SHOALWATER BAY INDIAN TRIBE
2014 HAZARD MITIGATION PLAN

Bridgeview Consulting, LLC
Bridging the Gap in Emergency Management Services
915 No. Laurel Lane
Tacoma, WA 98406
Tel 253.301.1330 Fax 253.460.8220

HAZARD MITIGATION PLAN

FINAL

SEPTEMBER 2014

Prepared for:
Shoalwater Bay Indian Tribe
P.O. Box 130
Tokeland, WA 98590

Prepared by:

Bridgeview Consulting, LLC
Bridging the Gap in Emergency Management Services
915 No. Laurel Lane
Tacoma, WA 98406
Tel 253.301.1330 Fax 253.460.8220

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ACKNOWLEDGMENTS

Project Manager

Lee Shipman
Emergency Management Director
Shoalwater Bay Tribe
PO Box 130
Tokeland, WA 98590
(360) 267-8120
lshipman@shoalwaterbay-nsn.gov

Shoalwater Bay Tribal Staff

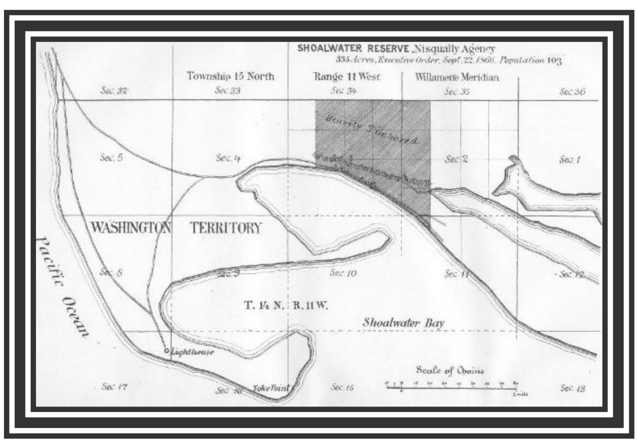
Jamie Judkins
Grant Program Coordinator
Shoalwater Bay Tribe
PO Box 130
Tokeland, WA 98590
jjudkins@shoalwaterbay-nsn.gov
(360)267-8152

Consultants

Beverly O'Dea, Project Manager/Lead Planner, Hazard Mitigation Plan and THIRA, Bridgeview Consulting, LLC

Cathy Walker, GIS Analyst, Bridgeview Consulting, LLC

Adam Palmer, Planner and Tribal Liaison, Bridgeview Consulting, LLC



Shoalwater Reserve, Nisqually Agency, 1879
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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The Disaster Mitigation Act (DMA; Public Law 106-390) is the latest federal legislation enacted to encourage and promote proactive, pre-disaster planning as a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA emphasizes planning for disasters before they occur. Under the DMA, a pre-disaster hazard mitigation program and new requirements for the national post-disaster hazard mitigation grant program were established.

In recognition of tribal sovereignty and the government-to-government relationship that currently exists between FEMA and Indian Tribal governments, FEMA amended 44 CFR 201 at 72 Fed. Reg. 61720 on October 31, 2007, and provided further amendments on September 16, 2009, amending 74 Fed. Reg. 47471 to consolidate and clarify the requirements for Indian Tribal governments. These amendments established protocol for Tribal Hazard Mitigation Plans to be separate from State and Local Mitigation Plans. It also finalized the Mitigation Planning Guidelines, which became effective March 2010. It is under those guidelines which this Tribal Hazard Mitigation Plan was developed.

For consistency, 44 CFR 201.2 defines *Indian Tribal Government* as any Federally recognized governing body of an Indian or Alaska Native tribe, band, nation, pueblo, village, or community that the Secretary of Interior acknowledges to exist as an Indian Tribe under the Federally Recognized Indian Tribe List Act of 1994, 25 U.S.C. 479a. This does not include Alaska Native corporations when the ownership is vested in private individuals.

The DMA encourages tribes, states and local authorities to work together on pre-disaster planning, and it promotes sustainability as a strategy for disaster resistance. "Sustainable hazard mitigation" includes the sound management of natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context. The enhanced planning network called for by the DMA helps local government's articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk reduction projects.

Embracing this initiative as a foundation for proactive planning as well as FEMA's "whole community approach," the Shoalwater Bay Indian Tribe (Tribe) has developed this Update to the Shoalwater Bay Indian Tribe Hazard Mitigation Plan in an effort to reduce loss of life and property resulting from disasters. While it is impossible to predict exactly when and where disasters will occur, or the extent to which they will impact the Tribe, with careful planning and collaboration among the various Tribal departments, members, and communities, and the surrounding public jurisdictions, agencies, private non-profit organizations, stakeholders, and local citizens, it is possible to minimize losses that can occur from disasters. This has been and will continue to be the driving force behind this plan development. Utilizing the three primary characteristics of mitigation efforts to: retreat, accommodate or protect, the Shoalwater Bay Indian Tribe

"**Whole Community** is an approach to emergency management that reinforces the fact that FEMA is only one part of our nation's emergency management team; that we must leverage all of the resources of our collective team in preparing for, protecting against, responding to, recovering from and mitigating against all hazards; and that collectively we must meet the needs of the entire community in each of these areas. This larger collective emergency management team includes, not only FEMA and its partners at the federal level, but also local, tribal, state and territorial partners; non-governmental organizations like faith-based and non-profit groups and private sector industry; to individuals, families and communities, who continue to be the nation's most important assets as first responders during a disaster."

–FEMA

http://www.fema.gov/whole-community

will develop techniques and practices that will contribute to the environment by developing non-regret actions which will, in all hopes, create multiple positive outcomes.

Hazard mitigation is defined as a way to reduce or alleviate the loss of life, personal injury, and property damage that can result from a disaster through long- term strategies. It involves strategies such as planning, policy changes, programs, projects, and other activities that can mitigate the impacts of hazards on the Shoalwater Bay Indian Tribe. The responsibility for hazard mitigation lies with many, including private property owners; business and industry; and Tribal, local, state, and federal governments.

There is a strong desire on the part of the Tribe for this plan to be a user-friendly document that is understandable to the layperson and not overly technical. Many of the Tribe's mitigation efforts involve working with private property owners, so it is important for everyone to understand what "risk" is and how mitigation can reduce its impacts upon the Tribal lands and its members.

Many elements went into making this Tribal Hazard Mitigation Plan a success, including scientific analyses, expertise of the Tribal members and subject matter experts, the contents of previous written works, and historical photographic evidence, all of which has been compiled in the development of this Tribal Hazards Mitigation Plan. The Tribal Planning Team was instrumental in providing ideas, concepts, historical data and information, discussions, and support needed to develop this plan.

Development of the Shoalwater Bay Indian Tribe Update to the Hazard Mitigation Plan was completed in coordination with the Planning Committee Members and the Tribe's consultant. Lead authorship and project management of this plan was provided by Beverly O'Dea, with primary GIS support and analysis provided by Cathy Walker.

This plan represents an update from the 2008 plan. For purposes of FEMA review, this plan structure has been comprehensively modified. All existing information has been incorporated into the new template as appropriate, with additional current data added. Where old data cannot be re-created, reference to that fact is made. Readers should assume that this update includes all new maps, charts, and graphs, unless otherwise indicated by date, or are historic cultural maps, which have not been modified. Hazard profiles have been updated to include all events occurring since 2008 through April 2014. Best available science, including applicable new studies and products (e.g., Shakemaps) were used in conducting the risk assessment. The one exception to this are the new FIRM maps, which have not been adopted yet by the Tribe as of May 2014. Once adopted, new data will be incorporated into the flood portion of the plan as appropriate. Datasets utilized are defined within each profile. Hazus-MH, which was not utilized in previous editions, was utilized for this update, as well as extensive GIS analysis. In addition, a complete CDMS update of all Tribal facilities was also completed as part of this process, and that data was utilized during the risk assessment phase to determine vulnerability and impact. Once approved, FEMA will be provided with the dataset for use in updating the Hazus CDMS program should it elect to utilize the data.

PLAN DEVELOPMENT METHODOLOGY

The development of the hazard mitigation plan included five phases:

- Phase 1—Organize and review
- Phase 2—Risk assessment
- Phase 3—Engage the public
- Phase 4—Assemble the plan

- Phase 5—Plan adoption

Phase 1—Organize and Review

Under this phase, the steering committee was assembled to oversee the development of the plan update. The committee consisted of Tribal staff and Tribal members, as well as other stakeholders in the planning area, and the technical consultant was also provided technical support to the planning team. The planning process and planning team were formally recognized by the Tribal Council. Full coordination with other tribal, county, state, and federal agencies involved in hazard mitigation occurred from the onset of this plan's development through its completion. A multi-media public involvement strategy centered on a hazard preparedness questionnaire was also implemented under this phase. Also occurring under this phase was a comprehensive review of the exiting plan as well as the State's Enhanced Hazard Mitigation Plan and a comprehensive review of existing programs within the operational area that may support or enhance hazard mitigation actions. A key function of the planning team was to identify the goals and objectives for this plan.

The layout of this plan was also modified significantly. As such, this update should be considered a comprehensive review with best available science and most relevant data incorporated. Where changes of significance are made or updated analysis conflicts with 2008 information, those items are noted within the body of the text. For review purposes, all charts, maps and graphs have been updated to incorporate information occurring during the 2008-2014 update cycle, and have been dated accordingly. The planning timeframe associated with this plan is March 1, 2008 – May 31, 2014.

Phase 2—Risk Assessment

Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from natural hazards. This process assesses the vulnerability of people, buildings, cultural resources, and infrastructure to natural hazards. It focuses on the following parameters:

- Hazard identification and profiling
- Identification of Cultural resources
- The impact of hazards on physical, cultural, social and economic assets
- Vulnerability identification
- Estimates of the cost of damage or costs that can be avoided through mitigation.

Of relevance occurring during this 2014 update cycle is the Shoalwater Bay Indian Tribe's development of its first Threat Hazard Identification and Risk Assessment (THIRA). Hazard profile data developed from that risk/threat assessment process, wherever possible, has been incorporated within the 2014 updated THMP, including within the Strategy portion of the plan. Therefore, this edition of the Tribal Hazard Mitigation Plan incorporates information not only on the natural hazards of concern which have the potential to impact the Reservation, but also identifies man-made and technological hazards as well. It should be noted that different methodologies for determining risk were conducted for the natural hazards when compared to the technological and human caused hazards. This, in part, was due to the limited data existing for the non-natural hazards; difficulties in establishing loss data; and lack of recurrence intervals. Specific THIRA hazard analysis is not included within this document, and remains protected and confidential. Rather, a more generalized qualitative analysis is provided.

Inclusion of all hazards of concern within the THMP is a significant modification from the 2008 THMP, which previously addressed only natural hazards and hazardous materials as a separate element. Within the 2014 update, hazardous materials are addressed as a secondary hazard of impact for the natural hazards, and is also profiled within the THIRA component of the man-made and technological hazards which are also included within the THMP. In addition, more information is provided with respect to Climate Change, and its potential impacts associated with the established natural hazards.

The risk assessment for this hazard mitigation plan meets the requirements outlined in Chapter 44 of the Code of Federal Regulations (44 CFR). Phase 2 occurred simultaneously with Phase 1, with the two efforts using information generated by one another to create the best possible risk assessment.

Phase 3—Engage the Public

Specific to Tribal plans, 44 CFR 201.7 states that Tribal governments may define who they feel constitute "public" within the planning realm, as many Tribal members have difficulty or apprehension about how to honor traditional beliefs and cultural attributes while still fully participating in the mitigation planning process. For many Tribes, the term *natural hazards* contradicts cultural beliefs of the Elements which are living beings: wind, rain, earth and sky live and breathe, providing for the needs of the Tribal Members. Because of this, it was necessary for the Tribe to meld both western and traditional cultures into a method that met the needs of both worlds.

Under this phase, a public involvement strategy was developed by the planning team that maximized the capabilities of the Tribe, while still maintaining their cultural beliefs and responsibilities to the Elements. The planning team provided oversight to the actual plan development, as well as the information necessary for inclusion within the document. One of the first steps taken was the development of a contact list which included individuals whose input was needed to complete this plan to its fullest capacity. Additionally, the strategy also included: Tribal Council Government weekly meeting updates; public meetings to review the draft plan; distribution of the draft plan to planning committee members; utilization of a hazard mitigation survey; a Tribal sponsored website dedicated to the plan, and media releases throughout various stages in the process. Public engagement also included involvement during the annual Yellow Brick Road Tsunami and Health Walk, which occurred in August 2013, and during which preliminary maps were presented and survey completion solicited. Throughout the course of this project, numerous meetings were held with, and briefings given to, federal and local officials and other stakeholders. This strategy was deemed by the planning team as a key function in the success of this planning effort.

Phase 4—Assemble the Plan

The Planning Team assembled key information from Phases 1 and 2 into a document to meet the DMA requirements. Under 44 CFR 201.7, a Tribal Hazards Mitigation Plan must include the following:

- A description of the Planning process
- Risk assessment
- Mitigation Strategy
  - Goals
  - Review of alternatives
  - Prioritized "action plan"
- Plan Maintenance section

- Documentation of Adoption

Phase 5—Plan Adoption/Implementation/Assurances

The Tribe has elected to review and adopt the plan after receipt of notification from FEMA Region X of its approval. A copy of the Resolution will be included within this document in Chapter 18.

