand or gravel, overlies the fine-grained Lawton Clay or Whidbey formation.

Commonly, landslides occur on slopes and in areas where they have taken place before, as well as in areas where they have not been previously documented. Areas in Washington State historically subject to landslides include the Columbia River Gorge, the banks of Lake Roosevelt, the Interstate 5 corridor, U.S. 101 Highway corridor along the Pacific Coast and from the coast to Olympia, the Cascade and Olympic mountain ranges, and Puget Sound coastal bluffs.

Determining probability of future landslide events is difficult because so many factors can contribute to the cause of a landslide or ground failure. Scientists from the U.S. Geological Survey are testing a pilot system that warns of increased risk of landslides in Seattle during certain heavy rainfall events. Such a system is possible, and only applies to Seattle, because the city has extensive records of landslides covering nearly a century.

Past Events

There is no record of past landslides in the immediate area of the Reservation.

Location

The Shoalwater Bay Tribal lands are located in one of the six landslide provinces of Washington State:

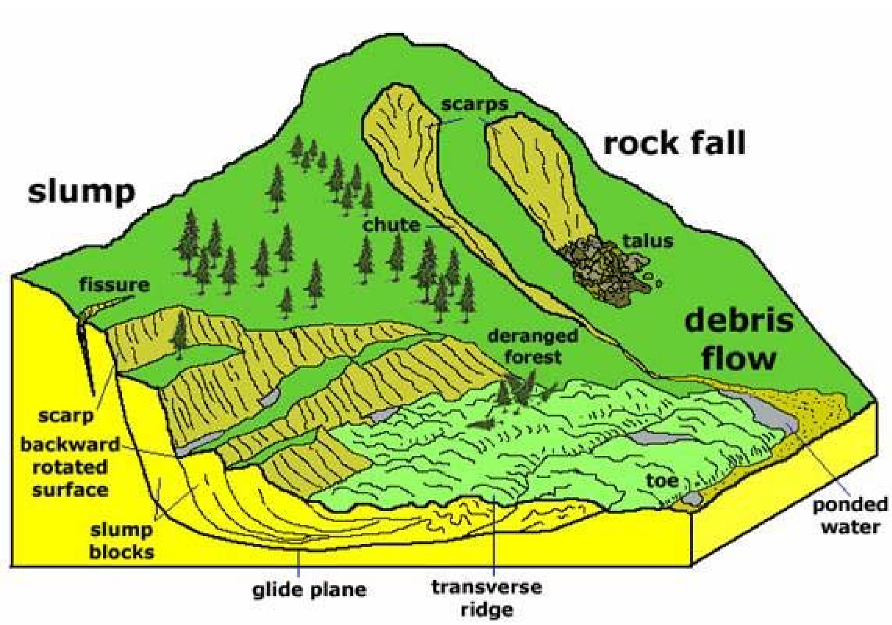
Southwest Washington

The primary characteristics of this landslide province are the lack of glaciation and localized exposure to glacial melt waters. In places, weathering processes exposed surfaces in this province for millions of years. Much of the province has deeply dissected terrain, with gentle slopes uncommon.

• Earth flow – This is the dominant form of landslide in the province. Both ancient and active earth flows are common, not only in the high and steep terrain, but also in the low, rolling hills of the Chehalis-Centralia area. Stream erosion along the toes of the flow usually causes reactivation of these landslides. Excavations, such as those for freeway construction, also may reactivate dormant earth flows or start new ones.

• Debris flow – These types of landslides are locally a problem in the western Cascades and Olympic mountains; they tend to occur where the rocks are strong and relatively un-weathered. These rocks tend to have steep slopes and smooth surfaces overlain by thin soils. Intense rainstorms, or rain on the wet snow in the mountains trigger these landslides.

Figure 4-13: Types of Landslides



Shoalwater Bay Indian Reservation

Although the developed areas of the Shoalwater Bay Indian Reservation is on the flat coastal plain, the northern part of the Reservation is made up of steep hills subject to landslides. Eagle Hill Road and the Potable Water system are in this area.

Frequency

Landslides are often triggered by other natural hazards such as earthquakes, heavy rain, floods or wildfires. The frequency of a landslide is related to the frequency of earthquakes, heavy rain, floods, and wildfires. Because there is no inventory of past landslide events in the area, it is impossible at this time to determine a frequency of reoccurrence.

Severity

Landslides destroy property, infrastructure, transportation systems, and can take the lives of people. Slope failures in the United States result in an average of 25 lives lost per year and an annual cost to society of about $1.5 billion. [36]

Warning Time

Mass movements can occur either very suddenly or slowly. There are methods used to monitor mass movements that can provide an idea of type of movement and amount of time prior to failure. It is also possible to determine what areas are at risk during general time periods. Assessing the geology, vegetation, and amount of predicted precipitation for a given area can help in these predictions.

Secondary Hazards

Landslides can typically cause several different types of secondary effects. Several landslides have blocked egress and ingress on roads. This has the potential to cause isolation for affected residents and businesses. Roadway blockages caused by landslides can also create traffic problems resulting in delays for commercial, public and private transportation. This could result in economic losses for businesses.

Other potential problems resulting from landslides are power and communication failures. Vegetation on slopes or slopes supporting poles can be knocked over resulting in possible losses to power and communication lines. This, in turn, creates communication and power isolation. Landslides also have the potential of destabilizing the foundation of structures that may result in monetary loss for residents.

It is possible for landslides to affect environmental processes. Landslides can damage rivers or streams, potentially harming water quality, fisheries and spawning habitat.

[36] http://www.metrokc.gov/prepare/hiva/landslide.htm

Exposure

The northern half of the Shoalwater Bay Indian Reservation is made up of steep hills that can potentially have landslides. Eagle Hill Road and the Potable water system, including the 57,000 gallon storage tank, are exposed to landslides.

Vulnerability

The Tribe's main vulnerability from landslides is from the potential blockage and closure of SR 105. West of the Reservation, at Washaway Beach, there is a steep slope that if it failed, would wash out SR 105 and prevent access north to Westport and beyond.

East of the Reservation, between the Cedar River and the mouth of the Willapa River at Johnson Slough, SR 105 straddles steep rocky hills made up of terraced sediments. A rock or debris slide from these hills would also potentially block access to Raymond, Highway 101 and points beyond.

On the Reservation the main vulnerability from landslides is the Water system. A landslide on the hill could destroy the water tank and its infrastructure. Parts of Eagle Hill Rd. could also be lost in landslides, preventing access to the Tsunami Evacuation Road and the Water Tank.

Loss Estimation

The primary potential structural loss from a landslide is to the water tank/ water system. The estimated cost to replace this would be $700,000.

Assuming that the water tank would be totally lost in landslide, the estimated loss from landslides is: **$700,000.**

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Figure 4-14: Landslide Hazard Zones (Slopes > 15%)

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4.6. Severe Weather

Definitions

Advection fog: Cool moist air that moves inland from the ocean at night and turns to haze throughout the day.

Aleutian Low: A large area of low pressure on or over the Aleutian Islands of Alaska. Temperate and polar winds meet here, creating major action for air circulation in the western hemisphere.

Cyclone: Winds blowing counterclockwise around a low pressure area in the Northern Hemisphere.

Gale: A sustained wind of 39 to 54 miles per hour (34 to 47 knots).

Hurricane force wind: Sustained winds of 74 miles per hour (64 knots) or more.

Pacific High: A large high pressure system located in the Eastern North Pacific.

Storm surge: Abnormally high, wind-driven surf that rises above normal high tide or high surf levels and inundates coastal areas, eroding beaches and destroying shoreline roads and structures.

Squall line: A distinct line of instability, usually bringing turbulence, wind, and heavy rain.

General Background

The location of the State of Washington on the windward coast in mid-latitudes is such that climatic elements combine to produce a predominantly marine-type climate west of the Cascade Mountains, while east of the Cascades the climate possesses both continental and marine characteristics.

The state's climate is impacted by two significant factors:

- Mountain ranges: The Olympic Mountains and the Cascade Mountains affect rainfall. The first major release of rain occurs along the west slopes of the Olympics, and the second is along the west slopes of the Cascade Range. Additionally, the Cascades are a topographic and climatic barrier. Air warms and dries as it descends along the eastern slopes of the Cascades, resulting in near desert conditions in the lowest section of the Columbia Basin in eastern Washington. Another lifting of the air occurs as it flows eastward from the lowest elevations of the Columbia Basin toward the Rocky Mountains. This results in a gradual increase in precipitation in the higher elevations along the northern and eastern borders of the state.
- Location and intensity of semi-permanent high and low-pressure areas over the North Pacific Ocean: During the summer and fall, circulation of air around

> a high-pressure area over the North Pacific brings a prevailing westerly and northwesterly flow of comparatively dry, cool and stable air into the Pacific Northwest. As the air moves inland, it becomes warmer and drier, resulting in a dry season. In the winter and spring, the high pressure resides further south while low pressure prevails in the Northeast Pacific. Circulation of air around both pressure centers brings a prevailing southwesterly and westerly flow of mild, moist air into the Pacific Northwest. Condensation occurs as the air moves inland over the cooler land and rises along the windward slopes of the mountains. This results in a wet season beginning in late October or November, reaching a peak in winter, and gradually decreasing by late spring.

In interior valleys, measurable rainfall occurs on 150 days each year and on 190 days in the mountains and along the coast. Thunderstorms over the lower elevations occur up to 10 days each year and over the mountains up to 15 days.

During the wet season, rainfall is usually of light to moderate intensity and continuous over a period of time, rather than heavy downpours for brief periods; heavier intensities occur along the windward slopes of the mountains.

The strongest winds are generally from the south or southwest and occur during the fall and winter. In interior valleys, wind velocities reach 40 to 50 mph each winter, and 75 to 90 mph a few times every 50 years. The highest summer and lowest winter temperatures generally occur during periods of easterly winds.

During the coldest months, freezing drizzle occasionally occurs, as does a Chinook wind that produces a rapid rise in temperature. Chinook winds (referring to the Indian Tribe in southwest coastal Washington are warm, moist wind patterns originating in the Pacific Ocean during the winter that cool, and then rapidly warm as they pass over the western and eastern slopes of the Cascades and Rockies. On the Columbia Plateau they can cause drastic and rapid increases in temperature, which can also cause rapid snow melt and contribute to flooding. Chinook winds are more commonly referred to as the Pineapple Express nowadays.

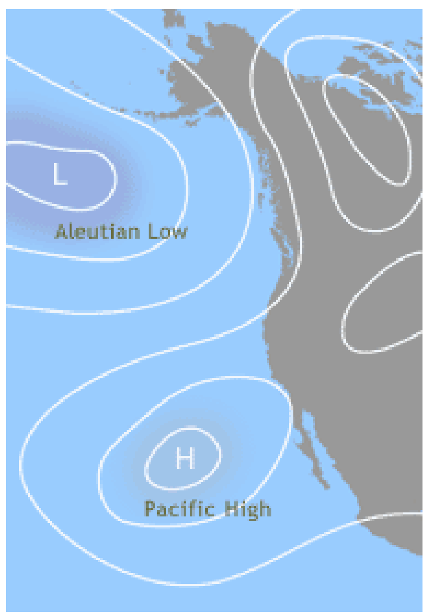
During most of the year, the prevailing wind is from the southwest or west. The frequency of northeasterly winds is greatest in the fall and winter. Wind velocities ranging from four to 12 mph can be expected 60 to 70 percent of the time; 13 to 24 mph, 15 to 24 percent of the time; and 25 mph or higher, one to two percent of the time. The highest wind velocities are from the southwest or west and are frequently associated with rapidly moving weather systems. Extreme wind velocities can be expected to reach 50 mph at least once in two years; 60 to 70 mph once in 50 years; and 80 mph once in 100 years.

Hazard Profile

"A hard rain all the last night we again get wet the rain continues at intervales all day. Wind verry high from SW and blew a storm all day ...and our situation is truly a disagreeable one."
--- William Clark, Lewis & Clark Expedition, Monday, Nov. 11, 1805

Severe storms hit Washington's coast during the winter, bringing heavy rains, strong winds, and high waves. Storms blow in about 70 to 100 inches of rain per year, the heaviest precipitation on the continent north of Guatemala. Coastal storm winds regularly top 40 miles per hour. The annual peak speed of 55 miles per hour can topple chimneys, utility lines, and trees. The Shoalwater Bay Indian Reservation is continually affected by severe storms each winter. The most recent storm in December of 2007 led to a Presidential Declaration and cut off the Shoalwater Bay Tribe's electricity and water supply (which runs on electricity) for days. Communications and access to the area was also limited.

Figure 4-15: Aleutian Low



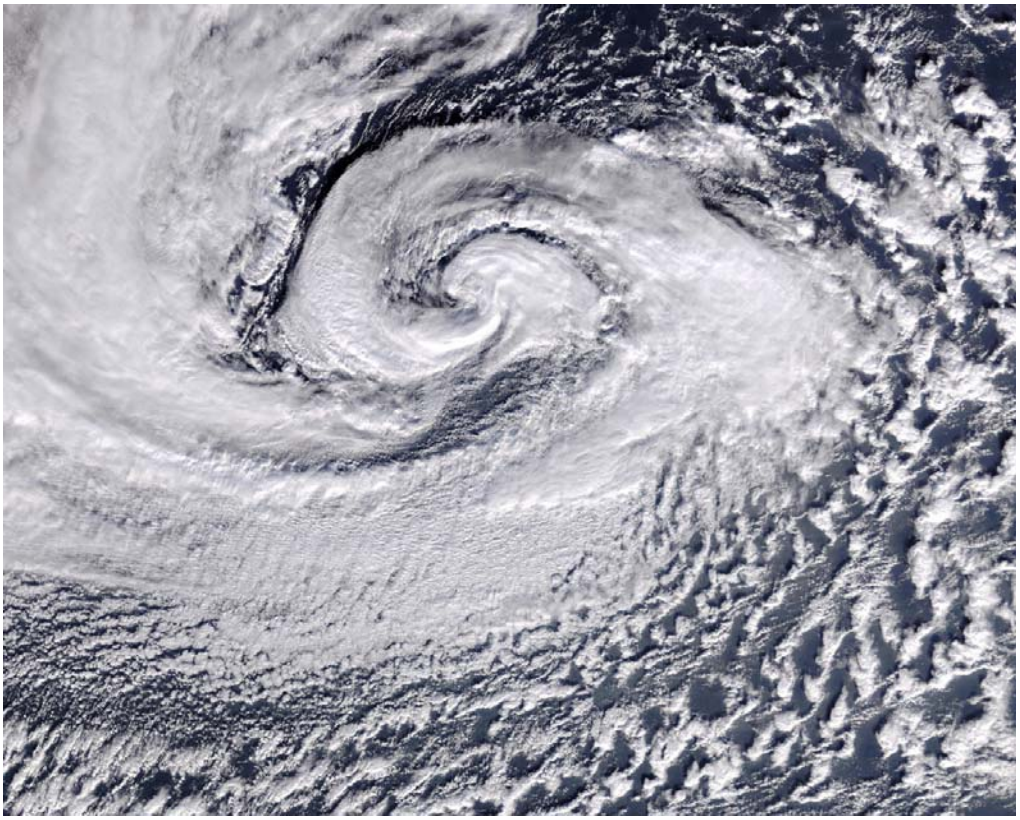
Severe weather on the coast is caused by a weather phenomenon called the Aleutian Low. Large cyclonic systems sweep down from the Alaska panhandle, bringing storms to Washington's coast. Cyclonic systems sometimes line up, one after the other, causing stormy weather on Washington's coast for weeks. Storms spawned off the coasts of Japan and Siberia circle around the Pacific High into the Aleutian Low, rekindling old storms and starting new ones. Winter storms also bring coastal erosion, high storm surges and coastal flooding. The flooding aspects of severe weather will be discussed further in the Flood Profile, Section 4.4.