This document further includes a plan implementation and maintenance section that details the formal process for ensuring that the plan remains an active and relevant document. The plan maintenance process includes a schedule for monitoring and evaluating the plan's progress annually and producing a plan revision every 5 years. This process seeks to keep a planning team that meets the criteria of the original planning team intact to perform this annual review. This phase includes strategies for continued public involvement and incorporation of the recommendations of this plan into other planning mechanisms of the Tribe, such as the comprehensive plan, capital improvement plan, building code, and development design guidelines.

This section of the plan also includes the assurances required of the Shoalwater Bay Tribe pursuant to 44 CFR 13.11(c) with respect to all applicable Federal statutes and regulations in effect for the periods for which it receives grant funding. Additionally, the Tribe also agrees to amend its plan whenever necessary to reflect changes in Tribal or Federal laws and statutes as required under 44 CFR 13.11(d).

MITIGATION GOALS AND OBJECTIVES

Goals

During its July 2013 meeting, the Planning Team reviewed the existing Goals and Objectives established within the 2008 Hazard Mitigation Plan, and confirmed the goals as written:

Goal 1. Protect people, property and the natural environment

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

Objectives

Review of the original objectives determined that they remained consistent and applicable. However, it was determined that the effectiveness of the objectives would be better suited if developed in a linear fashion to allow for a broader approach to develop applicable action items/strategies. This will allow for objectives which are multi-goal oriented and address multiple hazards. As such, while the intent of the 2008 objectives remains the same, for the 2014 update, each objective was modified slightly to facilitate greater linkage potential with more general terminology to address multiple hazards. A complete list of the objectives is contained within Table 1-1.

MITIGATION INITIATIVES – PROGRESS REPORT

The initial hazard mitigation planning effort produced a partnership that embraced the concept of risk reduction through proactive mitigation. The partnership was able to complete identified actions or initiate activities on a significant portion of the strategies identified, as discussed in greater detail in Section 4 of the Plan.

Chapter 6 of the initial plan also identified a comprehensive plan maintenance strategy that involved the completion of an annual review. The primary purpose for the progress report was to help keep the plan dynamic and establish opportunities to fine-tune or enhance the plan. Additionally, progress reporting provided an opportunity to identify and coordinate available grant funding opportunities. While the Tribe made significant progress with respect to completion of many of the identified strategies identified in Section 4, limited formal review of the entire plan was conducted during its five year life cycle due to limited resources.

The updated version of the hazard mitigation action plan is again a key element of this plan. It is through the implementation of this action plan that the Shoalwater Bay Indian Tribe can strive to become disaster-resilient through sustainable hazard mitigation. This 2014 action plan includes an enhanced assessment of the capabilities of the Tribe to implement hazard mitigation initiatives, a review of alternatives, a prioritization schedule, and a mitigation strategy matrix that identifies the following:

- Initiative by hazard addressed
- Objectives addressed
- Lead implementation agency (or agencies)
- Estimated benefits
- Estimated costs
- Timeline for implementation
- Funding sources
- Prioritization

For the purposes of this document, mitigation initiatives are defined as: *activities designed to reduce or eliminate losses resulting from the impacts of natural hazards of concern*.

Although one of the driving influences for preparing this plan was grant funding eligibility, this plan is not a “how to get grant money” plan. It was important to the Tribe that they examine initiatives that would work through all phases of emergency management and that contribute to rather than remove from the environment. It was significant to the Tribal Members that the mitigation efforts include mainstreaming adaptive, ‘no-regrets’ strategies which improved their abilities to live with the Elements, while not adversely impacting their beliefs and culture. They have adopted a philosophy of “accommodate, retreat or protect” when developing their mitigation strategies. As such, some of the initiatives outlined in this plan are not grant-eligible, and grant eligibility was not the focus of the selection. Rather, the focus was on the initiatives’ effectiveness in achieving the goals of the plan and whether or not they are within the Tribe’s capabilities. Detailed descriptions for these actions can be found in Section 4.

IMPLEMENTATION AND ASSURANCES

Full implementation of the recommendations of this plan will require time and resources. This plan reflects an adaptive management approach in that specific recommendations and plan review protocols are provided to evaluate changes in vulnerability and action plan prioritization after the plan is adopted. The true measure of the plan’s success will be its ability to adapt to the ever-changing climate of hazard mitigation. Funding resources are always evolving, as are programmatic changes based on new mandates. The Shoalwater Bay Tribe has a long-standing tradition of proactive response to issues that may impact its members. The Tribe as a whole is forward thinking, and strives whenever possible to improve the lives of its members, and the residents living on the Reservation. This point is recognized industry-wide through the continual requests for the Tribe and its Emergency Manager to present its innovative concepts for protecting its Tribal Members at various conferences and meetings. This tradition is further reflected in the development of this plan, as it is not an easy task to accomplish. The Tribal Council will assume responsibility for adopting the recommendations of this plan and committing Tribal resources toward its implementation. The framework established by this plan will help identify a strategy that maximizes the potential for implementation based on available and potential resources. It commits the Tribe to pursue initiatives when the benefits of a project exceed its costs. Most important, the Tribe developed this plan with community input. These techniques will set the stage for successful implementation of the recommendations in this plan.

As established within 44 CFR 13.11(c), the Tribal Government will continue to comply with all applicable federal statutes and regulations in effect, including those periods during which the Tribe receives grant funding. In compliance with 44 CFR 13.11(d), the Tribe, whenever necessary, will reflect new or revised federal statutes or regulations, or any material changes in Tribal policy or operation. It is understood that the Tribe will submit those amendments for review and approval in coordination with FEMA Region X and, if it elects to do so, the Washington State Emergency Management Division.

SECTION 1 — THE PLANNING PROCESS

Chapter 1.
INTRODUCTION TO THE PLANNING PROCESS

1.1 WHY PREPARE THIS PLAN?

1.1.1 The Big Picture

The federal Disaster Mitigation Act (DMA) emphasizes the importance of planning for disasters before they occur by requiring tribes, states and local governments to develop hazard mitigation plans as a condition for federal grant assistance. The DMA (Public Law 106-390; approved by Congress October 10, 2000), amended the Stafford Disaster Relief and Emergency Assistance Act by repealing its previous mitigation planning provisions and replacing them with a new set of requirements that emphasize the need to closely coordinate mitigation planning and implementation.

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.

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.

Hazard Mitigation Plan Requirements for Indian Tribal Governments

Requirements for Indian Tribal governments were consolidated and clarified when the U.S. Federal Emergency Management Agency (FEMA) amended Title 44 of the Code of Federal Regulations (44 CFR; Section 201) on October 31, 2007 (72 Fed. Reg. 61720) and again on September 16, 2009 (74 Fed. Reg. 47471). These amendments were made in recognition of the status of tribal sovereignty and the government-to-government relationship between FEMA and Indian Tribal governments. They established a protocol for Tribal hazard mitigation plans to be separate from state and local mitigation plans. Final mitigation planning guidelines became effective March 2010. Tribal hazard mitigation plan requirements differ from local hazard mitigation plan requirements, and are more like the requirements for a state-level type plan. This hazard mitigation plan for the Shoalwater Bay Indian Tribe was developed under those guidelines. The federal statutes define *Indian Tribal Government* as “any Federally recognized governing body of an Indian or Alaska Native tribe, band, nation, pueblo, village, or community that the Secretary of Interior acknowledges to exist as an Indian Tribe under the Federally Recognized Indian Tribe List Act of 1994, 25 U.S.C. 479(a)” (44 CFR 201.2). This does not include Alaska Native corporations when the ownership is vested in private individuals.

Underlying Principles of the DMA

Hazard mitigation is a way to reduce or alleviate loss of life, personal injury and property damage that can result from a disaster through long- and short-term strategies. It involves planning, policy changes, programs, projects and other activities that can mitigate the impacts of hazards. The responsibility for hazard mitigation lies with many, including private property owners; business and industry; and tribal, state, local, and federal government. The DMA encourages tribes and state and local authorities to work together on pre-disaster planning, and it promotes sustainability for disaster resistance. “Sustainable hazard mitigation" includes the sound management of cultural and natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context. The enhanced planning network called for by the DMA helps tribes and governments articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk reduction projects.

1.1.2 Shoalwater Bay Indian Tribe's Initial Plan

This 2014 update to the 2008 plan has been developed in accordance with requirements of the DMA, including criteria addressing the planning process, risk assessment, mitigation strategy, plan maintenance, and the adoption process. Once the plan is approved by FEMA, the Tribe remains eligible for funding under the Stafford Act. FEMA grant programs provide funding through state emergency management agencies to support mitigation planning and projects to reduce potential disaster damages. It is the intent of the Tribe to pursue grant opportunities in the future to assist in mitigating against the Tribe's hazards of concern. Current grant opportunities are delineated in Table 1-1.

1.1.3 Purposes for Planning

DMA compliance is only one of multiple objectives driving this planning effort. Elements and strategies in this plan were selected because they meet a program requirement and because they best meet the needs of the Reservation. This hazard mitigation plan identifies resources, information, and strategies for reducing risk from natural hazards. It will also help guide and coordinate mitigation activities. The plan was developed to meet the following objectives:

- Meet or exceed program requirements specified under the DMA.
- Enable the Tribe to continue using federal grant funding to reduce risk through mitigation.
- Meet the needs of the Tribe as well as federal requirements.
- Coordinate existing plans and programs so that high-priority initiatives and projects to mitigate possible disaster impacts are funded and implemented.
- Create a linkage between the hazard mitigation plan and established plans of the Shoalwater Bay Tribe so that they can work together in achieving successful mitigation.

1.2 WHO WILL BENEFIT FROM THIS PLAN?

All Tribal Members, local citizens and businesses of the Shoalwater Bay Tribe are the ultimate beneficiaries of this hazard mitigation plan. The plan reduces risk for those who live in, work in, and visit the Reservation. It provides a viable planning framework for all foreseeable natural hazards. Participation in development of the plan by key stakeholders helped ensure that outcomes will be mutually beneficial. The plan's goals and recommendations can lay groundwork for the development and implementation of local mitigation activities and partnerships.

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.

1.3 HOW TO USE THIS PLAN

This hazard mitigation plan is organized into four primary Sections:

- Section 1—The Planning Process
- Section 2—Community Profile
- Section 3—Risk Assessment
- Section 4—Mitigation Strategy.

Each Section includes chapters and subsections within those chapters required under federal guidelines to develop a detailed, all-encompassing Tribal Hazard Mitigation Plan under the Disaster Mitigation Act (DMA). DMA compliance requirements are sometimes cited within a subsection to illustrate compliance with the requirement.

The following appendices provided at the end of the plan include information or explanations to support the main content of the plan:

- Appendix A—A glossary of acronyms and definitions
- Appendix B—Public outreach information, including the hazard mitigation questionnaire and summary and documentation of public meetings.
- Appendix C—Catalogs of hazard mitigation alternatives to be considered for recommendation in the plan
- Appendix D—A template for progress reports to be completed as this plan is implemented

TABLE 1-1.
GRANT OPPORTUNITIES

Program	Enabling Legislation	Funding Authorization	Hazard Mitigation Plan Requirement	
			Grantee	Sub-Grantee
Public Assistance, Categories A-B (e.g., debris removal, emergency protective measures)	Stafford Act	Presidential Disaster Declaration	☐	☐
Public Assistance, Categories C-G (e.g., repair of damaged infrastructure, publicly owned buildings)	Stafford Act	Presidential Disaster Declaration	☑	☐
Individual Assistance (IA)	Stafford Act	Presidential Disaster Declaration	☐	☐
Fire Management Assistance Grants	Stafford Act	Fire Management Assistance Declaration	☑	☐
Hazard Mitigation Grant Program (HMGP) Planning Grant	Stafford Act	Presidential Disaster Declaration	☑	☐
HMGP Project Grant	Stafford Act	Presidential Disaster Declaration	☑	☑
Pre-Disaster Mitigation (PDM) Planning Grant	Stafford Act	Annual Appropriation	☐	☐
PDM Project Grant	Stafford Act	Annual Appropriation	☑	☑
Flood Mitigation Assistance (FMA)	National Flood Insurance Act	Annual Appropriation	☑	☑
Severe Repetitive Loss (SRL)	National Flood Insurance Act	Annual Appropriation	☑	☑
Repetitive Flood Claims (RFC)	National Flood Insurance Act	Annual Appropriation	☑	☐
Tribal Homeland Security	Dept. of Homeland Security	Annual Appropriation	☑	☐

☑ = Tribal Hazard Mitigation Plan Required
☐ = No Tribal Hazard Mitigation Plan Required

1.4 GOALS AND OBJECTIVES

Hazard mitigation plans must identify goals for reducing long-term vulnerabilities to identified hazards (44 CFR Section 201.7(c)(3)(i)). The Planning Team, during its July 2013 meeting, confirmed the 2008 goals and redefined measurable objectives for this plan, based on data from the preliminary risk assessment and the results of the public involvement strategy. The goals, objectives and actions in this plan all support each other. Goals were selected to support the overall purpose of the mitigation plan – that of supporting resilience throughout the Reservation. Objectives were selected that met multiple goals. Actions were prioritized based on the action meeting multiple objectives.