El Niño

El Niño is a recurring ocean-atmosphere phenomenon. Along Washington's coast, strong El Niños can bring: extreme waves from the south-southwest, more frequent severe storms, increased sea levels, above average river flows, warmer than normal water temperatures, flooding, and erosion.

El Niño occurs every two to ten years. In the past 98 years, there have been 23 El Niños. Four of the most powerful El Niños have occurred since 1980.

Figure 4-16: Aleutian Low over the Northern Pacific, 2002[37]



Past Events

This section documents some of the major storm events affecting Western WA. Many of these storms also affected the Shoalwater Bay area. Detailed information on

[37] Taken from MODIS, http://www.geog.ucsb.edu/~jeff/wallpaper2/page.html

storms affecting the Shoalwater Bay Reservation area are discussed if information was available.

1948 storm

Windstorms:

- October 12, 1962 – The Columbus Day Wind Storm: The top weather event in Washington during the 20th Century, according to the National Weather Service, Seattle Forecast Office. This storm is the greatest windstorm to hit the Northwest since weather record keeping began in the 19th century, and is called the "mother of all wind storms". All windstorms in the Northwest are compared to this one. The Columbus Day Storm was the strongest widespread non-tropical windstorm to strike the continental U.S. during the 20th century, affecting an area from northern California to British Columbia. The storm claimed seven lives in Washington State; 46 died throughout the impacted region. One million homes lost power. More than 50,000 homes were damaged. Total property damage in the region was estimated at $235 million (1962 dollars). The storm blew down 15 billion board feet of timber worth $750 million (1962 dollars); this is more than three times the timber blown down by the May 1980 eruption of Mount St. Helens, and enough wood to replace every home in the state.
- November 1981 - Record high winds
- January 20, 1993 – The Inauguration Day Wind Storm: Federal Disaster #981. Stafford Act disaster assistance provided – $24.2 million. Hurricane force winds swept King, Lewis, Mason, Pierce, Snohomish, Thurston and Wahkiakum counties. This storm claimed five lives. More than 870,000 million homes and businesses lost power. Fifty-two single-family homes, mobile homes, and apartment units were destroyed, and 249 incurred major damage, many from falling trees and limbs. More than 580 businesses were damaged. Total damage in western Washington estimated at $130 million. Winds in Puget Sound area gusted to 70 mph. A gust at Cape Disappointment on the Washington Coast reached 98 mph. This storm caused two deaths. Damage estimated at $250 million. The Interstate 90 – Lake Washington floating bridge between Seattle and Mercer Island sank during this storm event.
- December 1995 - California Express Windstorm
- December 1996-January 1997 "Holiday Blast" Storm: Federal Disaster #1159. Stafford Act disaster assistance provided – $83 million. Small Business Administration loans approved – $31.7 million. Saturated ground combined with snow, freezing rain, rain and rapid warming and high winds within a five-day period produced flooding and landslides. Impacted counties – Adams, Asotin, Benton, Chelan, Clallam, Clark, Columbia, Cowlitz, Douglas, Ferry, Franklin, Garfield, Grant, Grays Harbor, Island, Jefferson, King, Kitsap, Kittitas,

Klickitat, Lewis, Lincoln, Mason, Okanogan, **Pacific**, Pend Oreille, Pierce, San Juan, Skagit, Skamania, Snohomish, Spokane, Stevens, Thurston, Walla Walla, Whatcom, and Yakima. Twenty-four deaths; $140 million (est.) in insured losses; 250,000 people lost power.

- January – March 1999 – La Niña Winter Windstorms
  - On March 3, 1999, a storm surge of 4.6 feet, accompanied by 49.7 mile an hour winds, caused widespread coastal flooding. Wave heights exceeded 29.5 feet for over 5 hours, peaking at 34.8 feet. At Ocean Shores, several houses were damaged and a public restroom was destroyed.

Severe Flooding

Many severe weather storms lead to storm surge and coastal flooding. For past events of flooding refer to Section 4.4.

- Super Bowl Storm, 2006

- More recently, The Puget Sound region from Olympia, Washington to Vancouver, BC received several inches of rain per day in November 2006 from a series of successive Pineapple Express storms that caused massive flooding in all major regional rivers and mudslides which closed the mountain passes. These storms included heavy winds which are not usually associated with the phenomenon. Regional dams opened their spillways to 100% as they had reached full capacity due to rain and snowmelt. Officials referred to the storm system as "the worst in a decade" on November 8, 2006. This led to Presidential Disaster #1671.

- A windstorm in December 2006, known as the Chanukah Eve Storm that led to a second presidential disaster (#1682) being declared in the winter of 2007.

- November 11-12th, 2007 Windstorm, numerous trees down around Reservation and Tokeland Peninsula. Power out to the Tribe. See Figure 4-17 and Figure 4-18 at the end of this Section.

- December 2007 windstorm, Presidential Disaster # 1734

The 2003 Pacific County hazard Identification and Vulnerability Assessment (HIVA) also had a table of past events affecting the County specifically. It is shown below:

Table 4-11: Severe Storms Affecting Pacific Co.[38]

Severe Storms affecting Pacific County 1921-2003		
Date	**Storm Type**	**Description**
1921	Windstorm	
1933	Windstorm	
1949	Snow Storm	
1950	Snow Storm	
1958	Windstorm	
1960	Windstorm	
1961	Snow Storm	
1962	Windstorm	Columbus Day
1969	Snow Storm	
1970	Snow Storm	
1971	Windstorm	
1977	Windstorm	
1978	Windstorm	
1980	Snow Storm	
1990	Windstorm	
1991	Windstorm	
1992	Windstorm	
Jan 1993	Windstorm	Inauguration Day Storm, Federal Disaster #981
1993	Snow Storm	
Aug 1994	El Nino	Adverse weather, Federal Disaster #1037
Dec 1996	Windstorm	Winter winds & gale conditions, Federal Disaster #1159
Nov 1998	Windstorm	Winds of 80 miles per hour recorded.
Mar 1999	Windstorm	Winds of 40 miles per hour with gusts recorded at 129.
Oct 1999	Windstorm	Marine storm and coastal flooding.
Dec 1999	Windstorm	Widespread flooding, tropical weather system.

Location

Severe weather can affect whole regions; thus the whole of the Shoalwater Bay Tribal Reservation can experience severe weather. Because storms often significantly affect utility and transportation systems, power and telephone outages are a frequent result of storms and ingress and egress may be limited. Consequently, isolated areas like the Shoalwater Bay Indian Reservation may experience greater effects from storms. Severe local storms significantly impact driving conditions on roads, and downed power lines can cause isolation. They can also hinder police, fire, and medical responses to urgent calls.

[38] www.aasa.dshs.wa.gov/professional/EmergencyPlanning/documents/**Pacific**%20**County**%20**HIVA**.doc

Frequency

Severe winter storms affect the Shoalwater Bay Indian Reservation at least twice a year. The frequency of major severe weather, based on wind speeds is shown below:

Wind speeds exceed
55 mph every year
76 mph every 5 years
83 mph every 10 years
92 mph every 25 years
100 mph every 50 years
108 mph every 100 years

Severity

The recent December 2007 Windstorm can be used to explain the severity of a major wind storm.

Warning Time

A meteorologist can often predict the likelihood of an onset of a severe storm. This can give several days of warning time, however, meteorologists cannot predict the exact time of onset or the severity of the storm. Some storms may come on more quickly and have only a few hours of warning time.

Secondary Hazards

The most significant secondary hazards to severe local storms are floods, landslides and electrical hazards (fires) from downed power lines Landslides occur when the soil on slopes becomes oversaturated and fail.

Exposure Inventory

All people, property and infrastructure of the Shoalwater Bay Indian Tribe are exposed to severe weather.

Vulnerability

The Shoalwater Bay Reservation is extremely vulnerable to sever weather as it is located in an isolated area with limited egress and ingress. Furthermore the

Reservation does not have a back-up power system to sustain itself if it became isolated for a long period of time.

Loss Estimation

Currently there are no standards in place to estimate losses from wind damage during severe weather[39]. Severe weather has the potential to affect all people, property and infrastructure, but in most cases, it is infrastructure, such as power lines, that suffer the most damage from severe weather, such as high winds. Damages from floods and storm surge will be estimated in the Flood Profile. This estimate will be limited to wind damage.

Most losses to the Tribe would be economic and/or social in nature and would be from the effects of power outages and road closures.

For planning purposes, we estimated damages to structures at 2% and to contents at 2%. This takes into account that most severe weather damage will be from wind gusts (ripping off roofs and blowing out windows) and falling debris (trees onto buildings and houses).

Thus:

Estimated losses to structures: **$394,000**

Estimated loss to contents: **$174,200**

[39] FEMA State and Local Mitigation Planning How-to Guide: Understanding Your Risks, p 4-32. http://www.fema.gov/library/viewRecord.do?id=1880

Figure 4-17: Tree on Powerlines at Tribal Center, Nov 11, 2007[40]

Figure 4-18: Tree Down, from Different Angle, Nov 11, 2007[41]

[40] Photo by Todd Ellingburg
[41] ibid

4.7. Tsunami

Definitions

Tsunami: Tsunamis are sea waves usually caused by displacement of the ocean floor and are typically generated by seismic or volcanic activity or by underwater landslides. They are a series of traveling ocean waves of extremely long wavelength and are generally associated with earthquakes.

General Background

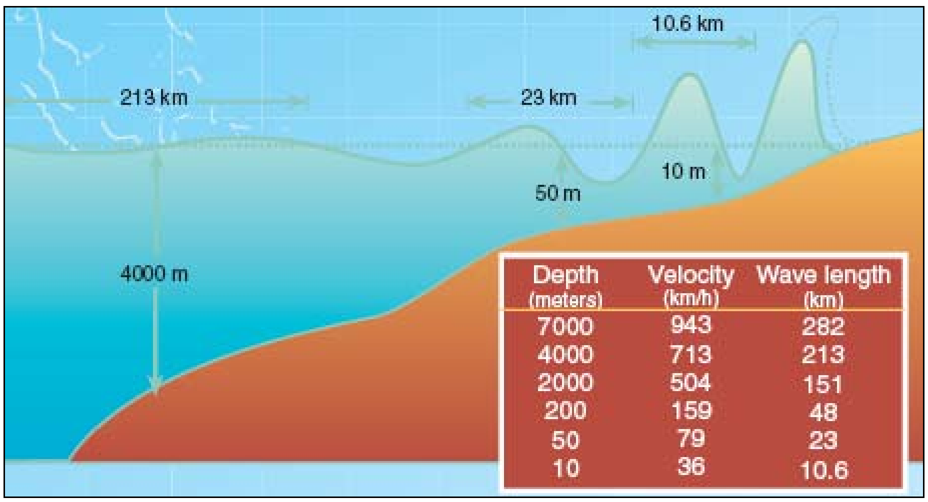
A tsunami consists of a series of high-energy waves that radiate outward like pond ripples from the area in which the generating event occurred. The sequence of tsunami waves arrives at the shore over an extended period. The first wave will be followed by others a few minutes or a few hours later with the following waves generally increasing in size over time. Tsunamis are commonly 60 or more miles from crest to crest and travel at remarkable speeds, often more than 600 miles per hour in the open ocean. **Figure 4-19** shows the size and speed of tsunamis. They can traverse the entire Pacific Ocean in 20 to 25 hours. These are extremely destructive to life and property. The tsunami caused by the 1883 eruption of Krakatau, in Indonesia, caused more than 30,000 fatalities, and the 1886 tsunami on the Sunriku coast of Japan killed about 26,000 people. The most recent disastrous tsunami generated by an earthquake occurred in 2004.

The 2004 Indian Ocean earthquake, known by the scientific community as the **Sumatra-Andaman earthquake**, was an undersea earthquake that occurred at 00:58:53 UTC (07:58:53 local time) on December 26, 2004. The earthquake triggered a series of lethal tsunamis that spread throughout the Indian Ocean, killing large numbers of people and devastating coastal communities in Indonesia, Sri Lanka, India, Thailand, and elsewhere. Initial estimates of the death toll were more than 283,100 people, however, more recent analysis indicates that the actual casualties was 186,983 dead, with 42,883 missing, for a total of 229,886. Nevertheless, this catastrophe is still one of the deadliest disasters in modern history. The disaster is known in Asia and in the international media as the Asian Tsunami, and also called the Boxing Day Tsunami in Australia, Canada, New Zealand, and the United Kingdom because it took place on Boxing Day.

The magnitude of the earthquake was originally recorded as 9.0 (Richter scale), but has been upgraded to between 9.1 and 9.3. At this magnitude, this is the second largest earthquake ever recorded on a seismograph, after the 9.5 magnitude Great Chilean Earthquake of May 22, 1960. The earthquake caused the ground to shake approximately 100 times harder than the Loma Prieta earthquake of 1989. This earthquake was also reported to be the longest duration of faulting ever observed, lasting between 500 and 600 seconds. It was large enough that it caused the entire planet to vibrate at least half an inch, or over a centimeter. It also triggered earthquakes in other locations, even as far away as Alaska.

The earthquake originated in the Indian Ocean just north of Simeulue island, off the western coast of northern Sumatra, Indonesia. The resulting tsunami devastated the shores of Indonesia, Sri Lanka, South India, Thailand and other countries with waves up to 30 m (100 ft). It caused serious damage and deaths as far as the east coast of Africa, with the furthest recorded death due to the tsunami occurring at Port Elizabeth in South Africa, 8,000 km (5,000 mi) away from the epicenter.[42]

Figure 4-19: Size and Speed of Tsunami Waves



Hazard Profile

Past Events[43]

While tsunamis have caused significant damage, deaths and injuries elsewhere in the world, only one significant tsunami struck Washington's Pacific coast in recent history.

The 1964 Alaska earthquake generated a tsunami that resulted in more than $640,000 (in 2004 dollars) in damage. However, geologic investigations indicate that tsunamis have struck the coast a number of times in the last few hundred years.