1.4.1 Goals and Objectives

Goals

During its July 2013 meeting, the Planning Team reviewed the existing Goals and Objectives established within the 2008 Hazard Mitigation Plan, and confirmed the goals as written:

Goal 1. Protect people, property and the natural environment
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.

Objectives

Review of the original objectives determined that they remained consistent and applicable. However, it was determined that the effectiveness of the objectives would be better suited if developed in a linear fashion to allow for a broader approach to develop applicable action items/strategies. Each selected objective was modified to meet multiple goals, serving as a stand-alone measurement of the effectiveness of a mitigation action, rather than as a subset of a goal. The objectives are measureable in nature, and are used to help establish priorities. This will allow for objectives which are multi-goal oriented and address multiple hazards. A complete list of the objectives are contained within Table 1-2.

TABLE 1-2.
SHOALWATER BAY TRIBE HAZARD MITIGATION PLAN OBJECTIVES

Objective Number	Objective Statement	Goals for which it can be applied
O-1	Acquire (purchase), retrofit, or relocate structures in high hazard areas.	1
O-2	Encourage open space uses in hazardous areas or ensure that if building occurs in these high-risk areas that it is done in such a way as to minimize risk.	1, 2
O-3	Use best available data, science and technologies to improve understanding of location and potential impacts of hazards, and to promote disaster resilient communities by discouraging new development in hazardous areas or ensuring that development is done in such a way as to minimize risk.	3
O-4	Consider the impacts of natural hazards in all planning mechanisms that address current and future land uses on the Reservation.	4
O-5	Educate the reservation residents and surrounding communities on the risk exposure to natural hazards and ways to increase the member’s capability to prepare, respond, recover and mitigate the impacts of these events.	3, 4
O-6	Increase resilience and the continuity of operations of identified critical facilities within the Reservation.	3
O-7	Preserve the Cultural Resources of the Shoalwater Bay Indian Tribe.	3
O-8	Provide/improve flood protection through various means, such as with flood control structures and drainage maintenance where appropriate and feasible.	4
O-9	Consider NFIP with the ultimate goal to lower the cost of flood insurance premiums through the CRS program.	4

O-10	Establish a partnership among the Tribal Government and Tribal business leaders with surrounding area government and business community to improve and implement methods to protect life, property and the environment, while preserving the cultural integrity of the Shoalwater Tribe and its members.	4
O-11	Enhance community emergency management capability (i.e., prepare, plan, respond, recover, mitigate).	3, 4
O-12	Encourage the development and implementation of long-term, cost-effective and environmentally sound mitigation projects.	1, 3, 4
O-13	Develop or improve emergency warning response and communication systems and evacuation procedures.	3, 4
O-14	Enhance land use regulations to proactively impact the hazards of concern.	1, 2, 3
O-15	Encourage hazard mitigation measures that result in the least adverse effect on the natural environment and that use natural processes, while preserving and maintaining the cultural elements of the Shoalwater Bay Indian Tribe.	All

Chapter 2.
PLAN DEVELOPMENT METHODOLOGY

2.1 PLANNING RESOURCE ORGANIZATION

The process followed to develop the Shoalwater Bay Indian Tribe Hazard Mitigation Plan had the following primary objectives, which are discussed in detail in the following sections:

- Secure grant funding
- Define the planning area
- Establish a planning team
- Coordinate with other agencies
- Review existing programs
- Engage the public (as defined by the Tribe)

2.1.1 Grant Funding

This planning effort was supplemented by a grant from the Federal Emergency Management Agency Pre-Disaster Mitigation Program. The grant was applied for in 2012, with funding appropriated in 2013.

2.1.2 Defining the Planning Area

Due to the frequency of hazard events impacting the Shoalwater Bay Indian Reservation and its remote location, the Tribe elected to conduct its own hazard mitigation planning and not become an annex to any multi-agency local government plan. This Shoalwater Bay Tribe Hazard Mitigation Plan is a single-jurisdiction plan covering the entire Reservation, and also includes areas defined as having cultural and historical significance to the Tribe. While no specific locations or items of cultural significance have been identified within this document in an effort to protect the areas and items, they have been considered within this planning process and risk assessment analysis, as well as strategy development. It should be understood that the entire Reservation is considered to be of cultural significance, and as such, this process includes all of the people, property, infrastructure and natural environment within the boundaries of the Shoalwater Reservation, as well as any property owned or used by the Tribe outside this area, such as the hunting, gathering and fishing areas. The planning area for this plan update is shown in Figure 2-1 and Figure 2-2. Figure 2-1 also depicts the topography of the Tribe. Presently, there are tribal members who live outside of what is currently recognized as the tribal boundary. The tribe also owns properties which fall outside of the current Reservation boundary as identified in Figure 2-3. This plan includes such areas in its analysis and overall mitigation strategy that are within its federally recognized boundary, ancestral boundary, usual and accustomed fishing grounds, as well as other properties owned and operated by the Tribe in other areas of the county and state.

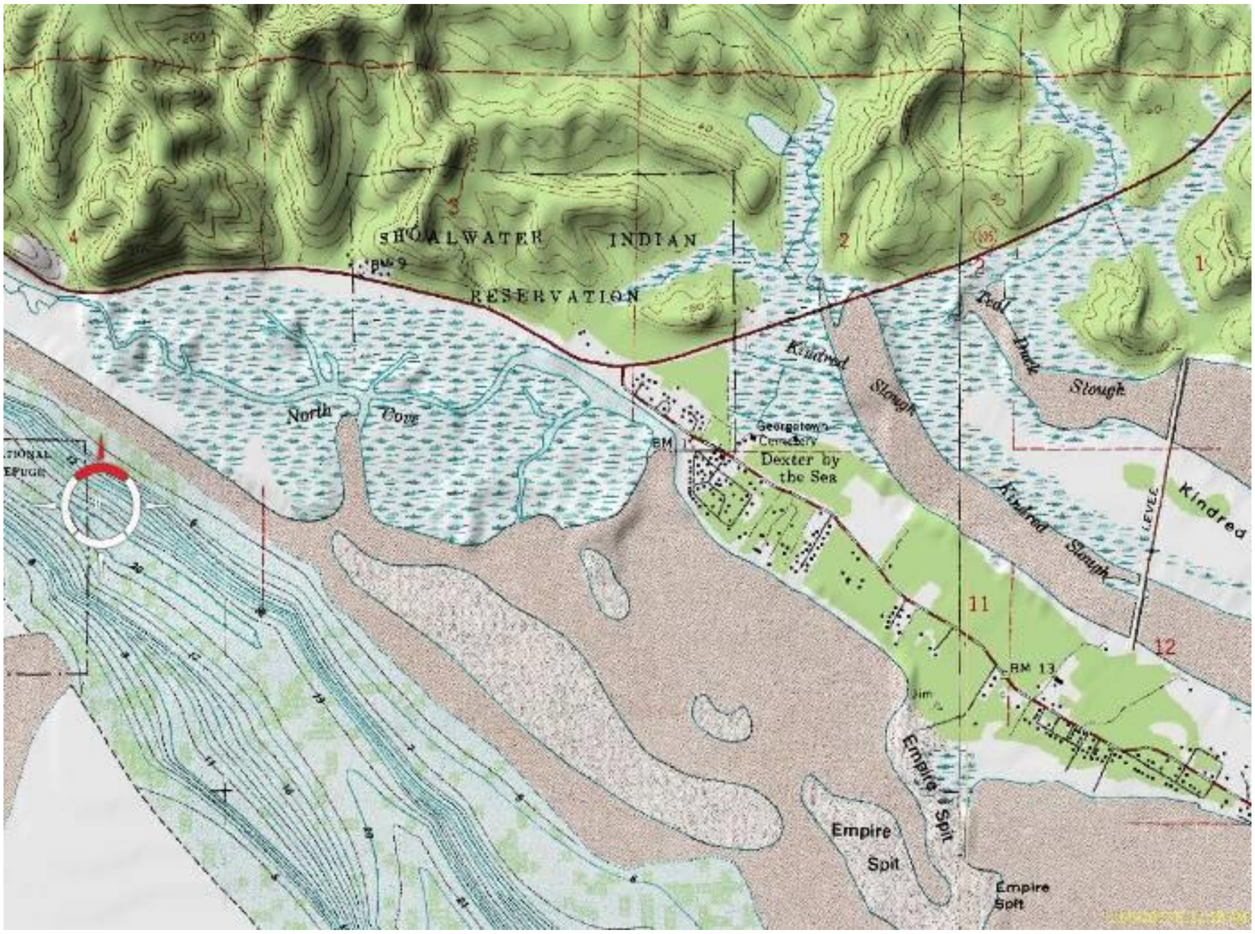


Figure 2-1. Planning Area

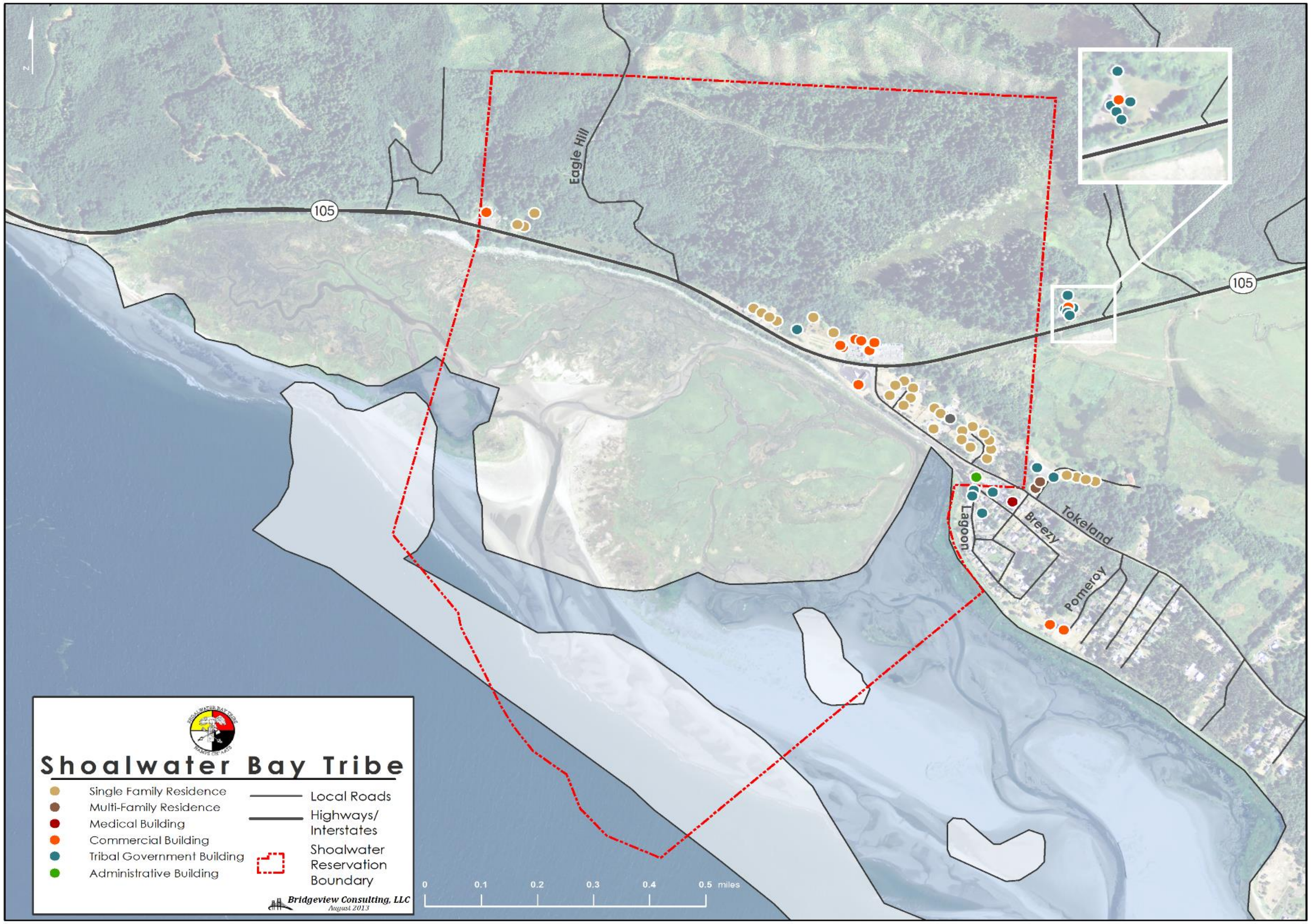


Figure 2-2 Planning Area with Federal Boundary

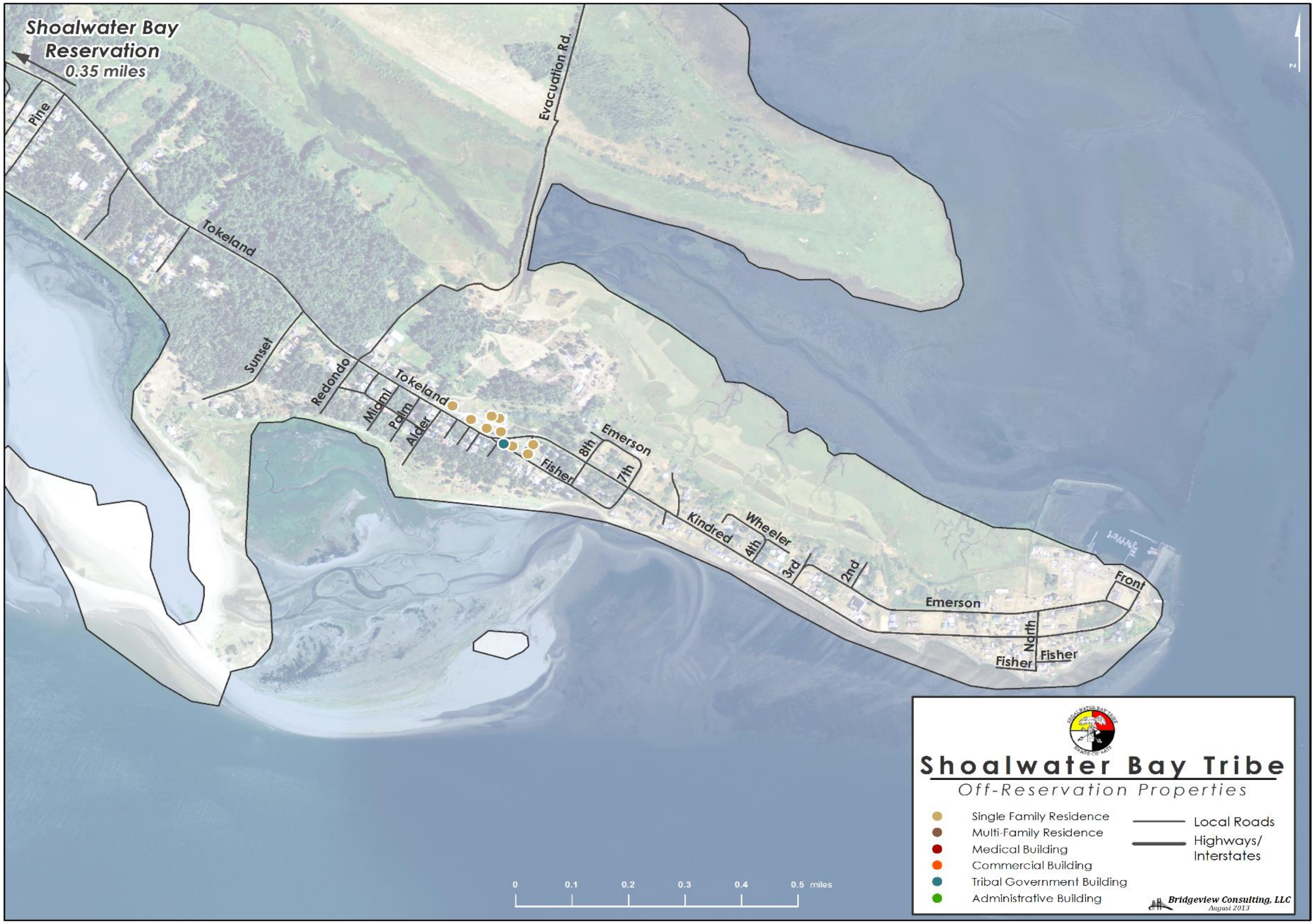


Figure 2-3 Shoalwater Bay Tribe Facilities Off Reservation Boundary

2.1.3 Formation of the Planning Team

The Shoalwater Bay Indian Tribe hired Bridgeview Consulting, LLC to assist with development and implementation of the plan. The Bridgeview Consulting project manager assumed the role of the lead planner, reporting directly to the Shoalwater Bay Tribe project manager. A planning team was formed to lead the planning effort as identified in Table 2-1.

TABLE 2-1.
PLANNING TEAM MEMBERSHIP

Name	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July
Lee Shipman Emergency Management Director Shoalwater Bay Indian Tribe Leshipman@shoalwaterbay-nsn.gov (360) 267-8120	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Jamie Judkins Grant Program Coordinator jjudkins@shoalwaterbay-nsn.gov (360) 267-8152	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Leah Thomas Public Relations Showalter Bay Indian Tribe lthomas@shoalwaterbay-nsn.gov (360) 267-8202		✓		✓									✓	✓	
Rick Wilcox Contractor: Tactical Interoperable Communications Coordinator wa7rw@comcast.net (360) 589-8336	✓	✓	✓	✓								✓	✓	✓	
Joel Blake Outdoor Maintenance/Tribal Council - Member At Large Shoalwater Bay Indian Tribe jblake@shoalwaterbay-nsn.gov (360) 267-6766															
Holly Blake Special Projects Shoalwater Bay Indian Tribe hblake@shoalwaterbay-nsn.gov (360) 267-6766 x1105				✓		✓							✓	✓	
Brad Phernetton IT Technician Shoalwater Bay Indian Tribe bphernetton@shoalwaterbay-nsn.gov (360) 267-8204 or 267-6766 x1151			✓									✓	✓	✓	✓
Robin Souvenir Chief of Police Shoalwater Bay Indian Tribe rsouvenir@shoalwaterbay-nsn.gov (360) 267-8391 or main & x4101			✓				✓			✓			✓	✓	✓

TABLE 2-1.
PLANNING TEAM MEMBERSHIP

Name	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July
Penny Burns Grant Accountant Shoalwater Bay Indian Tribe pburns@shoalwaterbay-nsn.gov (360) 267-8162	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Michael Rogers Tribal Administrator Shoalwater Bay Indian Tribe mrogers@shoalwaterbay-nsn.gov (360) 267-6766 x1102 (360) 591-1614 (cell)		✓												✓	✓
Gary Burns Shoalwater Bay Indian Tribe Environmental Department gburns@shoalwaterbay-nsn.gov (360) 267-6766 x2420	✓	✓	✓											✓	
Steve Spencer Shoalwater Bay Indian Tribe Environmental Department sspencer@shoalwaterbay-nsn.gov (360) 267-6766 x2421		✓	✓	✓	✓									✓	
Troy Colley Housing Director Shoalwater Bay Indian Tribe tcolley@shoalwaterbay-nsn.gov (360) 268-7331 or Main & x1206		✓				✓				✓	✓	✓	✓	✓	
Leatta Anderson Court Clerk Shoalwater Bay Tribal Court landerson@shoalwaterbay-nsn.gov (360) 267-8174 x 2101			✓											✓	✓
Jake Christensen Construction/Maintenance and Volunteer EM Communication Asst. Shoalwater Bay Housing Jchristensen@shoalwaterbay- nsn.gov		✓		✓							✓		✓	✓	✓
Jon Deacon Panamaroff President and CEO – Willapa Bay Enterprises Corp. ceo@spit-wbe.com (360) 637-6486		✓			✓									✓	
Christopher Robideau Contractor: Land Use Planning Chris.Robideau@red-plains.com			✓												
Gary Urbas Washington State Military Department Gary.Urbas@mil.wa.gov		✓													

TABLE 2-1.
PLANNING TEAM MEMBERSHIP

Name	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July
Sadie Whitener Washington State Department of Ecology swhi461@ECY.WA.GOV		✓	✓			✓		✓	✓				✓	✓	
Chuck Wallace Emergency Management Director Grays Harbor County		✓													
Tim Walsh Washington State Department of Natural Resources – Geologist		✓									✓		✓		
Beverly O'Dea, Consultant/Lead Planner Bridgeview Consulting, LLC bevodea@bridgeviewconsulting.org (253) 301-1330	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cathy Walker, Lead GIS Analyst Bridgeview Consulting, LLC (253) 301-1330		✓	✓	✓	✓		✓		✓	✓		✓	✓	✓	✓
Adam Palmer, Planner Bridgeview Consulting, LLC (253) 301-1330		✓	✓	✓	✓		✓		✓	✓	✓		✓	✓	✓

2.1.4 Coordination with Other Agencies

Opportunities for involvement in the planning process must be provided to neighboring communities, local and regional agencies involved in hazard mitigation, agencies with authority to regulate development, businesses, academia, and other private and nonprofit interests (44 CFR, Section 201.7(b)). This task was accomplished by the planning team as follows:

- **Steering Committee Involvement**—Agency representatives were invited to participate on the Steering Committee.
- **Agency Notification**—The following agencies were advised of the planning process and/or invited to participate in the plan development process:
  - FEMA Region X (Braden Allen)
  - U.S. Dept. of Interior, Bureau of Indian Affairs
  - U.S. Dept. of Health and Human Services, Indian Health Services
  - U.S. Dept. of Interior, Bureau of Land Management
  - American Red Cross
  - Washington State Emergency Management Division
  - Washington State Department of Natural Resources
  - Washington State Department of Ecology

  These agencies received meeting announcements, meeting agendas, and meeting minutes by e-mail throughout the plan development process. These agencies supported the effort by attending meetings or providing feedback on issues.

- **Pre-Adoption Review**— Agencies listed above were provided an opportunity to review and comment on this plan, primarily through the hazard mitigation plan website (see 2.1.6). E-mails were distributed containing informing concerning draft review, as well as a link to download the plan if desired.
- **Newsletters—**In addition to the above, the Tribe distributes a regular newsletter, which announced plan development and milestones. The newsletter also directed Tribal members to the newly developed website, and the on-line survey.
- **Press Release –** The Tribe also distributed a press release in March which announced the planning effort, and provided the address to the Survey, asking citizens to complete the document.

2.1.5 Review of Existing Programs

Hazard mitigation planning must include review and incorporation, if appropriate, of existing plans, studies, reports and technical information (44 CFR, Section 201.7(c)(1)(iii)). Chapter 5, Section 3 of this plan provides a review of laws and ordinances in effect within the planning area that can affect hazard mitigation initiatives. In addition, the following programs and plans can affect mitigation within the planning area, just as this plan can provide information to support the various plans and programs:

- Shoalwater Bay Indian Tribe 2008 Hazard Mitigation Plan
- Shoalwater Bay Indian Tribe Hazmat Response Plan
- Shoalwater Bay Indian Tribe Comprehensive Emergency Management Plan
- Shoalwater Bay Indian Tribe Land Use Documentation
- Shoalwater Bay Indian Tribe Housing Program
- Shoalwater Bay Indian Tribe Environmental/Natural Resource Program
- Washington State Enhanced Multi-Hazard Mitigation Plan (2010)
- Willapa National Wildlife Refuge Comprehensive Conservation Plan (Volume 2)
- Various papers and studies concerning the impacts of climate change and coastal erosion on the Reservation

An assessment of all Shoalwater Bay Indian Tribe regulatory, technical and financial capabilities to implement hazard mitigation initiatives is presented in Chapter 5. Many of these relevant plans, studies and regulations are cited in the capability assessment.

2.1.6 Public Involvement

Broad public participation in the planning process helps ensure that diverse points of view about the planning area's needs are considered and addressed. The public must have opportunities to comment on disaster mitigation plans during the drafting stages and prior to plan approval (44 CFR Section 201.7(b), 201.7(c)(1)(i) and 201.7(c)(1)(ii)). For this planning effort, "public" is defined as tribal members, tribal employees, the contractor, and some members of surrounding jurisdictions. While surrounding jurisdictions and governmental agencies had some involvement in the planning effort, the planning team was limited to Tribal members, Tribal employees, and the contractor. Part of the reason for this decision was to preserve information concerning the Tribe's cultural resources.

The Tribe did extensive outreach and used different methods to increase involvement, such as pairing meetings with existing Tribal Council meetings, holding Web-based meetings, and scheduling conference calls that allowed participation by agencies and individuals. Interviews were also conducted with individuals and specialists from outside organizations. Those interviews identified common concerns related to natural and manmade hazards, and key long- and short-term activities to reduce risk. Interviews included representatives from public safety personnel, planning department personnel, natural resources personnel, cultural resource personnel, other Tribal government, and agencies and entities from surrounding jurisdictions.

The planning team developed a comprehensive public involvement strategy using websites, media sources, and utilized existing meetings to gain input on the process. The Tribe created a new website, which hosted a mitigation section, wherein all notices and survey links were posted. During meetings on the reservation or attended elsewhere by tribal employees or members, individuals were directed to the website to gain better insight of the Tribe's endeavors, and to solicit input. The planning team also identified stakeholders to target through the public involvement strategy. As members of the planning team attended various conferences or meetings, they provided updates to those in attendance, asking for input and review of the plan. In addition, the Emergency Management Director also gave updates on the process and requested input during a number of conferences which she attended, including: the LEPC/SERC meeting in March 2014; ITEMA conference in March 2014; LEPC Conference in May 2013 and 2014; FEMA/State Summit in May 2014; and the NAIC Conference in June 2014.

Strategy

The strategy for involving the public in this plan emphasized the following elements:

- Include members of the public on the planning team.
- Use a questionnaire to determine general perceptions of risk and support for hazard mitigation and to solicit direction on alternatives. This outreach was not limited to tribal members, but was to all planning participants. The questionnaire was available to anyone wishing to respond via the website, as well as distributed by hand during Tribal events. The Tribe also posted a news release in the Tribal Newsletter, seeking response and input.
- Attempt to reach as many planning area tribal members and citizens as possible using multiple formats. This is of significant importance because many tribal members do not have computers, or access to computers – so alternate methods of seeking input were very important.
- Identify and involve planning area stakeholders.
- Provided newsletter articles about various mitigation efforts, such as watershed protection.

Planning Team Input

The majority of the members of the planning team live or work on the Shoalwater Bay Indian Reservation. The make-up of the steering committee proved to be integral in the success of this planning effort. This helped to add a historical perspective to this committee that proved to be valuable in identifying direction for the plan development process.