[42] 2004 Indian Ocean earthquake, http://en.wikipedia.org/wiki/Indian_Ocean_Tsunami
[43] WA HMP

1700 Cascadia Tsunami

The most recent Cascadia Subduction Zone earthquake, estimated M9, produced a tsunami on Washington's coast in 1700. The tsunami overran Native American fishing camps and left behind telltale sheets of sand on marshes and in lakes along the southern part of the coast. A sand sheet at Discovery Bay in the eastern Strait of Juan de Fuca also probably resulted from the 1700 tsunami.

Japanese written history pinpoints this event to the evening of January 26, 1700. There, the tsunami began in the middle of the night of January 27-28 Japan time and continued until the following afternoon or evening. Its waves drove villagers to high ground, drowned their paddies and crops, damaged their salt kilns and fishing shacks, entered a government storehouse, and ascended a castle moat. It destroyed dozens of buildings, including 20 houses consumed by a fire that the flooding started or spread. It set in motion a nautical accident that sank tons of rice and killed two sailors. It led samurai to give rice to villagers left hungry and to request lumber for those left homeless. The tsunami left a village headman wondering why no earthquake had warned of its coming.

1960 Chilean Tsunami

A magnitude 9.5 earthquake along the coast of Chile generated a tsunami that struck the Washington coast at Grays Harbor (small waves), Tokeland (two feet), Ilwaco (two feet), Neah Bay (1.2 feet), and Friday Harbor (0.3 feet). No damage occurred.

1964 Alaskan Tsunami

The tsunami generated by the March 27, 1964 Alaska earthquake was the largest and best-recorded historical tsunami on the southern Washington coast. Tsunami wave heights generally were greatest on the south coast and smaller on the north coast; additionally, the tsunami was recorded inland in the Strait of Juan de Fuca (Friday Harbor), Puget Sound (Seattle), and the Columbia River (Vancouver).

Observations were made of the tsunami in Grays Harbor County at Westport, Joe Creek, Pacific Beach, Copalis, Grays Harbor City, and Boone Creek.

Damages included debris deposits throughout the region, minor damage in Ilwaco, damage to two bridges on State Highway 109, a house and smaller buildings being lifted off foundations in Pacific Beach (the house was a total loss), and piling damaged at the Moore cannery near Ilwaco.

Table 4-12: Recorded Height of Tsunami Waves from 1964 Alaska Earthquake

Wreck Creek	4.5 meters	Neah Bay	0.7 meters
Seaview	3.8 meters	Taholah	0.7 meters
Moclips	3.4 meters	Hoh River Mouth	0.5 meters
Ocean Shores	2.9 meters	Friday Harbor	0.4 meters
La Push	1.6 meters	Vancouver	0.1 meters
Ilwaco	1.4 meters	Seattle	0.1 meters

November 2006 Tsunami

On Nov 15, 2006, a magnitude 8.3 earthquake occurred near the Kuril Island northeast of Japan. Washington was put into a Tsunami Advisory which resulted in a 5 cm tsunami that was reported on the Neah Bay tide gage. However, after the cancellation of the Tsunami Advisory, a train of tsunami waves hit Crescent City, California six hours after the earthquake and destroyed docks, tore about a dozen boats lose from moorings, and sank at least one boat.

Table 4-13: Recorded Height of Tsunami Waves from 2006 Kuril Island Earthquake

Location	Wave height
La Push	.52 feet
Neah Bay	.01 feet
Port Angeles	.39 feet
Westport	.16 feet

Location

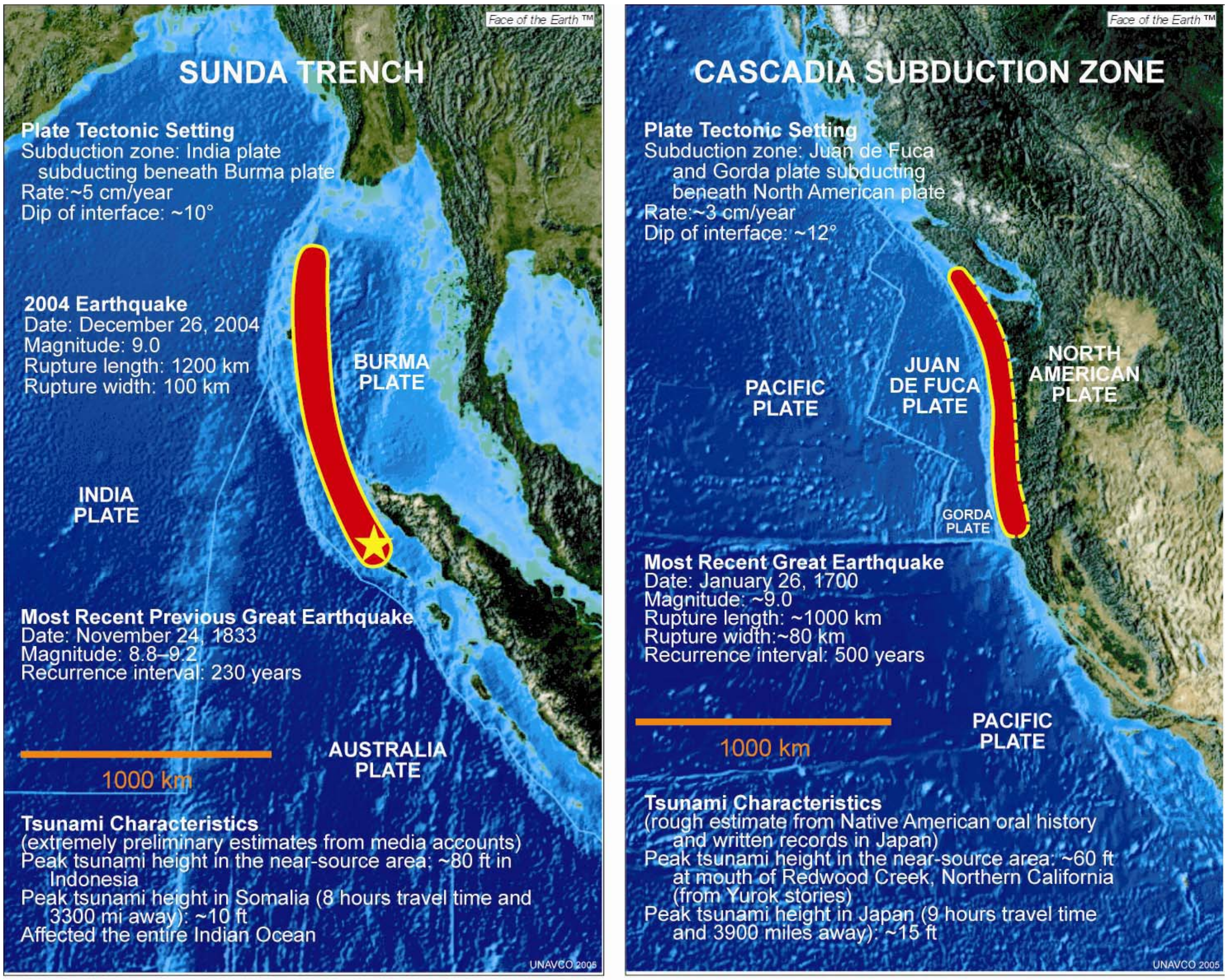
Washington's outer coast faces a dual threat: tsunamis generated by distant sources such as earthquakes in Alaska and Chile, and tsunamis generated directly offshore during earthquakes on the Cascadia Subduction Zone.

The Cascadia Subduction Zone has generated magnitude 8 or larger earthquakes and tsunamis at least six times in the past 3,500 years. The most recent of these events occurred the evening of January 26, 1700. During such an earthquake, much of the land on Washington's outer coast subsides, or falls, making coastal communities more susceptible to flooding and damage from a tsunami.

Computer models indicate that a Cascadia-generated tsunami could reach nearly 30 feet in height and affect the entire Washington coast. The first wave would reach coastal communities within 30 minutes after the earthquake, and communities along the Strait of Juan de Fuca in 90 minutes. Tsunamis from great Cascadia earthquakes probably account for several sand sheets on northwestern Whidbey Island and at Discovery Bay in Puget Sound.

The Cascadia Subduction Zone, in its earthquake and tsunami potential, is similar to the Sunda Trench off the coast of Sumatra Island, Indonesia. A graphic that compares those two geologic structures is shown in **Figure 4-20** below.

Figure 4-20: Comparison of Sunda Trench and Cascadia Subduction Zone



This graphic, compiled by Lori Dengler, Professor of Geology at Humboldt State University, Arcata, CA, compares the Sunda Trench subduction zone, the location of the December2004 Indonesia earthquake and tsunami, with the Cascadia Subduction Zone off the Pacific Northwest Coast. The earthquake rupture zones are red with yellow border; the star shows the epicenter of December 2004 earthquake.

Frequency

Great earthquakes in the Pacific Ocean generate tsunamis that sweep through the entire Pacific basin occur at a rate of about six every 100 years. In the Cascadia Subduction Zone, scientists currently estimate there is a 10 to 14 percent chance an M9.0 earthquake and associated tsunami will occur in the next 50 years.

Severity

Tsunamis are a threat to life and property to anyone living near the ocean. From 1895 to 1995, 454 tsunamis were recorded in the Pacific Basin. Ninety-four of these tsunamis killed over 51,000 coastal residents during the past century. Recent tsunamis have struck Nicaragua, Indonesia, and Japan, killing several thousand people. Property damage due to these waves was nearly one billion dollars. The Indian Ocean tsunami of 2004 killed 230,000 people. Historically, tsunamis originating in the northern Pacific and along the west coast of South America have caused more damage on the west coast of the United States than tsunamis originating in Japan and the Southwest Pacific. For example, the 1960 Chile Earthquake generated a Pacific-wide tsunami that caused widespread death and destruction in Chile, Hawaii, Japan and other areas in the Pacific. In contrast, the tsunami generated by the 1883 eruption of Krakatau Volcano in Indonesia caused more than 30,000 fatalities and the 1886 tsunami on the Sunriku coast of Japan killed about 26,000 people, but neither of these events were destructive outside their immediate locales.

Closer to the Northwest, a tsunami hit the Washington coast after the great 1964 Alaska earthquake; in places wave heights reached 15 feet. No deaths were reported in Washington but it caused $115,000 in damage. This same tsunami killed 11 people and caused $7.4 million damage in Crescent City, California. Scientific studies indicate that local tsunamis generated off the northern California, Oregon and Washington coast could reach Washington shores within 3 to 30 minutes after the earthquake is felt. Estimated heights for tsunamis affecting the Shoalwater Bay Reservation are 30-55 feet.

Warning Time

Tsunamis generated near Japan and Chile may take hours to reach Washington, while those generated off the Oregon/Washington coast may reach shore within 3 to 30 minutes.

Typical signs of a tsunami hazard are earthquakes and/or a sudden and unexpected rise or fall in coastal water. The large waves are often preceded by coastal flooding and followed by a quick recession of the water. Tsunamis are difficult to detect in the open ocean, with waves only one or two feet high. The tsunami's size and speed, as well as the coastal area's form and depth are factors that affect the impact of a tsunami; wave heights of fifty feet are not uncommon. In general, scientists believe it requires an earthquake of at least a magnitude 7 to produce a tsunami.

It is also important to know that Tsunami waves in the ocean can continue for hours; later waves can be larger, more deadly, and more damaging.

For example, the first wave to strike Crescent City, CA, following the 1964 Alaska earthquake was 9 feet above the tide level; the second was 6 feet above tide; the third was about 11 feet above the tide level; and the fourth, most damaging wave was more than 16 feet above the tide level. The third and fourth waves killed 11 people. Estimates of the damage range from $47 million to $97 million (2004 dollars). The same tsunami destroyed property in many areas along the Pacific coast from Alaska to California.

In Washington, the largest wave entered Willapa Bay about 12 hours after the first one; the tsunami caused $640,000 (2004 dollars) in damage.

Secondary Hazards

Aside from the tremendous hydraulic force of the tsunami waves themselves, floating debris carried by a tsunami can endanger human lives and batter inland structures. Many of the lives lost in Banda Aceh were caused by debris carried by the waves. Ships moored at piers and in harbors often are swamped and sunk or are left battered and stranded high on the shore. Breakwaters and piers collapse, sometimes because of scouring actions that sweep away their foundation material and sometimes because of the sheer impact of the waves. Railroad yards and oil tanks situated near the waterfront are particularly vulnerable. Oil fires frequently result and are spread by the waves.

Port facilities, naval facilities, fishing fleets, and public utilities are frequently the backbone of the economy of the affected areas, and these are the very resources that generally receive the most severe damage. Until debris can be cleared, wharves and piers rebuilt, utilities restored, and the fishing fleets reconstituted, communities may find themselves without fuel, food, and employment. Wherever water transport is a vital means of supply, disruption of coastal systems caused by tsunamis can have far-reaching economic effects.

Exposure Inventory

An inventory was made of all structures, population and critical facilities and infrastructure that are potentially exposed to the effects of a tsunami. Findings include:

All of the Shoalwater Bay Tribe's housing, critical facilities and infrastructure would be destroyed.

The major road, SR 105, as sole access in and out of the Reservation, would be affected.

Vulnerability

The Shoalwater Bay Indian Tribe is extremely vulnerable to a tsunami. The Tribe is located near a major off-shore subduction zone capable of generating a 30 foot tsunami that could reach the flat, marshy sea-level high Reservation within 30 minutes. The only road in and out of the Reservation is the sea-level SR 105, which would not be a safe location when the tsunami struck and most likely would be washed away or blocked by debris in many locations after the first waves arrived. None of the Tribe's facilities or homes would withstand the 600mph walls of water that would strike the Reservation head-on.

Loss Estimation

Currently there are no standards in place to estimate losses from tsunamis. For this estimate it was assumed all structures would be destroyed The values used in this loss estimation are a hypothetical estimate of all *potential* damage. Its purpose is to come up with a value that can be used to compare with other hazards, in order to prioritize and focus mitigation efforts.