Questionnaire

A hazard mitigation plan questionnaire (see Figure 2-4) was developed by steering committee members. The questionnaire was used to gauge household preparedness for natural hazards and the level of knowledge of tools and techniques that assist in reducing risk and loss from natural hazards. This questionnaire was designed to help identify areas vulnerable to one or more natural hazards. The answers to its questions helped guide the planning team in selecting goals, objectives and mitigation strategies. Over 100 hard copies of the questionnaires were disseminated throughout the planning area by multiple means, including door to door distribution of the surveys. Additionally, a web-based version of the questionnaire was made available on the hazard mitigation plan website. Surveys were also made available at Tribal office locations in hardcopy format. The complete questionnaire and a summary of its findings can be found in Appendix B.

1. Survey Introduction

In response to Federal programs enabling the Shoalwater Bay Tribe to use pre- and post- disaster financial assistance to reduce the exposure of risks associated with natural hazards, a planning partnership comprised of members from the Shoalwater Bay Tribe, industry, federal, state, county, and local governments are working together to update the Shoalwater Bay Tribe Hazard Mitigation Plan.

In order to identify and plan for natural disasters, we need your assistance! The below questionnaire is designed to help us gather information from Tribal Members and local citizens about disaster issues, and to find out from you about areas vulnerable to various types of natural disasters. The information you provide will help us coordinate activities to reduce the risk of injury or property damage in the future.

The survey consists of various questions related to the Reservation and its Tribal Members, and provides an opportunity for any additional comments at the end. The survey should take less than 10 minutes to complete and is anonymous, unless you decide to provide contact information. Please take a few moments to answer the following questions to the best of your ability (you may not know the answers to all of the questions, and that is perfectly fine!). If you have any questions, comments, or concerns about the process for updating the Hazard Mitigation Plan, or this survey, please feel free to call Lee Shipman, Emergency Manager, 360-267-8120 or leshipman@shoalwaterbay-nsn.gov

The Shoalwater Bay Tribal Planning Partnership thanks you for taking the time to participate in this information-gathering process.

1. Do you live or work on the Reservation?

◯ Yes ◯ No

2. Which of the following natural hazard events have you or has anyone in your household experienced in the past 20 years? (Check all that apply)

☐ Coastal Erosion
☐ Landslide
☐ Earthquake
☐ Severe Weather (wind, lightning, winter storm, etc.)
☐ Flood
☐ Tsunami/Seiche (waves generated by wind or seismic activity)
☐ Hazardous Materials
☐ Wildland Fire
☐ Household Fire
☐ None
☐ Other (please specify)

3. How many times have you been impacted by disaster events?

◯ 0 ◯ 1-3 ◯ 4-5 ◯ 5 or more

4. Have these occurred while you have lived (or worked) on the Shoalwater Reservation?

◯ Yes ◯ No

5. If the answer to the preceding question is in the affirmative, has the hazard event impacted your ability to use your residence because of damages?

◯ Yes ◯ No

Figure 2-4. Sample Page from Questionnaire Distributed to the Public

Public Meetings

An open-house public meeting was held on August 15, 2013 on the Reservation. This meeting took place during a public safety fair, and it is estimated that well over 200 people were in attendance (see Figure 2-5). The August 15th meeting ran from 10:00 a.m. to 2:00 p.m., and was held in conjunction with several other safety and health-related events in hope to capture more interest. The meeting format allowed attendees to examine maps and handouts and have direct conversations with project staff. Reasons for planning and information generated from the risk assessment were shared with attendees. Maps were set up for each of the primary hazards to which the planning area is most vulnerable. This allowed citizens to see information related to their property. This was very effective in illustrating risk to the public. Planning team members were present to answer questions. Each citizen attending the open houses was asked to complete a questionnaire, and each was given an opportunity to provide written comments to the Planning Team Members.

During the May 23, 2014 Council Meeting, the Emergency Management Director announced that the draft plan would be available for review within the next two weeks. Citizens were asked to review the draft plan, available on the Tribe's website, and to provide comments. The final public review period began June 23, 2014, lasting through July 13, 2014. The final plan will remain on the Tribe's website over the course of the next five years.

The third and final public meeting was held on September 12, 2014, during which time the plan was presented to the Council, and at which time the Council approved and adopted the plan, pending FEMA approval.

News Releases

A news release was also published to draw attention to the Tribe's update process, and the survey. The Tribe also has a regularly distributed newsletter, which was used to disseminate information through the planning process. Once the draft plan was available for public review, notice was also published in the Newsletter, which is disseminated to all tribal members, employees, and residents on the Reservation.

Internet

At the beginning of the plan development process, a website was created to keep the public posted on plan development milestones and to solicit relevant input. The plan was also provided via a file -transfer site, which allowed for the plan downloading for review.

The Tribe's website address was publicized in all press releases, mailings, questionnaires and public meetings. Information on the plan development process, the planning team, the questionnaire and phased drafts of the plan was made available to the public on the site throughout the process. The Tribe intends to keep a website active after the plan's completion to keep the public informed about successful mitigation projects and future plan updates.

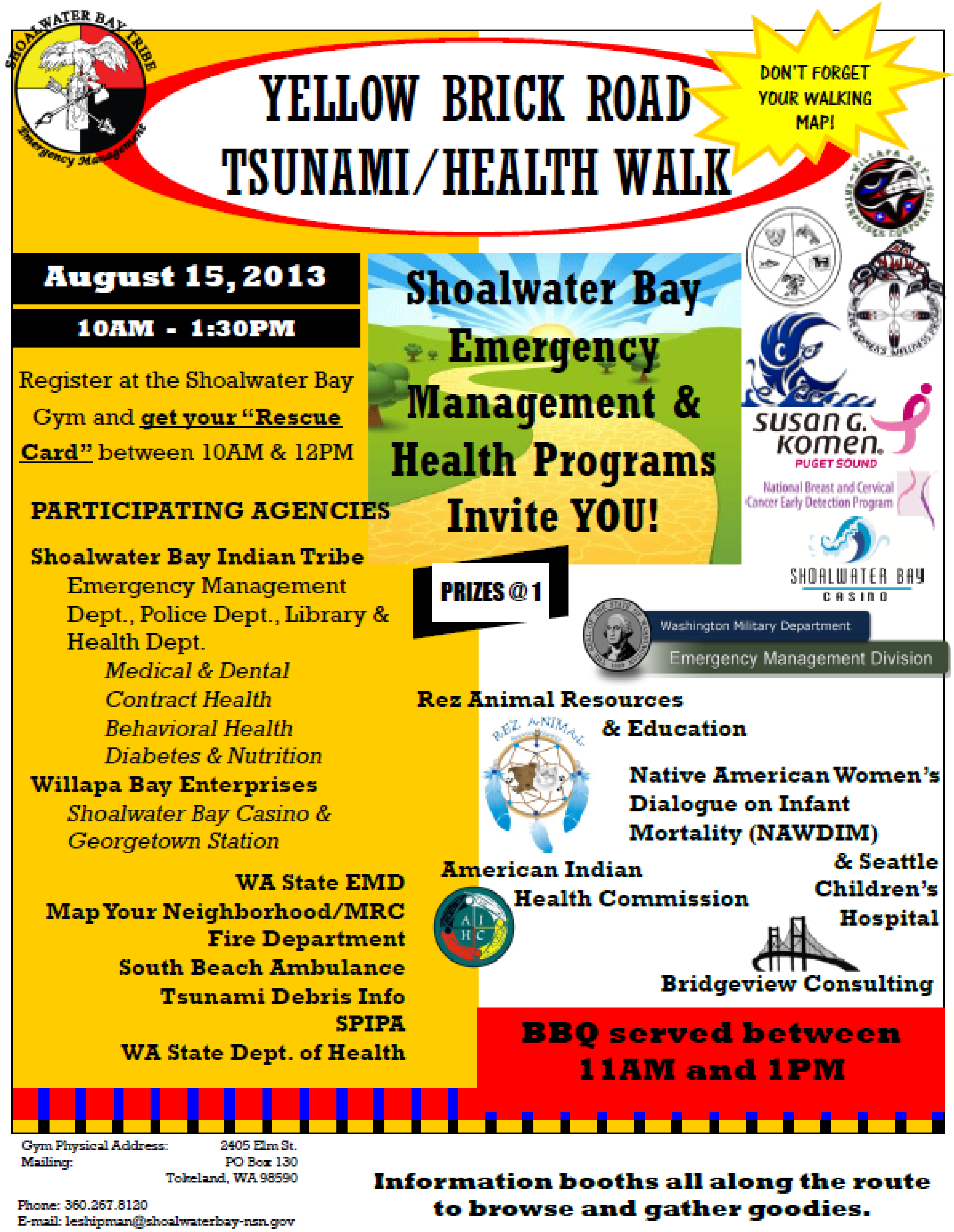


Figure 2-5. Yellow Brick Road Tsunami/Health Walk Announcement Poster

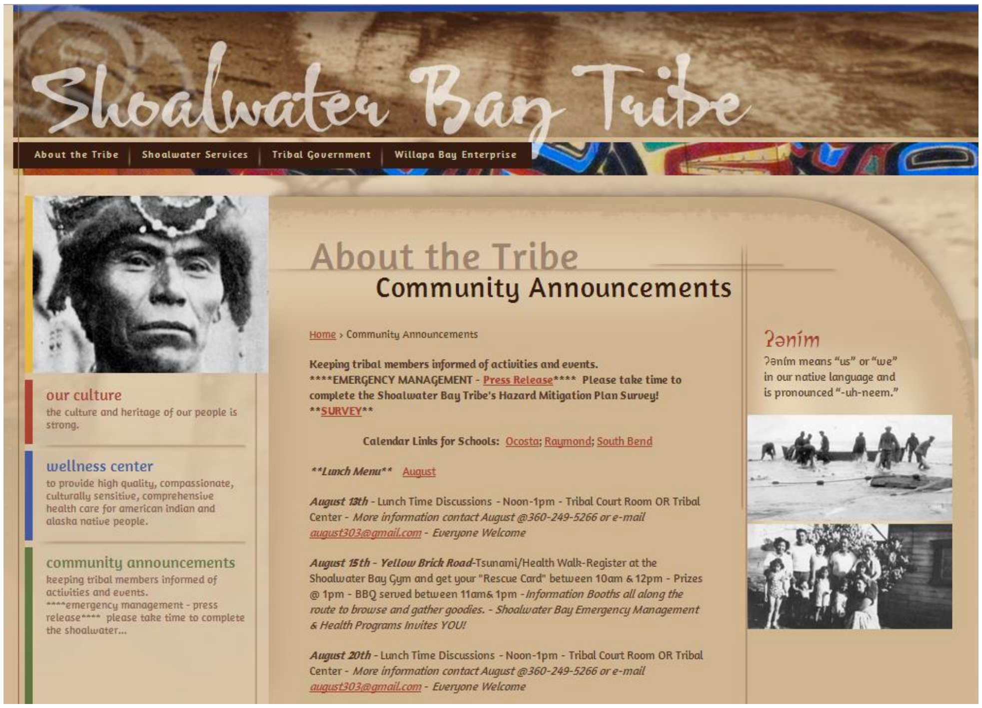


Figure 2-6. Sample Page from Shoalwater Bay Tribe Web Site

Public Involvement Results

By engaging the public through the public involvement strategy, the concept of mitigation was introduced to the public, and the planning team received feedback that was used in developing the components of the plan. As indicated, detailed analysis of the questionnaire findings is presented in Appendix B; as summary, while over 100 hard-copy questionnaires were distributed to residences and made available during all public outreach sessions, as well as at Tribal facilities. The survey was also available on-line. A total of 78 questionnaires were returned for analysis. From review of the data (Figure 2-7), the majority of the survey responses were received in August; however, responses continued to trickle in through April 2014.

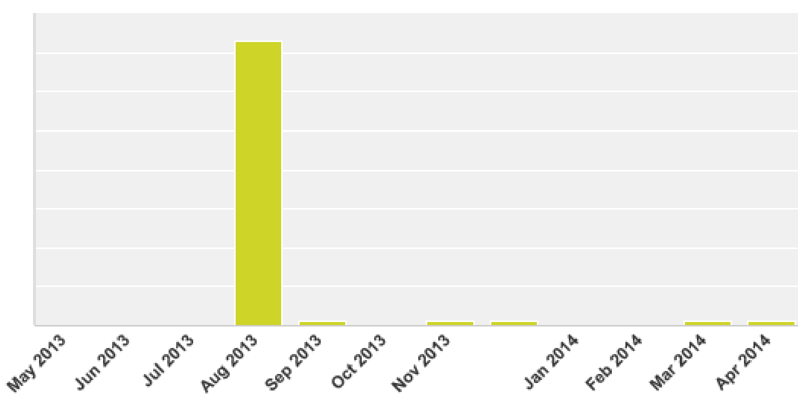


Figure 2-7. Survey Responses Received During Process

2.1.7 Plan Development Chronology/Milestones

Table 2-2 summarizes important milestones in the development of the plan.