Damage assumption: 100% damage to all structures and contents (Tribal facilities & infrastructure, tribal housing and private housing)

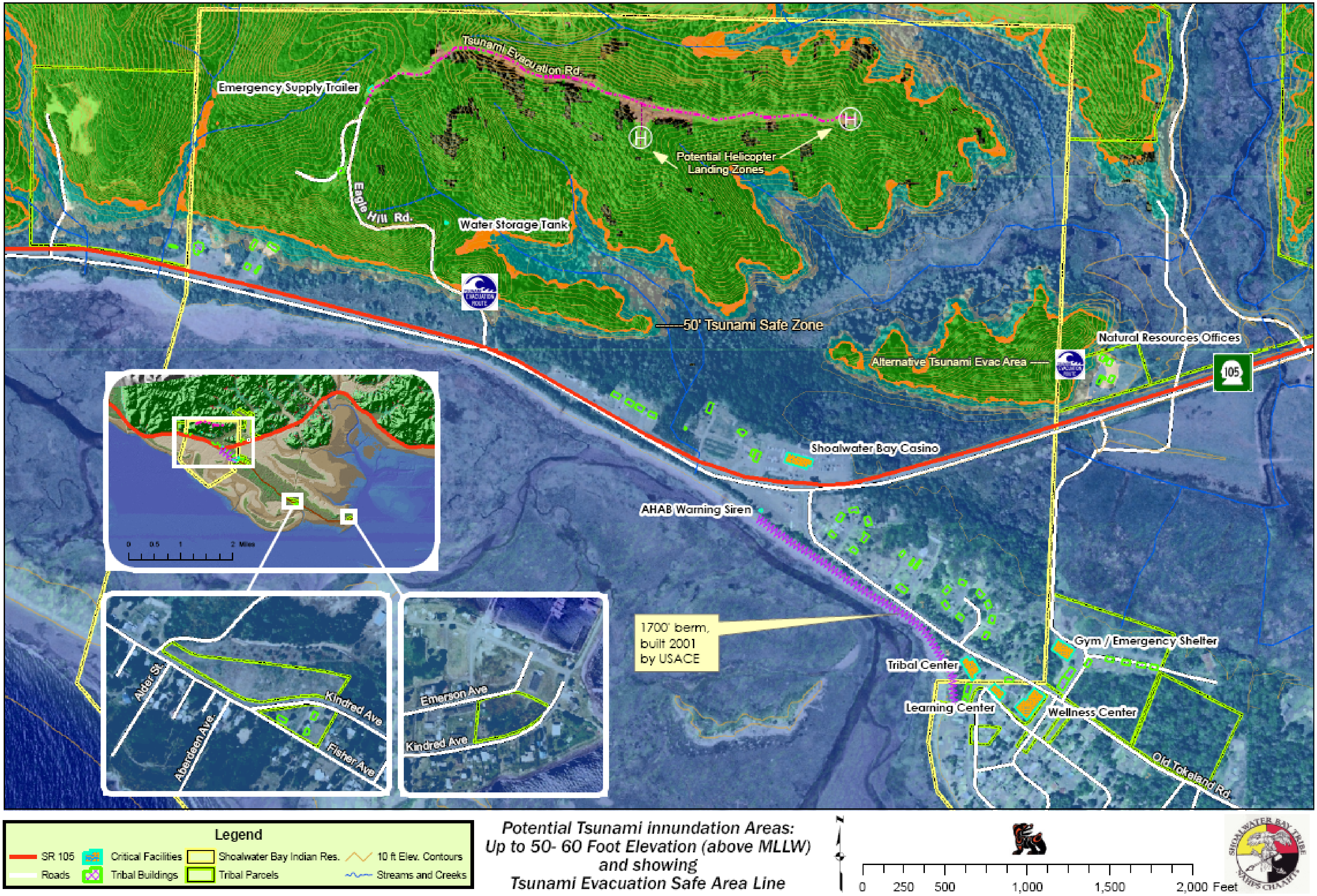
Loss estimate:

Estimated loss to tsunami-prone structures: **$19,700,000**

Estimated loss to contents for all structures: **$8,710,000**

Total estimated loss from a tsunami event: **$28,410,000**

Figure 4-21: Areas Potentially Affected by a Tsunami



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4.8. Wildland Fire

Definitions

Forest Fire: Forest fires are the uncontrolled destruction of forested lands caused by natural or human-initiated events. Wildfires occur primarily in undeveloped areas; these natural lands contain dense vegetation such as forest, grasslands or agricultural croplands. Because of their distance from firefighting resources and manpower, these fires can be difficult to contain and can cause a great deal of destruction.

Conflagration: A conflagration is a fire, which grows beyond its original source area to engulf adjoining regions. Wind, extremely dry or hazardous weather conditions, excessive fuel buildup and explosions are usually the elements behind a wildfire conflagration.

Firestorm: This term describes a fire that expands to cover a large area, often more than a square mile. A firestorm usually occurs when many individual fires grow together to make one huge conflagration. The involved area becomes so hot that all combustible materials ignite, even if they are not exposed to direct flame. Temperatures may exceed 1000° Celsius as the fire creates its own local weather: superheated air and hot gases of combustion rise upward over the fire zone, drawing surface winds in from all sides, often at velocities approaching fifty miles per hour. Although firestorms seldom spread because of the inward direction of the winds, once started there is no known way of stopping them. Within the area of the fire, lethal concentrations of carbon monoxide are present; combined with the intense heat this hazard poses a serious life threat to responding fire forces. In exceptionally large events, the rising column of heated air and combustion gases carries enough soot and particulate matter into the upper atmosphere to cause cloud nucleation, creating a locally intense thunderstorm and the hazard of lightning strikes.

Interface Area: An area susceptible to wildland or forest fires because wildland vegetation and urban or suburban development occur together. An example would be the smaller urban areas and dispersed rural housing in the forested area of Snohomish County. Whenever the majority of a parcel lies within the established wildland urban interface/interface area, the entire parcel shall be included in the area.

General Background

Wildland fires are fires caused by nature or humans that result in the uncontrolled destruction of forests, brush, field crops, grasslands, and real and personal property in non-urban areas.

The wildland fire season in Washington usually begins in early July and typically culminates in late September with a moisture event; however, wildland fires have occurred in every month of the year. Drought, depth of snow pack, and local weather conditions can expand the length of the fire season. The early and late shoulders of the fire season usually are associated with human-caused fires, with the peak period of July, August and early September related to thunderstorms and lightning strikes.

Short-term loss caused by a wildland fire can include the destruction of timber, wildlife habitat, scenic vistas, and watersheds; vulnerability to flooding increases due to the destruction of watersheds. Long-term effects include smaller timber harvests, reduced access to affected recreational areas, and destruction of cultural and economic resources and community infrastructure.

The Washington Department of Natural Resources protects 2.5 million acres of state-owned land and 10 million acres of land in private ownership through legislative directive (Revised Code of Washington 76.04).

People start most wildland fires; major causes include arson, recreational fires that get out of control, smokers' carelessness, debris burning, and children playing with fire. From 1992 to 2001, on average, people caused more than 500 wildland fires each year on state-owned or protected lands; this compares to 135 fires caused by lightning strikes. Wildland fires started by lightning burn more state-protected acreage than any other cause, an average of 10,866 acres annually; human caused fires burn an average of 4,404 state-protected acres each year.

Wildland fires usually are extinguished while less than one acre; they can spread to more than 100,000 acres and may require thousands of firefighters and several months to extinguish. A number of federal, state, county, city, and private agencies and private timber companies provide fire protection and firefighting services in Washington.

Factors that Influence Wildland Fire

A fire needs three elements in the right combination to start and grow – a heat source, fuel, and oxygen. How a fire behaves primarily depends on the characteristics of available fuel, weather conditions, and terrain.

Fuel:

Lighter fuels such as grasses, leaves, and needles quickly expel moisture and burn rapidly, while heavier fuels such as tree branches, logs and trunks take longer to warm and ignite.

Snags and hazard trees – those that are diseased, dying, or dead – are larger west of the Cascades, but more prolific east of the Cascades. In 2002, about 1.8 million acres of the state's 21 million acres of forestland contained trees killed or defoliated by forest insects and diseases.

Weather:

West of the Cascades, strong, dry east winds in late summer and early fall produce extreme fire conditions. East wind events can persist up to 48 hours with wind speed reaching 60 miles per hour; these winds generally reach peak velocities during the night and early morning hours.

Terrain:

Topography of a region or a local area influences the amount and moisture of fuel; the impact of weather conditions such as temperature and wind speed and direction; any potential barriers to fire spread, such as highways and lakes; and elevation and slope of land forms (i.e., fire spreads more easily as it moves uphill than downhill).

Peak burning period of a fire generally is between 1 p.m. and 6 p.m., with local factors (generally described above) greatly influencing this. Wildland fires can take on a life of their own when there is plenty of heat and fuel. They can create their own winds and weather, generating hurricane force winds of up to 120 miles per hour. Fires also can heat fuels in their path, making fuels easier to ignite and burn.

Fire Seasons:

Western Washington's fire season typically is shorter than Eastern Washington's for a number of reasons:

The western half of the state receives more rainfall. The Cascade Range tends to squeeze most of the rain from weather systems before they pass into the eastern half of the state.

The west has spring seasons that are wetter and cooler than the east. Much of the precipitation received in the east is snow that falls during winter months. Heavier snow packs keep fuels moist longer, while lighter snow packs allow fuels to dry out earlier in the year.

Hazard Profile

Past Events

The Washington Dept. of Natural Resources maintains of GIS database of all past wildfire events going back to 1972. This geodatabase was used to identify past wildfire events near or on the Shoalwater Bay Reservation. All wildfire events within a 5 miles radius of the Reservation were analyzed: Findings revealed:

There were 45 reported wildfire events within 5 miles of the Reservation

There were none on the Shoalwater Bay Reservation

40% were caused by logging activities and debris burns

18% were caused by fireworks

27% caused by careless hunters, campers children and smokers

The largest event occurred in May 1972, a 140 acre burn caused by debris burning that went out of control. It was located in the hilly logging areas northeast of the Reservation

There was a 5 acre burn caused by a reckless camper in September of 1987 on the beach at Tokeland, about 1.5 miles from the Reservation.

Location

Using the map of past events as an indicator, wildfires could anywhere near or on the Shoalwater Bay Reservation. 42% of the reported events occurred in the hilly logging areas, with the remaining 58% occurring along or near the coast. Many of these coastal fires occurred on the beaches where many people camp and recreate during the summer. Tribal members are concerned about the densely wooded hill and the homes below it on SR 105 just west of the Casino. See **Figure 4-22**.

Frequency

Within 5 miles of the Shoalwater Bay Indian Reservation, there have been 45 wildfires reported since 1972. Generally wildfires have occurred in clusters[44] every 2-3 years, almost always during the spring and summer and perhaps coinciding with particularly dry, hot conditions that season.

Severity

As mentioned above, past events indicate that wildfires would not be severe on the Shoalwater Bay Reservation. The Reservation is small in size, and thus a fire can be identified quickly. Secondly, the Reservation receives a large amount of rainfall, reducing the risk to dryness, which is an essential contribution of fires. In a worst-case scenario, a wildfire spread by heavy winds during extremely dry conditions may damage Tribal structures. DNR fire statistics indicate that a wildfire would be less than an acre in size.

Warning Time

After a wildfire is detected, it would only take minutes to at worst, hours to respond to a fire. Unless accompanied by very heavy winds , sufficient time should be available to protect property and/or evacuate.

[44] For example, there was one event reported in 1995, 5 events in 1996, zero in 1997 and two in 1998.

Secondary Hazards

Wildland fires can generate a range of secondary effects, which in some cases may cause more widespread and prolonged damage than the fire itself. Fires can cause direct economic losses in the reduction of harvestable timber. Wildland fires destroy transmission lines and contribute to flooding. Landslides can be a significant secondary hazard of wildfires. Wildfires strip slopes of vegetation, exposing them to greater amounts of rain and run-off. This in turn can weaken soils and cause failures on slopes. Major landslides can occur several years after a wildfire.

In addition to landslides, the following secondary effects are possible. Rehabilitation efforts after a fire occurs can reduce but cannot eliminate them:

Damaged Fisheries: Critical trout fisheries throughout the west and salmon and steelhead fisheries in the Pacific Northwest can suffer from increased water temperatures, sedimentation, and changes in water quality and chemistry.

Soil Erosion: The protective covering provided by foliage and dead organic matter is removed, leaving the soil fully exposed to wind and water erosion. Accelerated soil erosion occurs, causing landslides and threatening aquatic habitats.

Spread of Invasive Plant Species: Non-native woody plant species frequently invade burned areas. When weeds become established, they can dominate the plant cover over broad landscapes, and become difficult and costly to control. One of the Survey Respondents noted that Gorse is common in the area, which can thrive in wildfire prone areas.

Disease and Insect Infestations: Unless diseased or insect-infested trees are swiftly removed, infestations and disease can spread to healthy forests and private lands. Timely active management actions are needed to remove diseased or infested trees.

Destroyed Endangered Species Habitat: Catastrophic fires can have devastating consequences for endangered species. For instance, the Biscuit Fire in Oregon destroyed 125,000 to 150,000 acres of spotted owl habitat.

Soil Sterilization: Topsoil exposed to extreme heat can become water repellant, and soil nutrients may be lost. It can take decades or even centuries for ecosystems to recover from a fire. Some fires burn so hot that they can sterilize the soil.

Exposure Inventory

All the structures of the Shoalwater Bay Indian Tribe are potentially exposed to wildfires.

Vulnerability

The potential for a large wildfire on the Shoalwater Bay Reservation is extremely low Improved fire spotting techniques, better equipment, and trained personnel are major factors, as are the Reservation's wet climate and normally low fire fuel conditions.

Nonetheless, the Reservation is served by a small volunteer fire department which make take longer to deploy and fight the fire. Outside resources would also take a long time. The vegetation in the area is composed of thick forests and logging debris or beach grasses and driftwood, both of which are potential fuel sources for wildfires. Surveys indicate that Tribal members and staff are concerned with wildfires starting in the densely wooded hill behind the Reservation and spreading to nearby Tribal homes along SR 105

The main vulnerability and mentioned by survey respondents is careless campers and hunters who could start fires that spread uncontrolled onto the Reservation.

Loss Estimation

Wildfire loss estimates were based largely on the effects past wildfire events have had in the Reservation area. FEMA has developed a detailed methodology to estimate potential losses, but that is not presently available with the resources used to prepare this Hazard Mitigation Plan. For this estimate is was assumed that a small wildfire less than one acre (most likely 0.1-0.3 acres) could affect the built environment of the Reservation, possibly affecting one or two structures before the fire could be contained and put out.

Assumptions:

Wildfires will cause 20% damage to structures, and 20% damage to contents (which is estimated as ½ of improvement value)

Two homes, each estimated at $210,000

Loss estimate:

Estimated losses to structures is: **$84,000**

Estimated losses to contents is $**42,000**

Figure 4-22: Location of Wildfires 1970-2001

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4.9. Hazardous Materials

Although not a natural hazard, hazardous materials can cause widespread damage to people, property, and the environment. Hazardous materials can be released by a hazard event, such as an earthquake, flood, or even by severe weather (for instance, a truck accident during an icy winter storm). Hazardous material spills may be the most deadly and dangerous secondary effect of natural hazards. That is why it is essential to identify all potential locations where hazardous materials may be spilled and what locations store hazardous materials on-site. The Washington Dept. of Ecology identifies one (1) Facility/Site of interest on the Reservation, the Tokeland Cattle Dip Tank, located at 2604 Tokeland Rd. Other nearby facilities that pose a potential haz-mat concern are Nelson Crab and the Tokeland Marina . An oil spill off the Coast in the Pacific Ocean would be the greatest haz-mat threat. The Tribe is also studying the feasibility of a gas station on the Reservation and may be a future concern.

4.10. Tribal Critical Facilities and Infrastructure

This section will identify Tribal critical facilities and infrastructure and their vulnerability to hazards. It will conclude with a potential lost estimation from a worse case disaster event, namely a tsunami.

Critical Facilities and Infrastructure

Critical facilities and infrastructure are those that are critical to the health and welfare of the population. These become especially important after any hazard event occurs.

The Critical facilities for the Shoalwater Bay Indian Tribe include:

Tribal Center

Wellness Center

Learning Resources Center

Gymnasium/Emergency Shelter

Tribal Casino

Critical Infrastructure includes

Potable water system including 57,000 gallon storage tank

Wastewater System

Loss Estimation

At this time only a preliminary estimate can be made of potential losses to critical facilities and Infrastructure. For this loss estimate, the potential losses to Tribal buildings was made for a Tsunami disaster. This would have the most far-reaching effects and would affect the most structures, thus provides the best overview of the effects of a natural disaster. This loss estimate does not include economic losses, such as from the lost revenue from the Casino, and unemployment at the Casino and Tribal government.

Assumptions:

Critical facilities are worth approximately $ 12,200,000

Content value: $ 5,460,000

Loss estimation (100%):

- $12,200,00 in damages to Tribal structures
- $ 4,460,000 in damages to contents

Thus, in a potential worse-case scenario, the Shoalwater Bay Indian Tribe could see about **$16,660,000** in damages to Tribal facilities and infrastructure from a Tsunami or other natural disaster. This is only an estimate for planning purposes and not a prediction of actual damage from an event, which could be significantly higher or lower.

5. Mitigation Strategy

This section provides the blueprint for the Shoalwater Bay Tribe to reduce potential losses from the natural hazards identified in the Risk Assessment found in Chapter 4. The format of this chapter is as follows:

Section 5.1 will describe the Goals and Objectives the Shoalwater Bay Tribe has formulated to guide the selection of mitigation strategies.

Section 5.2 is an assessment of the Shoalwater Bay Tribe's pre-and post-disaster capabilities.

Section 5.3 identifies, evaluates and prioritizes the mitigation strategies the Shoalwater Bay Tribe is pursuing, including actions identified during the previous local-level planning process.

Section 5.4 identifies current and potential sources of Federal, State, Tribal, local and private funding to implement mitigation activities.

5.1. Goals and Objectives

This section defines the general outcomes that can be expected as a result of successful implementation of this plan. Plan goals are broad statements describing the principles that guide the actions suggested in this document. Plan objectives are more targeted statements that define strategies and implementation steps to attain the goals. The plan goals and objectives below were developed based on the outcome of planning meetings, the Risk Assessment and the goals and objectives defined in the Shoalwater Bay Mission Statement and the Shoalwater Bay Comprehensive Emergency Management Plan.

Goals and objectives:

1. Protect people, property and the natural environment
    - Regulate and/or Purchase hazard-prone areas for conservation and risk reduction
    - Retrofit and/or Relocate structures located in high-risk hazard areas
    - Reduce human-caused Coastal Erosion and its effects

2. Ensure continuity of critical economic and public facilities and infrastructure
    - Support redundancy of critical government functions
    - Retrofit or build to highest standards, critical facilities and infrastructure

3. Promote and protect Tribal sovereignty and identity

- Protect culturally and historically significant Tribal sites, places and materials
- Increase mitigation and emergency management capabilities for the Shoalwater Bay Indian Tribe
- Enable the Shoalwater Bay Tribe to be self-sufficient for at least 14 days after a disaster

4. Increase public awareness of natural hazards and involvement in hazards planning
   - Encourage organizations, businesses, and local governmental agencies within the North Cove/ Tokeland area community and greater Pacific/Grays Harbor Counties to develop partnerships
   - Implement hazard awareness, preparedness and reduction programs

5.2. Capability Assessment

This section will discuss the pre- and post-disaster hazard management policies, programs, and mitigation capabilities of the Shoalwater Bay Indian Tribe. This discussion will include an evaluation of Tribal laws, regulations, policies, and programs that are relevant to hazard mitigation and to development activity in hazard-prone areas.

Tribal Capabilities

Currently the Shoalwater Bay Indian Tribe's capabilities to deal with disaster events are quite limited. Nonetheless a framework is in place to develop and expand Tribal capabilities.

Planning

Shoalwater Bay Emergency Management Council

The Council meets monthly to discuss disaster mitigation and preparedness for the Tribe. The Council currently oversees the Planning Process for this Tribal Hazard Mitigation Plan.

Shoalwater Bay Comprehensive Emergency Management Plan (CEMP)

Emergency management is a system that through organized analysis, planning, decision-making, and assigning of resources will help prevent, prepare for, respond to and recover from the effects of all hazards. The Shoalwater Bay Indian Tribe, in conjunction with this hazard mitigation plan, is developing a comprehensive emergency management plan to prepare and respond to hazards that cannot otherwise be mitigated.

Regulations

No tribal regulations, generally follow Pacific Co. regulations

Communications

AHAB warning system

Hams/RACES, beachNET

NWAS warning system

Earthquake monitoring software

NOAA weather radios in most homes and all offices

800 mhz radios

MOU with Pacific Co. for disaster notification

Agencies and programs

National Flood Insurance Program (NFIP)[45]

The Shoalwater Bay Indian Tribe (CID #530341) joined the NFIP January 4th, 2002, adopting Pacific County's (CID # 530126) FIRM Panel No. 0016, the effective date of which was 9/27/1985. Coastal erosion and sea level change has affected the accuracy of the map and should be updated. The Shoalwater Bay Indian Tribe affirms continued compliance with the requirements of the National Flood Insurance Program.

Shoalwater Bay Health Department

Plays a vital role in Emergency management planning, Medical Reserve Corps, coordinating with DOH and IHS.

Shoalwater Bay CERT Training

The Shoalwater Bay Tribe has a Community Emergency Response Team CERT) training program. Many of the tribal and most of Tribal Council are part of the team. The Tribe also sponsors on-going training opportunities for CERT members.

Shoalwater Bay Office of Emergency Management

The Shoalwater Bay Tribe's Office of Emergency oversees the Tribe's Emergency Response and disaster Mitigation programs. The office coordinated with local, state and federal partners, as well as other tribes, in disaster planning. The office helps bring in grant funding to help the Tribe, and sponsors trainings.

Northwest Tribal Emergency Management Council

The Shoalwater Bay Tribe is member of the Northwest Tribal Emergency Management Council (NWTEMC), which was formed to address homeland security and emergency management issues each tribe faces.

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[45] Tribal information from The NFIP Community Status Book, WA State http://www.fema.gov/cis/WA.pdf

The development of the Northwest Tribal Emergency Management Council not only better prepares Tribal entities for emergency incidents, but will also provide more opportunities for the tribes to work collaboratively to assist one another in meeting the mandates of related emergency management programs and foster partnerships with their neighboring counties and municipalities. The Department of Homeland Security's guidance identifies tribal entities as key stakeholders in partnerships with state, local and private sectors.

The 14 tribes that currently make up the NW Tribal Emergency Management Council are:

- Colville
- Lummi
- Makah
- Muckleshoot
- Nooksack
- Samish
- Sauk-Suiattle
- ***Shoalwater Bay***
- Snoqualmie
- Stillaguamish
- Swinomish
- Tulalip
- Upper Skagit
- Yakama

National Incident Management System (NIMS) compliance training

The Shoalwater Bay Indian Tribe is coordinating with the NWTEMC, FEMA and WA EMD in the training of all tribal police officers, department heads, Board members and relevant staff in the National Incident Management System so they are compliant with NIMS and effectively respond to a major event.

Projects

The Shoalwater Bay Shoreline Erosion, Washington, study was conducted in accordance with Section 545 of the Water Resources Development Act (WRDA) of 2000, Public Law 106-541. Section 545 of WRDA 2000, signed into law on December 11, 2000, authorized both a study and a project for coastal erosion protection for the tribal reservation of the Shoalwater Bay Indian Tribe. This Project is also listed under Current Funding Sources.

Federal/Regional Capabilities

If the Governor of Washington asks for a Presidential Disaster Declaration, federal aid and assets will become available.

Support following a Presidential Declaration

There is considerable support for risk reduction measures following a Federal disaster declaration. Often these programs and their implications are not taken advantage of before permanent repairs are made. Some of the more significant ones include:

- The Hazard Mitigation Grant Program (HMGP) offers assistance for a wide range of mitigation projects following a presidential declaration. Eligibility is restricted to projects that have gone through a comprehensive hazard mitigation planning process.
- Minimal Repair Program often funds risk reduction such as the anchoring of mobile homes.
- The Small Business Administration will fund eligible mitigation measure to qualified owners of damaged homes.
- Outreach is available through Disaster Reconstruction Assistance Centers (DRACs), Recovery Information Centers or Hazard Mitigation Teams.
- Benefit/Cost Mitigation support is available from FEMA on infrastructure repair. To break the damage-rebuild-damage cycle FEMA Region 10 is encouraging communities to:
    - Institute mitigation betterments taking advantage of multi-hazard, multi-objective approaches whenever possible
    - Strengthen existing infrastructure and facilities to more effectively withstand the next disaster
    - Ensure that communities address natural hazards through comprehensive planning

Following a federal disaster declaration, FEMA can support cost effective mitigation on infrastructure and have published a manual on the subject.

5.3. Mitigation Actions and Activities

The Mitigations actions proposed for this Tribal Hazard Mitigation Plan were identified through the Community Hazards Survey and meetings with Tribal, Federal and local officials. This section identifies the nineteen mitigation actions the Shoalwater Bay Indian Tribe will implement as resources and funding become available.

Mitigation actions can be grouped into six broad categories:[46]

1. Prevention. Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and storm water management regulations.

2. Property Protection. Actions that involve the modification of existing buildings or structures to protect them from a hazard, or removal from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, storm shutters, and shatter-resistant glass.

3. Public Education and Awareness. Actions to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.

4. Natural Resource Protection. Actions that, in addition to minimizing hazard losses, also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.

5. Emergency Services. Actions that protect people and property during and immediately after a disaster or hazard event. Services include warning systems, emergency response services, and protection of critical facilities.

6. Structural Projects. Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include dams, levees, floodwalls, seawalls, retaining walls, and safe rooms.

Through meetings and workshops with Tribal officials, staff and community members, the Shoalwater Bay Indian Tribe has identified 19 mitigation actions for implementation. The mitigation actions were prioritized by the Shoalwater Bay Tribal Emergency Management Council on February 14th, 2008, with T-1 being the highest

[46] State and Local Mitigation Planning How-to Guide, p 2-1
http://www.fema.gov/library/viewRecord.do?id=1886

priority. The criteria used to prioritize included feasibility, costs and need. As the specific mitigation projects for retrofitting and elevation are further defined, the FEMA Benefit-Cost Analysis software will be used to rank said projects for feasibility.

Mitigation actions include:

T-1: Flood elevate homes and buildings

T-2: Acquire properties in low hazard- areas in order to locate new development or relocate existing vulnerable structures and critical facilities

T-3: Increase communications capabilities

T-4: Develop a system to protect and maintain historical and archival Tribal records

T-5: Create a back-up water supply system

T-6: Develop and/or improve Emergency Plans such as Evacuation Plans, Tribal Records Protection Plan, Continuity of Operations Plan etc…

T-7: Seismic retrofit of tribal buildings and infrastructure, including a reservation wide back-up generator system

T-8: Create new and improve existing Evacuation routes, including better signage

T-9: Build an Emergency Operations Center and Shelter (including helipad) in hazard-free location.

T-10: Continue and expand Disaster Training programs such as Community Emergency Response Teams (CERT) to train Tribal members and the local community to respond to an emergency

T-11: Partner with local jurisdictions and agencies in developing and implementing mitigation and emergency response strategies and actions.

T-12: Develop interlocal agreements with local agencies and other jurisdictions for disaster planning and emergency preparedness and response

T-13: Identify elders and other vulnerable populations to prioritize for mitigation and disaster assistance.

T-14: Expand protective berm along coastline

T-15: Create and/or expand culverts to allow better drainage of marshy areas

T-16: Develop Buildings Codes and Development/ Master Plan that focuses new development and construction on hazard free areas.

T-17: Create a community-wide comprehensive education program to educate the Tribe about hazards and hazard mitigation.

T-18: Implement vegetation and other Natural Resource management practices to reduce landslides and coastal erosion

T-19: Build protective berms and/or other flood protection systems for historic/cultural sites and buildings that cannot be mitigated by other means.

The format and explanation of each mitigation measure is shown below:

T-1: The mitigation action or activity is shown here. “T” stands for Tribal. These actions are proposed in the Shoalwater Bay Tribal Hazard Mitigation Plan Plan.

Problem/Opportunity: This describes either a problem or possible opportunity to reduce risk.

Implementation Strategy: Each mitigation strategy includes ideas to implement and accomplish the specific project.

Lead Agency: This is the agency or agencies that will organize resources, find appropriate funding or oversee project implementation, monitoring and evaluation.

Funding Options: This offers suggestions on potential financial resources for implementing the mitigation strategy. This includes funding from government agencies as well as various different types of grants.

Implementation Cost: This is the approximate amount that the strategy will cost to implement.

Timeline: This estimates the amount of time it will take to begin implementation of each strategy. Under timeline there are three categories, short term, long term and ongoing.

- Short Term: the mitigation strategy will be implemented in years 1 to 2.
- Long Term: the mitigation strategy will be implemented in years 3 to 5.
- Ongoing: the mitigation strategy will be implemented in years 1 to 5 and will continue into the future indefinitely.

Associated Hazards: Each mitigation strategy is related to one or more of the hazards that could affect the Shoalwater Bay Indian Tribe

Related Goals: Each mitigation strategy is related to a Goal listed in Section 5.1.

Mitigation actions and activities:

T-1: Flood elevate homes and buildings

Problem/Opportunity: During coastal storms, the Shoalwater Bay Tribe's homes and tribal facilities flood from storm surge. Other sources of flooding would be from a tsunami and/or elevation subsidence associated with an earthquake. Furthermore sea level rise may increase the frequency and height of storm surge flooding. Thus, tribal facilities and homes should be elevated above 100 or 500 year flood levels, with vital documents, records and equipment elevated above flood heights.

Implementation Strategy: The Tribe will work closely with its departments and community members to identify which structures to elevate. The FEMA Cost-Benefit Analysis software will be used to prioritize which buildings to elevate first. A PDM grant to FEMA will be prepared to secure funding.

Lead Agency: Shoalwater Bay Emergency Management

Funding Options: FEMA PDM grant funding is expected to provide much of the financing.

Implementation Cost: This information is not available at this time, but is expected to be in the hundreds of thousands of dollars.

Timeline: Ongoing

Associated Hazards: Coastal Erosion, Flooding, Tsunami, Earthquake, Severe Weather

Related Goals: Goals 1, 2

T-2: Acquire properties in low hazard areas in order to locate new development or relocate existing vulnerable structures and critical facilities

Problem/Opportunity: Elevating structures may not be the most- cost-effective long-term solution to reducing the risks of coastal flooding and tsunami. As the Tribe continues to build new homes and facilities, it will be best to locate them in areas that are less vulnerable to natural hazards. The Tribe should identify and acquire properties that are further inland and on higher elevations. For critical facilities, it may be best to relocate them as safer properties are acquired.