**TABLE 2-2.
PLAN DEVELOPMENT MILESTONES**

Date	Event	Description	Attendance
2012			
2012	Submit grant application	Seek funding for plan development process	N/A
2013	Receive notice of grant award	Funding secured.	N/A
2013			
05/01	Initiate consultant procurement	Seek a planning expert to facilitate the process	N/A
05/22	Select Bridgeview Consulting to facilitate plan development	Facilitation contractor secured	N/A
05/23	Begin Identifying planning team members	Begin formation of the planning team; Consultant begins review of various documentation	N/A
5/30	Identify planning team	Formation of the planning team and core project management team. Began review of existing plan and existing documentation supporting effort (e.g., studies, other planning documents, etc.)	N/A
7/16	Planning meeting	Presentation on plan process, hazards, goals, objectives and public outreach strategy. General plan template discussed. Discussed hazards to be addressed in plan update; discussed methodology which would be used to conduct the analysis. Hazards to be addressed confirmed; it was determined that the list would be expanded to include some of the technological and man-made hazards to allow for easier integration of THIRA process. Discussed public presentation of hazard maps at 8/15 meeting. Goals and objectives were confirmed.	7
8/15	Public Outreach	Health Fair - deployed survey both via web and hard copies. Surveys distributed during Yellow Brick Tsunami/Health Walk. Presentation of initial hazard information and maps presented during event.	~150
12/3	Planning meeting	Continue process of updating hazard information; review hazard data with respect to THIRA; discuss impacts from previous hazards to determine dollar losses; discuss previous landslide issues (Eagle Hill Road); review hazard information re: debris amounts for possible use in debris management plan;	2
2/6	Planning Team Meeting	Risk ranking exercise completed and confirmed; strategy/action items reviewed and discussed; incorporation of risk data into other planning mechanisms discussed (e.g., land use, CEMP, evacuation plans, etc.)	4
5/22	Planning Team Meeting	Included review and confirmation of risk ranking of hazards; continued update of strategies	7
6/4	Draft Plan Internal Review	Draft provided by planning team to Planning Team (additional strategies added during review process)	All

2014			
6/4	Public Outreach	Website announcement released concerning review and open comment period for plan update to commence 6/23/14.	All
6/23	Review Period	Initial public comment period of draft plan opens. Draft plan provided electronically to all planning members, both tribal and non-tribal, as well as the plan being made available at the Tribal Administrative Office for review and comment, and a link made available on the Tribe's Website	N/A
7/15	Submission	Plan submitted to FEMA (and state) for review and approval	
9/12	Public Outreach – Presentation at Tribal Council	Final public meeting on Plan presented at Tribal Council Meeting. Tribal Council adopted plan, allowing for modifications as required by FEMA/State after adoption is completed without the need for re-adoption.	11
9/2014	Plan Approval	Final plan approved by FEMA	N/A

2.2 RISK ASSESSMENT METHODOLOGY

Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from natural hazards. It focuses on the following elements:

- Hazard identification—The systematic use of all available information to determine the types of disasters likely to affect a jurisdiction ("hazards of concern"), how often these events can occur, and their potential severity.
- Vulnerability identification—The process of determining the impact of these events on the people, property, environment, economy and lands of a region.
- Estimation of the cost of damage or cost that can be avoided through mitigation.

The following definitions apply for terms used in the risk assessment:

- Hazard—Natural (or human-caused) source or cause of harm or damage, demonstrated by actual (historical events) or potential (probabilistic) events.
- Risk—The potential for an unwanted outcome resulting from a hazard event, as determined by its *likelihood or probability* and associated *consequences* and expressed, when possible, in dollar losses. Risk represents potential future losses, based on assessments of probability, severity, and vulnerability. In some instances, dollar losses are based on actual demonstrated impact, such as through the use of the Hazus model. In other cases, it is demonstrated through exposure analysis due to the inability to determine the extent to which a structure is impacted.
- Location—The area of potential or demonstrated impact within the region in which the analysis is being conducted. In some instances, the area of impact is within a geographically defined area, such as a floodplain. In other instances, such as for severe weather, there is no established geographic boundary associated with the hazard, as it can impact the entire Commonwealth.
- Probability/Likelihood—Probability is used as a synonym for likelihood, or the estimated potential for an incident to occur.
- Severity/Magnitude—The extent or magnitude upon which a hazard is ranked, demonstrated in various means, e.g., Richter Scale, Saffir-Simpson Hurricane Scale, Regional Snowfall Index, etc.

- Vulnerability—The degree or level of damage, e.g., building performance (functionality), damage, or the number of people injured.
- Consequence—The effect of a hazard occurrence. Consequence is demonstrated by impact on population, physical property (e.g., facilities, assets and general building stock, critical facilities), responders, operations, the environment, the economy, and public confidence in governance.

Mitigation planning provides risk assessment information that allows emergency management personnel to establish early response priorities by identifying potential hazards and vulnerable assets. The risk assessment for the Shoalwater Bay Tribe evaluates the risk of natural hazards prevalent within the reservation and its cultural resources locations, meeting the requirements of 44 CFR Section 201.7(c)(2).

The hazard profile chapters of the plan examine the natural hazards that have the potential to impact the Tribe, identify areas of concern and populations that are most vulnerable to each hazard. The risk assessment includes the following:

- An overview of the type and location of all natural hazards, including historical occurrences and probability of future occurrence
- An analysis of the regions' vulnerability to identified hazards, including its critical facilities
- An estimate of potential exposure and/or losses of population, facilities and structures (if possible).

The planning team compiled data from multiple sources, including, but not limited to: FEMA-approved regional and local hazard mitigation plans; county level information from the U.S. Census; Indiana State University; the University of Washington; SHELDUS; NOAA/NCDC; previous loss data; and other sources. Extensive GIS analysis and HAZUS modeling was performed, integrating information from federal, state, and local sources. Each hazard profile contains updated maps, which were produced to illustrate areas at risk from natural hazards. Each hazard profile presents risks in addition to areas most vulnerable to the hazard.

2.2.1 Identification of Hazards of Concern

For this plan, the Planning Team considered the full range of natural hazards that could impact the planning area and then listed hazards that present the greatest concern. The process incorporated review of state and local hazard planning documents, as well as information on the frequency, magnitude and costs associated with hazards that have impacted or could impact the planning area. Anecdotal information regarding natural hazards and the perceived vulnerability of the planning area's assets to them was also used. The 2008 Hazard Mitigation Plan addressed the following hazards:

- Coastal Erosion
- Earthquake
- Flood
- Landslide
- Severe Weather
- Tsunami
- Wildfire
- Hazardous Materials

After review of the hazards of concern by the planning team, it was determined the same hazards as addressed in the 2008 mitigation plan would be identified. Man-made and technological hazards would also be addressed, although the method of assessing risk/vulnerability would be limited due to the nature of the hazard involved.

2.2.2 Climate Change

This is a new addition to the 2014 plan. Climate includes patterns of temperature, precipitation, humidity, wind and seasons. Climate plays a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them. “Climate change” refers to changes over a long period of time. It is generally perceived that climate change will have a measurable impact on the occurrence and severity of natural hazards around the world. Impacts include the following:

- Higher temperatures
- Changing landscapes
- Wildlife and fish habitats at risk that impact the Tribe’s cultural resources
- Sea level rise
- Increased risk of drought, fire, floods and landslides
- Stronger storms and increased storm damage, including erosion
- More heat-related illness and disease
- Economic losses
- Depletion of fish stock
- Degradation of forestlands

This hazard mitigation plan addresses climate change as a secondary impact for each identified hazard of concern, as well as within the Coastal Erosion profile as a primary concern. Each chapter addressing one of the hazards of concern includes a section with a qualitative discussion on the probable impacts of climate change for that hazard. While many models are currently being developed to assess the potential impacts of climate change, there are currently none available to support hazard mitigation planning. As these models are developed in the future, this risk assessment may be enhanced to better measure these impacts.

2.2.3 Risk Assessment Tools

The risk assessments in Section 3 Chapters 6 through 15 describe the risks associated with each identified hazard of concern. Each chapter describes the hazard, the planning area’s vulnerabilities, and probable event scenarios. The following steps were used to define the risk of each hazard:

- Identify and profile each hazard—The following information is given for each hazard:
  - Geographic areas most affected by the hazard
  - Event frequency estimates
  - Severity estimates
  - Warning time likely to be available for response.
- Determine exposure to each hazard—Exposure was determined by overlaying any available hazard maps with an inventory of structures, facilities, and systems to determine which of them would be exposed to each hazard. Where such mapping is not available, the need to develop it is included among the mitigation actions recommended in this plan.
- Assess the vulnerability of exposed facilities—Vulnerability of exposed structures and infrastructure was determined by interpreting the probability of occurrence of each event and assessing structures, facilities, and systems that are exposed to each hazard. Tools such as GIS and FEMA’s hazard-modeling program called HAZUS-MH were used to perform this assessment for the flood and earthquake hazards. Outputs similar to those from HAZUS were generated for other hazards, using ArcGIS software and tools.

Earthquake, Flood and Tsunami—HAZUS-MH

Overview

HAZUS-MH is a GIS-based software program used to support risk assessments, mitigation planning, and emergency planning and response. It provides a wide range of inventory data, such as demographics, building stock, critical facility, transportation and utility lifeline, and multiple models to estimate potential losses from natural disasters. The program maps and displays hazard data and the results of damage and economic loss estimates for buildings and infrastructure. Its advantages include the following:

- Provides a consistent methodology for assessing risk across geographic and political entities.
- Provides a way to save data so that it can readily be updated as population, inventory, and other factors change and as mitigation planning efforts evolve.
- Facilitates the review of mitigation plans because it helps to ensure that FEMA methodologies are incorporated.
- Supports grant applications by calculating benefits using FEMA definitions and terminology.
- Produces hazard data and loss estimates that can be used in communication with local stakeholders.
- Is administered by the local government and can be used to manage and update a hazard mitigation plan throughout its implementation.

Levels of Detail for Evaluation

HAZUS-MH provides default data for inventory, vulnerability and hazards; this default data can be supplemented with local data to provide a more refined analysis. The model can carry out three levels of analysis, depending on the format and level of detail of information about the planning area:

- **Level 1**—All of the information needed to produce an estimate of losses is included in the software’s default data. This data is derived from national databases and describes in general terms the characteristic parameters of the planning area.
- **Level 2**—More accurate estimates of losses require more detailed information about the planning area. To produce Level 2 estimates of losses, detailed information is required about local geology, hydrology, hydraulics and building inventory, as well as data about utilities and critical facilities. This information is needed in a GIS format.
- **Level 3**—This level of analysis generates the most accurate estimate of losses. It requires detailed engineering and geotechnical information to customize it for the planning area.

Building Inventory

A User Defined Facility approach was used to model exposure and vulnerability. GIS building data utilizing detailed structure information for 69 facilities were loaded into the GIS and HAZUS model (75 structures total exist on the Reservation – six (6) of which are storage sheds and while identified on the hazard maps, dollar losses were not included). Building information was developed using best available Tribal data, including building address points, aerial imagery, Parcel Quest data (very limited) and Tribal staff resources. Building and content replacement values were estimated using values from the Tribe’s 2008 Hazard Mitigation Plan, as well as national replacement cost estimating guides. Emphasis was put on developing the most accurate representation of buildings using best available resources. Tribal building inventory included 26 Tribal facilities such as:

- Tribal Center/Tribal Main Office

- Health Center
- Learning Resource Center
- Gymnasium/Emergency Shelter
- Water Treatment Plant
- Fuel Mart
- Casino
- Indian Housing Authority
- Tribal Public Safety (Police)

The remaining 43 structures included in the inventory were broken down as follows:

- Non-Tribal Government Facilities – 1 (Post Office)
- Non-Single Family Residential Facilities (Duplex, Triplexl, etc.) – 2
- Single Family Residential Facilities— 40

Application for This Plan

The following methods were used to assess specific hazards for this plan:

- **Flood**—The Tribe is currently in the process of receiving new FEMA DFIRM maps. As such, in an effort to reduce redundancy, the Planning Team elected to not conduct a new flood hazard risk assessment until such time as the Tribe has adopted the new flood maps, which should be within the next six months. Once approved and adopted by the Tribe, FEMA will assist the Tribe in completing new maps, which will then be incorporated into the flood portion of the Risk Assessment. For the 2014 update as of this writing, the 2008 data was utilized and expanded within the current template. The assessment as completed in 2008 was based on exposure analysis and not modeled utilizing Hazus. The analysis utilized damage estimates for a flood depth of two (2) feet for all Tribal structures, assuming a Mean-high-high-tide and one story structures with no basements.
- **Tsunami**—Tsunami inundation mapping for the planning area was collected. This data was imported into HAZUS-MH and a modified Level 2 analysis was run using the coastal flood methodology. An estimated Tsunami depth grid was created using 1 meter LiDAR data. Modified Coastal Depth Damage Functions were selected from the HAZUS Library to more accurately represent the economic impact from a tsunami event. These updated damage functions were applied to the asset inventory using typical HAZUS protocol to estimate damage costs.
- **Earthquake**—A Level 2 analysis was performed to assess earthquake risk and exposure. Earthquake ShakeMaps and probabilistic data prepared by the U.S. Geological Survey (USGS) were used for the analysis of this hazard. The National Earthquake Hazard Reduction Program (NEHRP) soils inventory was used. Two scenario events and two probabilistic events were modeled:
  - The scenario were a Magnitude-9.0 and a Magnitude-8.3 events on the Cascadia Fault developed by USGS.
  - The standard HAZUS analysis for the 100- and 500-year probabilistic events was also ran.

Landslide, Severe Weather and Wildfire

For landslide, severe weather and wildfire, historical data was not adequate to model future losses. However, GIS is able to map hazard areas and calculate exposures if geographic information is available on the locations of the hazards and inventory data. Areas and inventory susceptible to some of the hazards of concern were mapped and exposure was evaluated. For other hazards, a qualitative analysis was conducted using the best available data and professional judgment. Locally relevant information was gathered from a variety of sources. Frequency and severity indicators include past events and the expert opinions of geologists, tribal staff, emergency management personnel and others. The primary data source was the Shoalwater Bay Tribe, augmented with state and federal data sets. Additional data sources for specific hazards were as follows:

> **Landslide**—Historic landslide hazard data from Washington Department of Natural Resources (DNR) was used to assess exposure to landslides. Additional data was also incorporated using Tribal data of historic events. Degree slope was the major factor in determining risk, with areas of slope >15 degree identified.
>
> **Severe Weather**—Severe weather data was downloaded from the Natural Resources Conservation Service, the National Climatic Data Center, SHELDUS, NOAA, as well as other sources.
>
> **Wildfire**—Information on wildfire analysis was captured from various sources, including the Washington State DNR, US Forest Service and LAND FIRE.

Limitations

Loss estimates, exposure assessments and hazard-specific vulnerability evaluations rely on the best available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

- Approximations and simplifications necessary to conduct a study
- Incomplete or outdated inventory, demographic or economic parameter data
- The unique nature, geographic extent and severity of each hazard
- Mitigation measures already employed
- The amount of advance notice residents have to prepare for a specific hazard event.

These factors can affect loss estimates by a factor of two or more. Therefore, potential exposure and loss estimates are approximate. The results do not predict precise results and should be used only to understand relative risk.

Further information for each hazard and the methodology utilized to conduct analysis is found within each profile. The Risk Ranking exercise is defined within Section 3, Chapter 16.

SECTION 2 —
COMMUNITY PROFILE

Chapter 3.
SHOALWATER BAY INDIAN TRIBE PROFILE

3.1 GENERAL OVERVIEW

Because this plan is a comprehensive update from the 2008 plan, all information from the Tribe's 2008 Hazard Mitigation Plan has been incorporated into this update to preserve that information. Additional information to enhance the data was taken from the Tribe's website (http://www.shoalwaterbay-nsn.gov/) or from communications with tribal members. Photos included in this chapter are from the 2008 plan, the Tribe's website or from other open source documents as referenced. The intent of the photographs is to demonstrate the historic nature of the Tribe and its members, as well as to preserve cultural information.

The Shoalwater Bay Tribe are descendants of the Willapa Chinook, Lower Chehalis, and Willapa Hills tribes. Ancestral lands spanned from the Columbia River to the Chehalis River.

Traditional ceremonies include the Deerskin Dance, Doctor Dance, Jump Dance, Brush Dance, Kick Dance, Flower Dance, Boat Dance, and others, that have drawn Shoalwater people and neighboring Tribes together for renewal, healing and prayer. The Shoalwater people held traditional ceremonies to prevent famine, earthquakes, tsunamis and floods. The Jump Dance or World Renewal Dance was held to end disaster during an early autumn ceremony. The land as a whole, referred to as Indian Country, stayed in balance and was kept that way by its members' good stewardship, hard work, wise laws and constant prayers to the Creator.

The following is an excerpt from the Shoalwater Bay Tribe's Website, which provides great insight into the history of the Shoalwater People:

> *Descended from welcoming, generous, and fiercely determined ancestors, tribal members inherit the rich tradition of Lower Chehalis and Chinook life, including an ancestral love of our land, fishing, cedar trees, drumming, singing, and cultural gatherings. In ages past, our people were clam diggers and oyster schooners, hunters, canoe people, basket weavers, and above all traders who possessed powerful inter-tribal status and denoted their high rank by forehead binding and, in later days, other symbols of community standing.*
>
> *Though the tribe faced near decimation at the hands of colonizing forces, residential schools, and dispossession, our ancestors stood firm, refusing to budge from tribal land, which led to the September 22, 1866 executive order to set aside the Naahps Chaahts community village site (also called Georgetown) for "miscellaneous Indian purposes." Later, the tribe was among the few Federally Recognized Reservations in the United States which did not treaty with the Federal Government. It took until 1971 for the Shoalwater Bay Tribe to be recognized as a Sovereign Nation. However, in the face of many trials and pressures to relocate, our ancestors preserved our Native land for future generations, allowing us to practice our culture in our homeland as we have done for countless centuries.*
>
> *Currently, about two thirds of our membership make their homes off reservation land, and there is a growing cultural awakening occurring among Shoalwater Bay members regardless of their location. Tribal artists contribute to our prosperity in many creative forms, including writing, photography, painting, wood-carving, bead-work, playing instruments, singing, and powwow dancing. For both on and off-reservation members, the heart of the Tribe exists in its history-language-culture, and the regality of our ancestors flows through the veins of all members with no distinction.*

3.1.1 Tribal History

Throughout historical contacts with the U.S. Government and State of Washington, Tribal Members have fought to protect and maintain access to Ancestral Lands. These struggles were legally complicated by the fact that the Shoalwater Bay people rejected the Indian Reorganization Act in 1934. However, President Andrew Johnson designated the Shoalwater Bay Reservation on September 22, 1866 by Executive Order. Realizing its need to formally organize itself in order to protect its place and heritage, the Tribe adopted a constitution and became formally organized on May 22, 1971. The Shoalwater Bay Tribal Council was elected shortly thereafter.

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.

In 1999, the Shoalwater Bay Indian Tribe 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 descendants) whose names appeared on the official eligible voters list which was prepared for the purpose of the Indian Reorganization Act.

The original Shoalwater Reservation, consisting of 334.5 acres, was the wintering place of both the Lower Chinook and Lower Chehalis people. Many Shoalwater descendants accepted an 80 acre allotment on the much larger Quinault Reservation, which allowed them to attain the privilege of Quinault Treaty Rights only if they became Quinault Tribal members.

3.1.2 Health

The Tribe began providing health care services in 1995. The primary health care provider for the Shoalwater Bay Tribe is through the United Indian Health Services, Inc., which provides medical, dental, pharmaceutical, and behavioral health services to the Tribal Members. There is currently one health clinic on the Reservation. The nearest hospital is located in South Bend, a 26-mile drive northwest around the harbor, with the next closest hospital in Aberdeen, 33 miles northeast. The Shoalwater Bay Tribe’s health clinic provides health care for tribal members and nontribal individuals; more than half of the patients seen annually are nontribal.

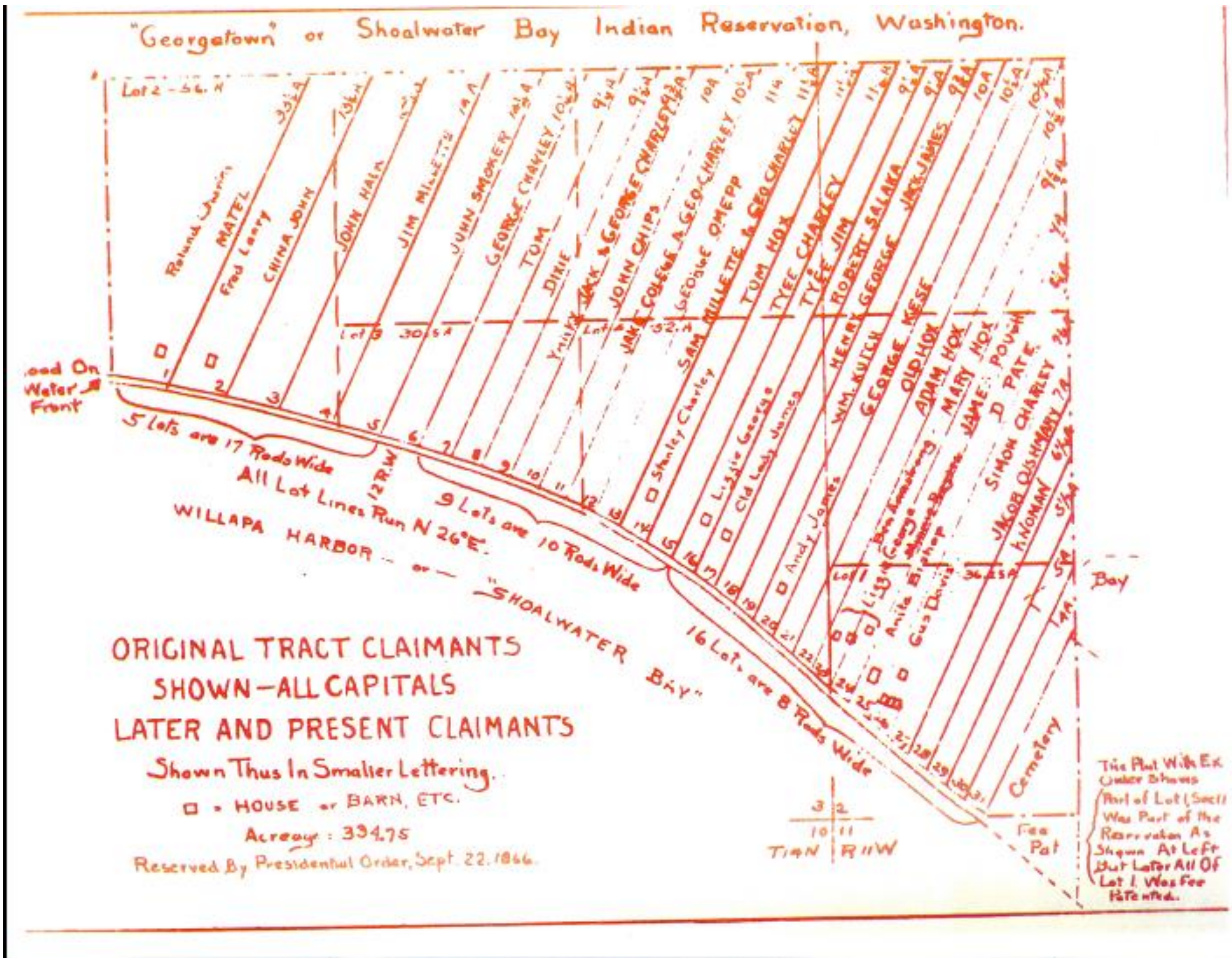
3.1.3 Language

The original language of the Shoalwater Bay Tribe belonged to the Chinook family of Native American languages. The use of the Shoalwater language dramatically decreased when non-Indians settled in the

Shoalwater Bay territory, and when Tribal Members were forced to move to other reservations in order to receive land allotments. By the early 1900s the Shoalwater language was near extinction. Today, what knowledge remains of the Shoalwater language is limited, but is shared and taught to the Tribe's youth.

Through collaborative efforts, the Tribe seeks to develop corpus that is as comprehensive as possible and contributes as much as possible to understanding the complexities of the Shoalwater Bay language. Through these sustained efforts, the language of the Reservation will evolve into one which will help ensure the continued growth and knowledge of the Shoalwater Bay language.

Figure 3-1. Shoalwater Bay Historical Map[1]



3.1.4 Tribal Governance

On May 22, 1971, the Constitution of the Shoalwater Bay Tribe was certified and approved, after having passed a Ratification Election by a majority of the Shoalwater Bay Tribal members. The Constitution defines the territory, jurisdiction and authority of its Tribal Government. The Showalter Bay Tribe's main

[1] *Map Courtesy of Leatta Anderson*

offices are located in Tokeland, Washington. Tribal members who are enrolled and registered to vote elect its five members to the Tribal Council. A Tribal Administrator oversees the administrative duties of the Tribe, and reports to the Tribal Council.

Each Council member serves a term of three years. The Council meets at least monthly. All regular and special meetings of the Council are open to members of the Shoalwater Bay Indian Tribe. All votes of the Council are a matter of public record.

In accordance with the Tribe's Constitution, in order to exercise the inherent sovereignty of the Shoalwater Bay Indian Tribe, the Tribal Council strives to:

- Preserve forever the survival of the Tribe and protect it from forces which may threaten its existence.
- Uphold and protect Tribal sovereignty which has existed from time immemorial and which remains undiminished.
- Reclaim the Tribal land base within the Shoalwater Reservation and enlarge the Reservation boundaries to the maximum extent possible within the Ancestral Lands of the Tribe and/or any compensatory land area.
- Preserve and promote the culture, language, religious beliefs and practices and pass them on to our children, our grandchildren, and to their children forever.
- Provide for the health, education, economy and social well-being of Tribal members and future members.
- Restore, enhance and manage Tribal fishery, Tribal water rights, Tribal forests and all other natural resources.
- Insure peace, harmony and protection of individual human rights among our members and among others who may come within the jurisdiction of our Tribal government.

3.1.5 Tribal Departments

The Shoalwater Bay Indian Tribe maintains a significant number of departments and agencies within its structure of government, all of which have been established for the enhancement and viability of the Reservation and its Tribal Members. With significant focus placed on the growth of the Reservation and (re)acquisition of both ancestral and new lands, the various departments have been established to further that goal, while concurrently improving the Reservation for its members. This section describes some, but not all, of the Tribe's departments and capabilities.

The Shoalwater Bay Public Safety Departments provide emergency services throughout the Reservation. The Departments include law enforcement and emergency management. Firefighting is provided by Pacific and Grays Harbor Counties. The law enforcement officers are commissioned both federally and through the State of Washington, providing services throughout the Reservation.