Implementation Strategy: The Tribe will work closely with its departments and community members to identify which properties to acquire for new developments and/or relocate existing critical facilities and other structures. The FEMA Cost-Benefit Analysis software will be used to prioritize which structures to relocate first.. A PDM grant to FEMA will be prepared to secure funding.

Lead Agency: Shoalwater Bay Emergency Management

Funding Options: PDM grant, HUD grants, USDA development grants

Implementation Cost: Hundreds of thousands to millions of dollars

Timeline: long-term

Associated Hazards: All

Related Goals: Goals 1,2

T-3: Increase communications capabilities

Problem/Opportunity: The Shoalwater Bay Indian Reservation is located in a very isolated area of Washington State. There is only one access route, SR 105, which is prone to blockages. The hills in the area prevent radio communications and hamper cellular coverage. Thus during a disaster, the Reservation can easily become isolated and lose communications with the outside world when is will most need outside assistance.

Implementation Strategy: The Tribe should identify its current communications capabilities and identify what will be needed to strengthen and increase its communications infrastructure. The Tribe should work with local, state and federal partners in implementing systems that will work during and after a disaster.

Lead Agency: Shoalwater Bay Emergency Management

Funding Options: BIA, Homeland Security grants, DOH grants

Implementation Cost: n/a

Timeline: Ongoing

Associated Hazards: All

Related Goals: Goals 2, 3, 4

T-4: Develop a system to protect and maintain historical and archival Tribal records

Problem/Opportunity: Currently the Shoalwater Bay Indian Tribe's historic and archival records and other culturally significant property are stored in conditions that they could be easily lost, damaged or destroyed in a disaster event such as a flood, earthquake, tsunami or fire. Furthermore modern storage such as computers that hold current tribal records could also be destroyed. Loss of materials like this could not only cripple the short-term operations of the Tribe, but permanently lead to the loss of important aspects of Tribal history and culture. A system could include the construction of a disaster proof archive building or off-site storage locations, as well as back-up copies of important documents in paper and digital form.

Implementation Strategy: Grants are available for historic preservation and archival safety. The Tribe needs to identify and inventory all important documents and materials and develop a system to preserve them.

Lead Agency: Shoalwater Bay Tribal Council

Funding Options: Federal grants, tribal budget

Implementation Cost: not available at this time

Timeline: on-going

Associated Hazards: all hazards

Related Goals: Goals 1, 2, 3

T-5: Create a back-up water supply system

Problem/Opportunity: Currently the Shoalwater Bay Tribe relies on one water system for all its potable water needs. A Major event, such as a earthquake and/or tsunami, could disable the infrastructure used to deliver the water or even worse, the wells could be come contaminated by salt water brought in by the tsunami. It is essential that the Tribe have a back-up water supply system if the primary system fails or is destroyed

Implementation Strategy: Identify potential well sites and infrastructure needed for back-up system. Apply for grants that would fund this type of work.

Lead Agency: Tribal Council, Emergency Management Office

Funding Options: Indian Health Service, DOH Grants, USDA

Implementation Cost: To be determined

Timeline: On-going

Associated Hazards: All

Related Goals: Goal 2

T-6: Develop and/or improve Emergency Plans such as Evacuation Plans, Tribal Records Protection Plan, Continuity of Operations Plan etc…

Problem/Opportunity: Having plans in place that can help the Tribe effectively respond to and recover from disaster events is vital to the short and long term survival of the community. Due to its isolated and hazard prone location, it is important that the Shoalwater Bay Indian Tribe develop emergency plans that will allow its members and leaders to know what to do to withstand and then recover from a major event that would cut-off the tribe from outside help for at least a week or more.

Implementation Strategy: Ideally a part or full time emergency manager and/or planner working closely with the Tribal Council and other departments, would develop the plans. Numerous grant sources are available for the development of plans and/or to hire staff to prepare the plans.

Lead Agency: Tribal Council, Emergency Management Office

Funding Options: Emergency Mgt Performance Grants, Dept of Health Grants, Regional Homeland Security funds and other sources

Implementation Cost: staff time to prepare plans, $30-80,000/ year

Timeline: ongoing

Associated Hazards: all

Related Goals: all

T-7: Seismic retrofit of tribal buildings and infrastructure, including a reservation wide back-up generator system

Problem/Opportunity: The Shoalwater Bay Reservation is located along the coast on soft marshy soils and adjacent to a major subduction zone capable of generating a 9.0 Magnitude earthquake or greater. Most of the Tribe's critical facilities, infrastructure and buildings lack the structural integrity to withstand a moderate to major earthquake. Furthermore they do not have the ability to maintain operations after an event. The loss of power occurs regularly in an isolated rural area like the Shoalwater Bay Reservation. Thus it is essential that the Tribe's buildings and infrastructure are seismically retrofitted and have back-up power to withstand and continue operations after an event, whether it be a severe storm, earthquake or flood. Back-up power is also essential to maintain the Tribe's water system

Implementation Strategy: An estimate will be made of the costs to implement this strategy. A benefit-cost analysis will be conducted for feasibility. Then a PDM project grant will be applied for to FEMA in order to help secure funding.

Lead Agency: Shoalwater Bay Emergency Management

Funding Options: PDM Grant Funding, HMGP funding, Indian Health Service

Implementation Cost: n/a

Timeline: Ongoing, as funds become available

Associated Hazards: All

Related Goals: Goals 1, 2 , 3

T-8: Create new, and expand existing Evacuation Routes, including better signage

Problem/Opportunity: SR 105 is the only route out of the Shoalwater Bay Reservation. Most of the Tribal facilities and housing is located on Tokeland Rd. During a tsunami evacuation, these roads will be utilized. If these roads are closed or are damaged, evacuation will become very difficult. Thus the Tribe should look at creating additional evacuation routes. The current evacuation route on the ridge behind the Reservation should also be improved, as well as the secondary evacuation route near the Natural Resources office. Routes should also be improved so that the elderly and handicapped can utilize them. Lastly, if SR 105 is blocked, the numerous and maze like logging routes will be needed to access the Reservation. A well defined route through the logging roads should be mapped and signed that would allow those without knowledge of the area ingress and egress from the Reservation.

Implementation Strategy: Identify potential logging road evacuation route as well as Evacuation Route from the Tokeland peninsula. Develop an action plan and secure funding to implement

Lead Agency: Shoalwater Bay Emergency Management Council

Funding Options: Homeland Security, NOAA, USDA, FEMA, DOH, IHS

Implementation Cost: approx $100,000

Timeline: on-going

Associated Hazards: All

Related Goals: All

T-9: Build an Emergency Operations Center (with helipad) and Evacuation Shelter in hazard-free area

Problem/Opportunity: The current Emergency Operations Center (located in the Wellness Center) and Evacuation Shelter (the Tribal Gymnasium) are located in very low-lying areas and on soft soils. Although the structures are new, they may not be usable after a major earthquake that causes liquifaction to the sandy soils they are built upon. Furthermore neither structure will be safe from a tsunami. It is necessary then that the Tribe build an Emergency Operations Center and Shelter in a hazard – free area that will be able to withstand the effects of a 9.0 magnitude earthquake. A heli-pad will needed because SR 105 will be impassable and a helicopter will be the most likely method to bring in supplies.

Implementation Strategy: Identify location and size of structures needed. Apply for grants that could help fund this project. This could also potentially be a partnership with the local Jurisdictions and the County.

Lead Agency: Shoalwater Bay Emergency Management

Funding Options: Homeland Security grants, IHS, USDA, FEMA

Implementation Cost: $1 – 5 Million

Timeline: long-term

Associated Hazards: All

Related Goals: All

T-10: Continue and expand disaster training programs such as Community Emergency Response Team (CERT) to train Tribal members and the local community to respond to an emergency

Problem/Opportunity: Not only is it important to educate the public about hazards and how to prepare for them, it is vital to train community members how to respond to an event. A major event will likely isolate the Reservation for a week or more, thus preventing aid from local emergency services who will be overwhelmed at the same time. Assistance from outside the region could take weeks or even months.

The Community Emergency Response Team (CERT) Program educates people about disaster preparedness for hazards that may impact their area and trains them in basic disaster response skills, such as fire safety, light search and rescue, team organization, and disaster medical operations. Using the training learned in the classroom and during exercises, CERT members can assist others in their neighborhood or workplace following an event when professional responders are not immediately available to help. CERT members also are encouraged to support emergency response agencies by taking a more active role in emergency preparedness projects in their community.

Implementation Strategy: Using grant funding and partnerships with local agencies, the Shoalwater Bay Indian Tribe can conduct regular CERT classes that are focused for the issues facing the Tribe.

Lead Agency: Shoalwater Bay Emergency Management

Funding Options: EMPG grants, regional homeland security grants, Citizens Corps funding and other sources

Implementation Cost: $10,000-20,000 per year

Timeline: Ongoing

Associated Hazards: All

Related Goals: 1, 3, 4

T-11: Partner with local jurisdictions and agencies in developing and implementing mitigation and emergency response strategies and actions.

Problem/Opportunity: Emergency planning and operations can not operate in a vacuum as disasters do not know political boundaries. It is vital that the Tribe and local community leverage its capabilities in order to effectively respond and recover from a disaster event that could cut-off the Tokeland area from outside help for weeks. As the local County, Fire Districts, Sheriff's Office and Towns develop plans to mitigate disasters, the Tribe needs to be right there as a voice to make sure that all are included and have input in the process.

Implementation Strategy: An emergency management planner or other tribal representative will work with local counterparts to developing Tokeland/Shoalwater Bay Indian Reservation area specific disaster plans, polices and actions that will allow the greater community to assist each other in the event of a major disaster.

Lead Agency: Shoalwater Bay Emergency Management

Funding Options: Grants, Tribal operating budget

Implementation Cost: Staff time needed to work with local partners

Timeline: Ongoing

Associated Hazards: All

Related Goals: All

T-12: Develop interlocal agreements with local agencies and other jurisdictions for disaster planning and emergency preparedness and response

Problem/Opportunity: Currently the Shoalwater Bay Tribe does not have interlocal agreements with local jurisdictions and Pacific County for sharing and using resources during disasters. Because of the isolated location and limited resources of all jurisdictions, it is essential that all the Jurisdictions and the Tribe work together during disasters. Due to liability issues though, this sometimes does not happen. Intelocal agreements will help solve some of these issues before a disaster occurs so that all parties can be prepared for when the disaster strikes.

Implementation Strategy: Working with Tribal and County attorneys, develop interlocal agreements for disaster planning and emergency preparation. Have Tribal and County Councils approve and adopt Interlocal Agreements.

Lead Agency: Tribal Council, Shoalwater Bay Emergency Management

Funding Options: Grants, Tribal Budget

Implementation Cost: staff time needed to develop and adopt agreements

Timeline: Short-term

Associated Hazards: All

Related Goals: All

T-13: Identify Elders and other vulnerable populations to prioritize for mitigation and disaster assistance

Problem/Opportunity: Elders and vulnerable populations typically have the least ability to withstand the effects of natural disasters. It is imperative that the Shoalwater Bay Tribe identify its Elders and vulnerable populations and understand their needs so that they can be prioritized for assistance and evacuation when the need arises.

Implementation Strategy: Using GIS or other database methods, compile a list of Elders and vulnerable populations, their location and any special needs for use during disasters.

Lead Agency: Shoalwater Bay Emergency Management

Funding Options: tribal budget, grants

Implementation Cost: Staff Time

Timeline: short-term

Associated Hazards: All

Related Goals: 1, 3

T-14: Expand protective berm along coastline

Problem/Opportunity: During winter storms and increased by the erosion of the offshore barrier beaches, storm surges typically wash onto the Reservation potentially flooding the buildings there. Part of the berm was built behind the Tribal Center, but the Tribe would like to see it extended, especially along SR 105. In 2007 The Army Corps of Engineers ruled against expanding the berm as part of their Mitigation Project for the Tribe instead opting for dune restoration along the barrier islands. Nonetheless, the Tribe is still interested in expanding the berm.

Implementation Strategy: Demonstrate need for protective berm to Federal agencies, such as Army Corps of Engineers

Lead Agency: Shoalwater Bay Emergency Management

Funding Options: Federal grants

Implementation Cost: n/a, expected to be in the Millions of dollars

Timeline: long-term

Associated Hazards: Flooding, Coastal Erosion, Tsunami

Related Goals: Goals 1, 2

T-15: Create and/or expand culverts to allow better drainage of marshy and frequently flooded areas

Problem/Opportunity: The Shoalwater Bay Reservation's buildings are built upon a narrow strip of low-lands between the ocean and the hills. Most of this land is marshy. During the storms, these marshes fill up and spill back onto the developed areas of the Reservation. Better drainage of the marshes would alleviate the amount of standing water in the marshes. Currently the culverts to drain the marshes are inadequate. Larger culverts could reduce flooding from the marshes.

Implementation Strategy: Identify culverts or locations for new culverts to alleviate marsh flooding. Apply for PDM or HMGP grants.

Lead Agency: Shoalwater Bay Emergency Management

Funding Options: PDM, HMGP grants

Implementation Cost: not known at this time, approx $100,000- $1 million

Timeline: long-term

Associated Hazards: Coastal Erosion, flooding, tsunami

Related Goals: Goals 1, 2

T-16: Develop Building Codes and a Development/Master plan that focuses new development and construction on less hazard vulnerable locations

Problem/Opportunity: Currently the Tribe does not have tribally-adopted building codes or a master development plan. Generally the Tribe follows Pacific County buildings codes and bases development on Pacific Co. zoning regulations. As the Tribe continues to grow, it may become necessary to formally plan the long-term development of the tribe and implement building and development codes to better manage development on the Reservation and Trust lands.

Implementation Strategy: Hire staff or contractors to develop Building codes and a Master plan for the Tribe. Tribal Council will adopt Codes and Plans.

Lead Agency: Tribal Council

Funding Options: tribal budget

Implementation Cost: staff time, approx $65-85,000

Timeline: on-going

Associated Hazards: All

Related Goals: All

T-17: Create a community-wide comprehensive education program to educate the Tribe about hazards and hazard mitigation.

Problem/Opportunity: One of the most important elements to mitigation is awareness. The general public is often unaware of the risk of hazards and what actions to take during a disaster event. Public awareness programs can provide information about mitigation measures for different hazards as well as preparedness, response and recovery measures after a disaster event. During and after a hazard event, emergency responders may be either overwhelmed with emergency calls or unable to access some residents. This means that it is important that individual households and local businesses are prepared for an event and have the ability to support themselves for a period of time while emergency responders deal with more immediate and life-threatening situations.

Implementation Strategy: The education program should be an ongoing program that is devoted to increasing the public's awareness of what hazards affect the Shoalwater Bay Indian Tribe and what can be done to mitigate these hazards and their effects. Following a disaster event, there should be extra efforts to provide the public with information about disaster preparedness and mitigation measures. Generally, the public is very receptive to this type of information at this time. The Emergency Management Planner could implement this strategy. Some of the measures that should be taken to educate the public are:

- Evaluate success of current public education efforts.
- Develop and index a mitigation/preparedness packet for the public and for the media for each type of hazard affecting the Shoalwater Bay Indian Tribe.
- Draft a campaign strategy to effectively distribute information about hazards and hazard mitigation.
- Create a link on the Shoalwater Bay web page that is specifically devoted to providing current information about hazards and hazard mitigation. This would include static information about existing hazards and up-to-date information on disaster events affecting the Tribe. For example, there could be information about what to do during an earthquake or tsunami
- Develop and implement workshops and training programs that address specific issues related to the hazards affecting the Shoalwater Bay Reservation. An example would be providing a workshop on how to non-structurally retrofit buildings in order to minimize loss from an earthquake.

Lead Agency: Shoalwater Bay Emergency Management

Funding Options: Emergency Management Performance Grant (EMPG), Hazards Mitigation Grant Program (HGMP), Pre-Disaster Mitigation Program, Citizens Corp Grants

Implementation Cost: The initial cost would be about $30-40, 000 and would include the material assembly, printing and distribution. The continuing cost would be about $10,000 per year and would include development and implementation of workshops and training programs.

Timeline: Ongoing

Associated Hazards: All Hazards

Related Goals: All

T-18: Implement Vegetation and other natural resource management practices to reduce landslides and coastal erosion

Problem/Opportunity: Although erosion is a natural process, human activities, such as logging and development can increase the rate or create new areas of landslides and erosion.

Implementation Strategy: Identify areas of landslides and erosion and develop action plan for implementation.

Lead Agency: Natural Resources Dept.

Funding Options: Staff time, conservation grants, HMGP, PDM grants

Implementation Cost: staff time

Timeline: On-going

Associated Hazards: Landslides, erosion

Related Goals: Goals 1, 2, 3

T-19: Build protective berms and/or other flood protection systems for historic/cultural sites and buildings that cannot be mitigated by other means.

Problem/Opportunity: Historical buildings and sacred sites, such as the Georgetown Cemetery, cannot be relocated. For areas such as these, flood protection measures, such as protective berms would be suitable to reduce vulnerabilities and potential damages to these historic and sacred sites.

Implementation Strategy: The Tribal Emergency Management should identify and prioritize which buildings and sites should have the berms. A FEMA cost-benefit analysis would be used to determine financial feasibility. The Tribe would then apply for a PDM grant or possibly a HMGP grant.

Lead Agency: Shoalwater Bay Emergency Management

Funding Options: FEMA PDM, HMGP, historic preservation grants

Implementation Cost: n/a

Timeline: long-term

Associated Hazards: Tsunami, flooding

Related Goals: Goals 1, 2, 3

Table 5-1: Mitigation Strategies

Mitigation Strategy		Associated Hazards: Coastal erosion	Associated Hazards: Earthquakes	Associated Hazards: Floods	Associated Hazards: Landslides	Associated Hazards: Severe Weather	Associated Hazards: Tsunami	Associated Hazards: Wildland Fire	Timeline	Lead Agency	Implementation Costs	Funding Options	Plan Goals Addressed: Goal 1: Protect people, property and the natural environment t	Plan Goals Addressed: Goal 2: Ensure continuity of critical economic and public facilities and infrastructure	Plan Goals Addressed: Goal 3: Promote and protect Tribal sovereignty and identity	Plan Goals Addressed: Goal 4: Increase public awareness of natural hazards and involvement in hazards planning
T-1	Flood elevate homes and buildings	✓	✓	✓		✓	✓		On-going	Emergency Management	n/a	FEMA PDM	✓	✓		
T-2	Acquire properties in low hazard areas in order to locate new development or relocate existing vulnerable structures and critical facilities	✓	✓	✓	✓	✓	✓	✓	Long-term	Emergency Management	n/a	PDM, HUD, USDA	✓	✓		
T-3	Increase communications capabilities	✓	✓	✓	✓	✓	✓	✓	On-going	Emergency Management	n/a	BIA, DHS, DOH		✓	✓	✓
T-4	**Develop a system to protect and maintain historical and archival Tribal records**	✓	✓	✓	✓	✓	✓	✓	On-going	Tribal Council	n/a	Tribal Budget, Federal grants	✓	✓	✓	
T-5	Create a back-up water supply system	✓	✓	✓	✓	✓	✓	✓	On-going	Tribal Council, Emergency Management	n/a	IHS, DOH, USDA		✓		
T-6	**Develop and/or improve Emergency Plans such as Evacuation Plans, Tribal Records Protection Plan, Continuity of Operations Plan etc…**	✓	✓	✓	✓	✓	✓	✓	On-going	Tribal Council, Emergency Mgt.	Staff time	EMPG, DOH, DHS grants	✓	✓	✓	✓

Mitigation Strategy		Associated Hazards: Coastal erosion	Earthquakes	Floods	Landslides	Severe Weather	Tsunami	Wildland Fire	Timeline	Lead Agency	Implementation Costs	Funding Options	Plan Goals Addressed: Goal 1: Protect people, property and the natural environment t	Goal 2: Ensure continuity of critical economic and public facilities and infrastructure	Goal 3: Promote and protect Tribal sovereignty and identity	Goal 4: Increase public awareness of natural hazards and involvement in hazards planning
T-7	**Seismic retrofit of tribal buildings and infrastructure, including a reservation wide back-up generator system**	✓	✓	✓	✓	✓	✓	✓	On-going	Emergency Management	n/a	PDM, HMGP, IHS	✓	✓	✓	
T-8	Create new, and expand existing Evacuation Routes, including better signage	✓	✓	✓	✓	✓	✓	✓	On-going	Emergency Management Council	approx $100,000	Homeland Security, NOAA, USDA, FEMA, DOH, IHS	✓	✓	✓	✓
T-9	Build an Emergency Operations Center (with helipad) and Evacuation Shelter in hazard-free area	✓	✓	✓	✓	✓	✓	✓	long-term	Emergency Management	$1 – 5 Million	Homeland Security grants, IHS, USDA, FEMA	✓	✓	✓	✓
T-10	Continue and expand disaster training programs such as Community Emergency Response Team (CERT) to train Tribal members and the local community to respond to an emergency	✓	✓	✓	✓	✓	✓	✓	On-going	Emergency Management	$10,000-20,000 per year	EMPG grants, regional homeland security grants, Citizens Corps	✓		✓	✓

Mitigation Strategy		Associated Hazards											Plan Goals Addressed			
		Coastal erosion	Earthquakes	Floods	Landslides	Severe Weather	Tsunami	Wildland Fire	Timeline	Lead Agency	Implementation Costs	Funding Options	Goal 1: Protect people, property and the natural environment t	Goal 2: Ensure continuity of critical economic and public facilities and infrastructure	Goal 3: Promote and protect Tribal sovereignty and identity	Goal 4: Increase public awareness of natural hazards and involvement in hazards planning
T-11	Partner with local jurisdictions and agencies in developing and implementing mitigation and emergency response strategies and actions.	✓	✓	✓	✓	✓	✓	✓	On-going	Emergency Management	Staff time	Grants, Tribal operating budget	✓	✓	✓	✓
T-12	Develop interlocal agreements with local agencies and other jurisdictions for disaster planning and emergency preparedness and response	✓	✓	✓	✓	✓	✓	✓	Short-term	Tribal Council, Emergency Management	Staff time	Grants, Tribal Budget	✓	✓	✓	✓
T-13	Identify Elders and other vulnerable populations to prioritize for mitigation and disaster assistance	✓	✓	✓	✓	✓	✓	✓	Short-term	Emergency Management	Staff time	Grants, Tribal Budget	✓		✓	
T-14	Expand protective berm along coastline	✓		✓			✓		long-term	Emergency Management	n/a	Federal grants	✓	✓		

Mitigation Strategy		Associated Hazards: Coastal erosion	Associated Hazards: Earthquakes	Associated Hazards: Floods	Associated Hazards: Landslides	Associated Hazards: Severe Weather	Associated Hazards: Tsunami	Associated Hazards: Wildland Fire	Timeline	Lead Agency	Implementation Costs	Funding Options	Plan Goals Addressed: Goal 1: Protect people, property and the natural environment t	Plan Goals Addressed: Goal 2: Ensure continuity of critical economic and public facilities and infrastructure	Plan Goals Addressed: Goal 3: Promote and protect Tribal sovereignty and identity	Plan Goals Addressed: Goal 4: Increase public awareness of natural hazards and involvement in hazards planning
T-15	Create and/or expand culverts to allow better drainage of marshy and frequently flooded areas	✓		✓			✓		long-term	Emergency Management	approx $100,000-$1 million	PDM, HMGP grants	✓	✓		
T-16	Develop Building Codes and a Development/Master plan that focuses new development and construction on less hazard vulnerable locations	✓	✓	✓	✓	✓	✓	✓	on-going	Tribal Council	staff time, approx $65-85,000	tribal budget	✓	✓	✓	✓
T-17	Create a community-wide comprehensive education program to educate the Tribe about hazards and hazard mitigation	✓	✓	✓	✓	✓	✓	✓	on-going	Emergency Management	Initial costs: $30-40, 000, Then $10K/yr	EMPG, Citizens Corps	✓	✓	✓	✓

Mitigation Strategy		Associated Hazards							Timeline	Lead Agency	Implementation Costs	Funding Options	Plan Goals Addressed			
		Coastal erosion	Earthquakes	Floods	Landslides	Severe Weather	Tsunami	Wildland Fire					Goal 1: Protect people, property and the natural environment t	Goal 2: Ensure continuity of critical economic and public facilities and infrastructure	Goal 3: Promote and protect Tribal sovereignty and identity	Goal 4: Increase public awareness of natural hazards and involvement in hazards planning
T-18	Implement Vegetation and other natural resource management practices to reduce landslides and coastal erosion	✓			✓				On-going	Natural Resources Dept.	Staff time,	Staff time, conservation grants, HMGP, PDM grants	✓	✓	✓	
T-19	Build protective berms and/or other flood protection systems for historic/cultural sites and buildings that cannot be mitigated by other means			✓			✓		long-term	Emergency Management	n/a	FEMA PDM, HMGP, historic preservation grants	✓	✓	✓	

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5.4. Current and Potential Funding Sources

This section identifies current and potential sources of federal, tribal, state, local and private funding to implement the mitigation actions and activities identified in Section 5.3. Due to the Shoalwater Bay Tribe's situation as a sovereign Indian Nation with a limited revenue base, most funding to implement mitigation measures will come from the federal government through grant programs. Limited funding is also possible from the State of Washington , Skagit County, Snohomish County as well as matching funds for grants from the Shoalwater Bay Tribe.

Current:

Below are the identified sources of funding that the Shoalwater Bay Tribe is receiving for mitigation planning and projects:

Federal

US Army Corp of Engineers. The Shoalwater Bay Shoreline Erosion, Washington, study was conducted in accordance with Section 545 of the Water Resources Development Act (WRDA) of 2000, Public Law 106-541. Section 545 of WRDA 2000, signed into law on December 11, 2000, authorized both a study and a project for coastal erosion protection for the tribal reservation of the Shoalwater Bay Indian Tribe.

FEMA. Pre-disaster Mitigation Planning funds to develop this Plan

BIA

Indian Health Service (focuses on Water Systems)

Tribal

Matching funds

State/local

Emergency Mgt Performance Grant

Hazard Mitigation Grant program

Citizen Corps Funds

Dept of Health Grant

Private

Donations, Volunteers from local community

Potential:

Federal

Below are listed the primary federal programs and agencies that can potentially fund mitigation actions and planning. Additional programs and agencies can also be found in the capability assessment and in **Appendix C**, Sources of Funding.

Pre-Disaster Mitigation Program, which provides funds to develop mitigation plans and implement mitigation projects, is administered by FEMA (by submitting a state level plan, the Shoalwater Bay Indian Tribe will qualify as a direct grantee);

Hazard Mitigation Grant Program, which provides post-disaster funds for hazard reduction projects (e.g., elevation, relocation, or buyout of structures), is administered by FEMA and the Washington State Emergency Management Division;

Flood Control Assistance Account Program, which provides funds for developing flood hazard management plans, for flood damage reduction projects and studies, and for emergency flood projects (e.g., repair of levees), is administered by the Washington State Department of Ecology (Ecology);

Flood Mitigation Assistance Program, which provides funds for flood mitigation on buildings that carry flood insurance and have been damaged by floods, is administered by FEMA;

Department of Homeland Security funding, in addition to FEMA programs;

U.S. Fire Administration, which provides wildfire program funds;

Environmental Protection Agency, which could provide funds for projects with dual hazard mitigation and environmental protection goals as well as updates to this HMP and related planning efforts such as spill prevention and response planning;

Indian Health Service, which could provide funds for hazard mitigation projects that address public health and safety;

Rural Development Agency, USDA, which provides loan and grant funds for housing assistance, business assistance, community development, and emergency community water and wastewater assistance in areas covered by a federal disaster declaration;

Community Development Block Grant, which provides funds for a variety of community development projects, is administered by the Department of Housing and Urban Development;

Small Business Administration Loans, which help businesses recover from disaster damages, is administered by the Small Business Administration; and

Bureau of Indian Affairs, which provides funds to support tribal activities.

U.S. Army Corps of Engineers, which provides funding for coastal and waterway projects

Tribal

The Shoalwater Bay Tribe is fully committed to the public safety and welfare of its residents and tribal members and to the goals of the Shoalwater Bay Tribal Hazard Mitigation Plan. The Tribe has only limited resources though to devote to mitigation planning. Nonetheless the Tribe may be willing to match grant funding, either through direct monies or through the allocation of resources, such as labor and expertise, in order to implement the actions discussed in this plan.

State/Local

In some cases, funding may be available from the State of Washington and/or Pacific County, especially on mitigation actions that overlap jurisdictions, such as road and flood mitigation projects. The main resource for funding opportunities from the State of Washington is from the Washington State Emergency Management Division, which helps fund mitigation projects. The Shoalwater Bay Tribe is continually building relationships with the State of Washington, Pacific County, Grays Harbor County as well as local communities such as Tokeland, in order to develop partnerships to implement mitigation measures that are regional in scope.

Private

No potential funding from the private sector is currently identified. Nonetheless local businesses and residents will be encouraged to participate and contribute to the mitigation effort.

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6. Plan Maintenance Process

When the PDM planning grant to prepare this plan was awarded, the federal hazard mitigation planning regulations (44 CFR 201.4) required tribal-level plans such as this Hazard Mitigation Plan to be reviewed, revised, and submitted for approval to the FEMA Regional Director every three years. The regulations required a plan maintenance process that includes an established method and schedule for monitoring, evaluating, and updating the plan; a system for monitoring implementation of mitigation measures and project closeouts; and a system for reviewing progress on achieving goals as well as specific activities and projects identified in the mitigation plan.

In December 2007, a new HMP regulation was developed specifically for Tribal Hazard Mitigation Plans, 44 CFR 201.7. The differences between 201.4 and 201.7 are minor, and this plan was prepared accordingly to meet both Regulations. This plan will be updated every 5 years as specified under 44 CFR 201.7.

The Shoalwater Bay Tribal Hazard Mitigation Plan is a living document that is intended to provide a guide for hazard mitigation to the Shoalwater Bay Indian Tribe. The Plan can be revised more frequently than five years if the conditions under which it was developed change significantly (e.g., a major disaster occurs or funding availability changes). This section details the Tribe's method and schedule for monitoring, evaluating, and updating the THMP and for monitoring the progress of mitigation actions.

6.1. Responsibility for Plan Maintenance

The Shoalwater Bay Tribal Council has final authority and responsibility over the Shoalwater Bay Tribal Hazard Mitigation Plan. Responsibility for plan maintenance and coordinating implementation of mitigation measures will be delegated to the Emergency Management Planning Committee. The Shoalwater Bay Emergency Management Planning Committee will also be responsible for annual progress reports to the Tribal Council and for the five-year update to be submitted to the Council and subsequently to FEMA for approval.

6.2. Incorporation into Other Planning Processes

This Hazard Mitigation Plan will serve as the basis of all Shoalwater Bay emergency management planning. This plan's vulnerability results and mitigation actions will be incorporated into the Tribe's Comprehensive Emergency Management Plan (CEMP), other Tribal emergency plans as well as future land use and development plans. This plan will also be consulted and referenced into the Pacific County local Hazard Mitigation Plan.

6.3. Continued Public Involvement

In order to continue public participation in the Plan Maintenance and Update process, the Shoalwater Bay Tribal Hazard Mitigation Plan will be available online on the Tribe's website.[47] The Plan will also be available in hardcopy at the Tribal Administration Building, the Emergency Management Office and at the Georgetown Community Library (which serves the greater Tokeland area).Comments can be submitted via e-mail, telephone or in person at the Emergency Management office, or during Tribal Council meetings relating to the Plan.

6.4. Monitoring, Evaluating and Updating the Plan

The Shoalwater Bay Emergency Management Planning Committee will review this THMP annually and will update the THMP every five years. Annual reviews will:

- Identify progress made on the implementation of mitigation measures and projects;
- Assess the impacts of disasters in the Reservation region to determine whether the HMP should be revised based on the new information;
- Examine and ensure that the Mitigation Plan requirements, as well as goals, objectives and actions, are incorporated into current and future Tribal planning processes.

The annual review will occur during the last quarter of each calendar year to coincide with the tribal fiscal year and to prepare for PDM grant deadlines.

The effectiveness of projects and other actions will be evaluated at appropriate, project specific intervals or, at a minimum, when the THMP is updated every five years as required for Tribal plans submitted to FEMA. The process of updating the THMP will include a review of hazard assessments, vulnerability assessments, potential losses, tribal capability, and coordination with other planning efforts, funding sources, and recommended and potential new mitigation measures. In support of the five-year update, the Emergency Management Planning Committee will:

[47] http://www.shoalwaterbay-nsn.gov/

- Examine and revise the Hazard Risk Assessment as necessary to ensure that it describes the current understanding of hazard risks;
- Examine progress on and determine the effectiveness of the mitigation actions and projects recommended in this THMP;
- Examine and Ensure that the Mitigation Plan requirements, as well as goals, objectives and actions, are incorporated into concurrent and future Tribal planning processes;
- Identify implementation problems (technical, political, legal, and financial) and develop recommendations to overcome them;
- Recommend ways to increase participation by Shoalwater Bay departments and to improve coordination with other jurisdictions and agencies; and
- Review and, if desirable, revise the Shoalwater Bay HMP Action Plan.

The updated THMP will be presented to the Shoalwater Bay Tribal Council for approval and adoption before it is submitted to FEMA for re-approval.

6.5. Monitoring Progress of Mitigation Actions

The Shoalwater Bay Emergency Management Planning Committee will frequently review progress on the implementation of mitigation actions. The Committee will also meet with representatives from Tribal Departments to discuss progress of mitigation activities. The implementation of all short-term mitigation actions will be monitored by the Emergency Management Planning Committee on an ongoing basis until implementation is complete. Long-term actions being actively implemented will be monitored on an ongoing basis, or at least annually as needed. Long-term actions planned for the future will be reviewed during plan updates every five years.

The system for reviewing progress on achieving goals, objectives, and specific actions included in the mitigation strategy will be based on a checklist of all objectives and actions. This checklist will be reviewed annually by the Emergency Management Planning Committee. As described in the previous section, progress on mitigation actions will be described in an annual report to Shoalwater Bay Tribal Council and in the five-year update of the Tribal Hazard Mitigation Plan.

In addition to the work products described in approved work plans for projects funded by the Pre-Disaster Mitigation Program, the Hazard Mitigation Grant Program, the Flood Mitigation Assistance Program, or other grant programs, quarterly or semi-annual (depending on reporting requirements of funding agencies) performance reports that identify accomplishments toward completing the work plan commitments, a discussion of the work performed for all work plan components, a discussion of any existing or potential problem areas that could affect project completion, budget status, and planned activities for the subsequent quarter will be submitted to the funding agency by the assigned Shoalwater Bay Project

Officer. The agency-specific final grant closeout documents will also be prepared by the Shoalwater Bay Project Officer at the conclusion of the performance period and submitted to the funding agency.

7. References

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State

Washington State Hazard Identification & Vulnerability Assessment

http://emd.wa.gov/3-pet/pal/hiva/06-hiva-scope-geo.htm

Washington State Hazard Mitigation Plan

http://emd.wa.gov/6-mrr/mit-rec/mit/mit-pubs-forms/hazmit-plan/hazmit-plan-idx.htm

Local

Skagit County Natural Hazards Mitigation Plan

http://www.skagitcounty.net/Common/Asp/Default.asp?d=EmergencyManagement&c=General&p=2003NHMPFinaltoc.htm

Snohomish County Natural Hazards Mitigation Plan

http://www1.co.snohomish.wa.us/Departments/Public_Works/Divisions/SWM/Work_Areas/River_Flooding/Planning/Countywide

Tribal

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Upper Skagit Tribe Annex, Skagit County Hazard Mitigation Plan

http://www.skagitcounty.net/Common/Asp/Default.asp?d=EmergencyManagement&c=General&p=2003NHMPFinaltoc.htm

Tulalip Tribes Hazard Mitigation Plan

http://www.tulaliptribes-nsn.gov/department/emergency_management/index.asp

Quil Ceda Village local Hazard Mitigation Plan (in development)

Lummi Nation Hazards Mitigation Plan

Puyallup Tribe Natural Hazard Mitigation Plan

http://www.co.pierce.wa.us/pc/abtus/ourorg/dem/EMDiv/MitPTIP.htm

WA Wildfire Statistics:
Updated March 2008
http://www3.wadnr.gov/dnrapp6/dataweb/dmmatrix.html

Appendix A Resolution Adopting Plan

SHOALWATER BAY INDIAN TRIBE
P.O. Box 130 • Tokeland, Washington 98590
Telephone (360) 267-6766 • FAX (360) 267-6778

SHOALWATER BAY INDIAN TRIBE
RESOLUTION # 06-11-08-17

WHEREAS, the Shoalwater Bay Tribe is a Federally recognized Tribe Headquartered on the Shoalwater Bay Indian reservation in the State of Washington, and

WHEREAS, the Shoalwater Bay Tribal Council is the governing body of the Shoalwater Bay Tribe in accordance with their Constitution and By-laws; and

WHEREAS, the Shoalwater Bay Tribal Council is charged with the responsibility and is committed to saving lives and to preserving the safety, health, and welfare of all people who live on, work on and visit our reservation and to the preservation of our lands, environment and our culture; and

WHEREAS, the Federal Emergency Management Agency requires local governments and Tribes to develop plans to mitigate the impact of disasters before applying for federal disaster aid; and

WHEREAS, the Shoalwater Bay Indian Tribe has worked with a consultant to develop such a plan;

NOW THEREFORE BE IT RESOLVED, that the Shoalwater Bay Tribal Council authorizes adopting the Shoalwater Bay Indian Tribe 2008 Tribal Hazard Mitigation Plan.

CERTIFICATION

The above Resolution was passed at a regular Council meeting held , 2005 at the Shoalwater Bay Tribal Center at which a quorum was present. 3 FOR 0 AGAINST 0 ABSTAIN

Charlene Nelson, Chairman
Shoalwater Bay Indian Tribe

Lynn Clark, Secretary
Shoalwater Bay Indian Tribe

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Appendix B Adoption Letter from FEMA

U.S. Department of Homeland Security
Region X
130 228th Street, SW
Bothell, WA 98021-9796

FEMA

July 8, 2008

Honorable Charlene Nelson
Chair, Shoalwater Bay Tribal Council
Shoalwater Bay Indian Tribe
2373 Old Tokeland Rd.
Tokeland, Washington 98590

Dear Chair Nelson:

The U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) has approved the ***Shoalwater Bay Indian Tribe – Tribal Hazard Mitigation Plan*** as a Tribal Mitigation Plan, in accordance with 44 CFR Part 201. The Shoalwater Bay Indian Tribe is now eligible to apply directly to FEMA as a grantee for Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) non-emergency programs through July 8, 2013. To continue eligibility, the plan must be reviewed, revised as appropriate and re-submitted for approval within five years from the date of this letter.

As a result of the Disaster Mitigation Action of 2000, States and Tribes are required to develop and maintain hazard mitigation plans compliant with FEMA standards as a condition for receiving non-emergency Stafford Act assistance. Applicable Stafford Act assistance includes Public Assistance (Categories C-G), Fire Management Assistance, Hazard Mitigation Grant Program, and Pre-Disaster Mitigation grants.

FEMA's approval of your plan as a Tribal Mitigation Plan provides the Shoalwater Bay Indian Tribe's eligibility to apply for various Stafford Act programs, as well as the Flood Mitigation Assistance program. All requests for assistance, however, will be evaluated individually according to the specific eligibility and other requirements of the particular programs. For example, a mitigation action identified in the approved plan may or may not meet the eligibility requirements for HMGP funding. If you have any questions regarding specific program requirements and eligibility, please contact Braden Allen, Hazard Mitigation Assistance (HMA) Specialist for HMA programs, 425-487-4749.

We look forward to continuing a productive relationship between FEMA Region X and the Shoalwater Bay Indian Tribe. Please contact our Regional Tribal Liaison, Andy Hendrickson, at 425-487-4784, or our Regional Mitigation Planning Manager, Kristen Meyers, at 425-487-4543 with any plan-specific questions or for further assistance.

Sincerely,

Susan K. Reinertson
Regional Administrator

cc: Mark Stewart, State Hazard Mitigation Programs Manager

KM:bb

www.fema.gov

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Appendix C Sources of Funding[48]

Catalog of Federal Disaster Assistance (CFDA) numbers are provided to help you find additional information on the CFDA website.

Disaster-Specific Assistance Programs

- Community Disaster Loan Program
  (CDFA Number: 97.03)
  Provides funds to any eligible jurisdiction in a designated disaster area that has suffered a substantial loss of tax and other revenue.
  (Localities)

- Fire Management Assistance Grant Program
  (CDFA Number: 97.046)
  Assistance for the mitigation, management, and control of fires on publicly or privately owned forests or grasslands, which threaten such destruction as would constitute a major disaster.
  (States, local and tribal governments)

- Hazard Mitigation Grant Program
  (CDFA Number: 97.039)
  Provides grants to States and local governments to implement long-term hazard mitigation measures after a major disaster declaration.
  (States, localities and tribal governments; certain private-nonprofit organizations or institutions; authorized tribal organizations; and Alaska native villages or organizations via states)

- Public Assistance Grant Program
  (CDFA Number: 97.036)
  Provides assistance to alleviate suffering and hardship resulting from major disasters or emergencies declared by the President.
  (States, localities, tribal governments and private-nonprofit organizations via states)

- Reimbursement for Firefighting on Federal Property
  (CDFA Number: 97.016)
  Provides reimbursement only for direct costs and losses over and above normal operating costs.
  (States, localities, tribal governments and fire departments)

[48] http://www.fema.gov/government/grant/government.shtm

Hazard-Related Grants and Assistance Programs

- Community Assistance Program, State Support Services Element (CAP-SSSE)
  (CDFA Number: 97.023)
  Provides funding to States to provide technical assistance to communities in the National Flood Insurance Program (NFIP) and to evaluate community performance in implementing NFIP floodplain management activities.
  (States)

- Flood Mitigation Assistance Program
  (CDFA Number: 97.029)
  Provides funding to assist States and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP.
  (States and localities)

- National Dam Safety Program
  (CDFA Number: 97.041)
  Provides financial assistance to the states for strengthening their dam safety programs.
  (States)

- National Earthquake Hazards Reduction Program (NEHRP)
  (CDFA Number: 97.082)
  Provides financial assistance to the states for strengthening their dam safety programs.
  (States)

- National Flood Insurance Program
  (CDFA Number: 97.022)
  Enables property owners in participating communities to purchase insurance as a protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages.
  (States, localities, and individuals)

- Pre-Disaster Mitigation Program
  (CDFA Numbers: 97.017)
  Provides funds for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event.
  (States, localities and tribal governments)

- Repetitive Flood Claims Program
  (CDFA Number: 97.092)
  Provides funding to States and communities to reduce or eliminate the long-term risk of flood damage to structures insurede under the NFIP that have

had one or more claims for flood damages, and that can not meet the requirements of the Flood Mitigation Assistance (FMA) program for either cost share or capacity to manage the activities.
(States and localities)

Non-Disaster Programs

- Chemical Stockpile Emergency Preparedness Program
  (CDFA Number: 97.040)
  Improves preparedness to protect the people of certain communities in the unlikely event of an accident involving this country's stockpiles of obsolete chemical munitions.
  (States, localities and tribal governments)

- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
  (PDF - 129KB) (TXT - 8KB)
  (CDFA Numbers: 97.02, 97.021)
  Supports programs designed to improve capabilities associated with oil and hazardous materials emergency planning and exercising.
  (States, localities and tribal governments, U.S. territories, state emergency response committee's (SERCs) and LEPCs)

- Cooperating Technical Partners
  (CDFA Number: 97.045)
  Provides technical assistance, training, and/or data to support flood hazard data development activities.
  (States, localities, tribal governments)

- Emergency Food and Shelter Program
  (CDFA Number: 97.024)
  Supplements the work of local social service organizations within the United States, both private and governmental, to help people in need of emergency assistance.
  (Private-Nonprofit community and government organizations)

- Map Modernization Management Support
  (CDFA Number: 97.070)
  Provides funding to supplement, not supplant, ongoing flood hazard mapping management efforts by the local, regional, or State agencies.
  (States and localities)

- Superfund Amendments and Reauthorization Act
  Provides funding for training in emergency planning, preparedness,

mitigation, response, and recovery capabilities associated with hazardous chemicals.
(Public officials, fire and police personnel, medical personnel, first responders, and other tribal response and planning personnel).