The Tribe maintains a Tribal Code, which includes both Civil and Criminal regulatory authority. While already progressive in its established codes, the Tribe, in its effort to promote resiliency, is in the early stages of developing its first land use authority. Once adopted, the new codes will enhance the viability of the Tribe by providing guidance which will directly mitigate the impacts of the hazards of concern upon the Tribe and its members.

The Shoalwater Bay Tribe Social Services Department administers a broad variety of services, including: General Assistance, Indian Child and Elder Welfare Program, Domestic Violence Intervention Services, Legal Services, Sexual Assault Services Social Work, and Emergency Assistance, among others.

Figure 3-2. Showalter Bay Tribal Members [2]

The Shoalwater Bay Indian Tribe's Housing Department's mission is:

> *To provide safe, sanitary, and affordable housing to low and medium income eligible Native American families on or near the Shoalwater Bay Indian Reservation.*

This is accomplished through pursuit of funding and resources to meet the housing needs by providing financial expertise and advocacy for tribal members.

The Education and Heritage/Culture Department ensures that tribal members are provided with the highest quality of educational opportunities possible, in a fair and equitable manner. Programs include: Summer Youth Program, After School Program, Cultural Education, Language Preservation, and Educational and Cultural Services.

The Shoalwater Bay Indian Tribe's Environmental Department's mission is to "protect and enhance the human and environmental health of the Shoalwater Bay Tribal community through natural resource management, education, research, advocacy and consensus building." Services include: Environmental Permits, Water Quality Monitoring, GIS, Noxious Weed Control, Wetlands Management, Forest Practices/Management Program, Recreational Trail System, Shellfish Monitoring, Food Handlers Examinations, Hunting/Shellfish License and a Renewable Energy Program.

3.1.6 Land Allotments and Infrastructure

Residential Land Assignment establishes the procedures for assignment of parcels of trust lands to individual members in an effort to preserve and regulate tribal resources, and to encourage development and inhabitation of assigned lots by tribal members. Currently, the Tribe has 40 Trust parcels, with 20 immediately adjacent fee parcels, and nine additional non-adjacent fee parcels. The Tribe manages its own housing program as of October 2013.

3.1.7 Future Land Use and Development Trends

Land use on the Shoalwater Reservation includes infrastructure and operations, private residential housing (on and off Reservation), and minor commercial activity (fireworks sales, gasoline and convenience stores sales). Specific Tribal land uses include a multi-building Tribal Center, which includes Tribal meeting spaces, a Tribal Wellness Center and Tribal Police; the Shoalwater Bay Casino, hotel and RV Park; and residential housing built by the Tribe. Tribal members reside in housing of various types both on and off the Reservation. In addition, there is private residential land use, and a hotel that is being converted to condominiums within the adjacent Dexter-by-the-Sea community.

The Tribe is currently in the process of developing its first comprehensive land use authority.

[2] Photo Courtesy of Shoalwater Bay Tribal Website

3.1.8 Membership and Economy

The Shoalwater Bay Tribe is a small Indian Tribe located on the Pacific Coast in Washington State with approximately 310 enrolled members. At present, the Tribe's economy is stifled by the lack of necessary infrastructure and land mass which will support economic growth and development. However, the Shoalwater Bay Tribe employs 91 full time individuals (tribal and non-tribal) and 15 part-time personnel. The Tribe is the largest employer within Pacific County, Washington, due in large part to the Casino. At present, the Willapa Bay Enterprises, the business sector for the Tribe, owns the Shoalwater Bay Casino and Chevron Gas Station (pictured below)[3]. The Tribe also owns a hotel, the Tradewinds Hotel, which is in close proximity of the Casino.

Figure 3-3. Shoalwater Bay Casino

[3] http://500nations.com/casinos/waShoalwaterBay.asp

Figure 3-4. Shoalwater Bay Gas Station

Figure 3-5. Tradewinds Hotel

3.1.9 Tribal Timber Harvesting

Timber harvesting is a limited source of income for the Tribe. While the Tribe has engaged in some timber harvesting historically, it has been limited in nature. Tribal timber harvesting on the Shoalwater Reservation is guided by the Tribe's Forest Management Plan. The plan includes a forest inventory and history, environmental and economic assessments, and three plan components: a resource protection plan; a timber management plan; and a woodland management plan.

3.1.10 Tourism

Tourism remains of vital importance to the Tribe as the number one source of income. During the July and August timeframe, in excess of 17,000 tourists visit the Reservation's casino, hotel, and restaurants. This does not include those individuals who travel through the Reservation, or come to visit its beaches monthly. November and December average approximately 11,000 casino guests. During the Fourth of July weekend, several thousand visitors flock the Reservation for beachcombing and to watch the fireworks display. Annually, the Tribe estimates that close to 200,000 tourists visit or travel through the Reservation. Given that the Reservation is home to a one-lane highway system as its primary ingress and egress to the Reservation, this causes an enormous strain on the roadways running through the Reservation and connecting it to other parts of the state.

3.2 TRIBAL INFRASTRUCTURE

3.2.1 Roadways

The transportation system on the Reservation is very limited. Because of the potential for isolation due to highway impasse, the Tribe also utilizes logging roads for evacuation planning purposes to help ensure the safety of its tribal members should certain natural disasters occur. High traffic volumes would significantly impact the ability of tribal members and tourists, or those passing through the Reservation to evacuate timely should a significant event occur.

Among the primary roadways, they include:

- SR 101, 103, 105 and 109
- Eagle Hill Road (serves as a primary evacuation route)
- Tokeland Road
- Miscellaneous residential streets

3.2.2 Buildings and Critical Facilities

Due to the potential economic impact that the loss of one facility or structure could have on the Reservation, the Tribe has determined that all 75 structures (69 buildings and residences with six essential storage sheds which serve as strategic stockpiles for the Tribe, maintaining rations, equipment and supplies) on the Reservation are considered critical for this planning purposes. However, there are specific structures which would have a greater impact should something occur to those facilities either because of the function they serve to the Tribe, or because of the number of citizens who may be visiting the facilities, increasing the Tribe's response requirements to any potential disaster event. Those facilities include:

- Tribal Center
- Shoalwater Bay Casino
- Shoalwater Bay Hotel
- Wellness Center
- Tribal Police Station
- Shoalwater Bay Learning Center (library)
- Gymnasium (also used as Emergency Shelter)
- Natural Resources Office

In addition, there are also a number of other structures which would adversely impact the Tribe economically if lost:

– Smoke Shop
– Fireworks Stand
– RV Park

3.2.3 Infrastructure

Additional infrastructure which serve primary purposes in either protection or delivery of life safety include:

– AHAB Warning Siren
– 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.
– A 1700 foot protective berm built by the US Army Corps of Engineers in 2001, runs along the coast, parallel to Tokeland Road from the Tribe's RV Park to behind the Tribal Center.

3.2.4 Cultural and Sacred Sites

Several cultural and sacred sites exist throughout the Reservation. Most are not identified to maintain the integrity of the locations and artifacts. A number, however, are well known to the general public, and include:

– Georgetown Graveyard
– Chief Charlie's House
– Other historic homes

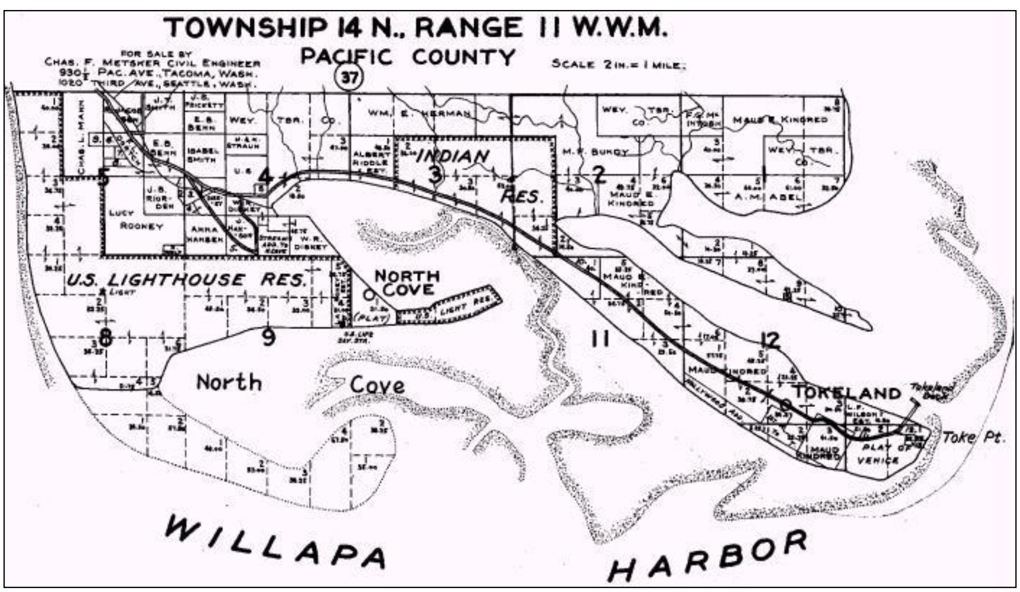


Figure 3-6. 1927 Metsker Map of North Cove area

3.3 ARCHEOLOGICAL OVERVIEW

3.3.1 Archeological Sites

The Shoalwater Bay Indian Tribe maintains numerous cultural resource sites, including cemeteries, original villages, and lithic scatters (surface-visible concentrations of stone chips, flakes, and tools) throughout its currently recognized Federal boundaries, as well as within its ancestral boundaries, including ridgelines and creeks where traveling between villages likely occurred.

3.3.2 Cultural Heritage

The culture and heritage of the Shoalwater People is strong. While it may be difficult to see since many traditions have been blended with modern life, the Tribal culture is alive and well on the Shoalwater Reservation. Children are still told family stories from long ago, gathering of the people such as our yearly general council, Saturday parent group, community dinners, and other ceremonies are still held. Many still hold true to traditional spiritual beliefs and practices, sometimes blending them with Christian traditions. Figure 3-7 is a mural of Chief George Allen Charley, an Ancestor of many members of the Shoalwater Tribe.[4]

Figure 3-7. Chief George Allen Charley, Ancestor of many Shoalwater Bay Tribal Members

The Shoalwater Bay Tribe is one of the few Native American Tribes that were not allocated usual and accustomed fishing areas within its treaties, nor were they provided the right to fish except as during those times open to the Western culture. While that may be the case, the members of the Tribe still rely heavily on the fishing industry, including Oyster harvesting.

Begun in 1989, the Canoe Journey is one such tradition that has blended Western life with Native culture. The Canoe Journey is a yearly spiritual trek during which the tribes of the Pacific Northwest and British Columbia, First Nations, come together to paddle together, share traditional songs and dances and celebrate.

Members of the crews, called "canoe families," are never called "paddlers" but "pullers," and the canoes never are called "boats." Offending pullers — and visitors — are asked to jump in the water as a corrective action for the verbal gaffe.

Each year one tribe organizes the journey, planning the route and coordinating with the other tribes. The various tribes camp along the way and meet together at the end for a potlatch, a celebration of life that involves traditional feasting, gifting and praying.

The Canoe Journey makes a drug- and alcohol-free space for elders and young people alike to re-learn and strengthen their tribal traditions. The Canoe Family Journey is an event designed to foster heritage and friendship between all Native peoples up and down the coast. The Shoalwater Bay Tribe today continues to ensure a strong future through development of many programs to ensure that future generations will prosper. From business ventures such as the casino and wellness center, to education programs and cultural activities for the children, the members of the Tribe look forward to the years ahead.

[4] Shoalwater Bay Culture-History

Chapter 4.
PLANNING AREA NATURAL ENVIRONMENT

4.1 THE PLANNING AREA

The Shoalwater Reservation is located on the north shore of Willapa Bay in Pacific County, Washington (Figure 4-1). At a little more than one-mile square, the reservation is relatively small, with a large portion of its lands lying at or below the intertidal zone.

Figure 4-1. Location of the Shoalwater Bay Indian Reservation

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.

Figure 4-2. A portion of Washaway Beach which is no longer there due to erosion

Within the tidal portion of the Shoalwater Reservation (behind Empire 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*). This marsh is a Category 1 estuarine marsh based on the 2004 Wetland Rating System for Western Washington State (as cited in USACE, 2009, p. 21).

Today, the Shoalwater Reservation consists of over 700 acres (~335 original acres plus ~450 acres recently acquired) comprised of uplands and 700 acres of marine salt marsh and tidal flat habitats. The original Reservation encompassed only 335 acres of uplands, but 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 was established 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 acquired an additional 105 acres of uplands which are held in trust. Since completion of the 2008 Hazard Mitigation Plan, the Tribe has purchased from Green Diamond Logging Company approximately 450 acres of additional land abutting the current Reservation. That area is currently pending Trust designation. These lands, when developed, will become a welcomed addition to the Tribe, as it will provide the opportunity to move its Tribal Members out of many of the hazards zones in which they currently reside.

Washington SR 105 runs east west through 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.

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 existing tribal structures are at very serious and increasing risk of coastal flooding and shoreline erosion associated with extreme high tide storm events. A portion of Washaway Beach, pictured in Figure 4-2, has been lost to erosion. Figure 4-3 represents a USGS Topographic Map of the Shoalwater Bay Indian Reservation.

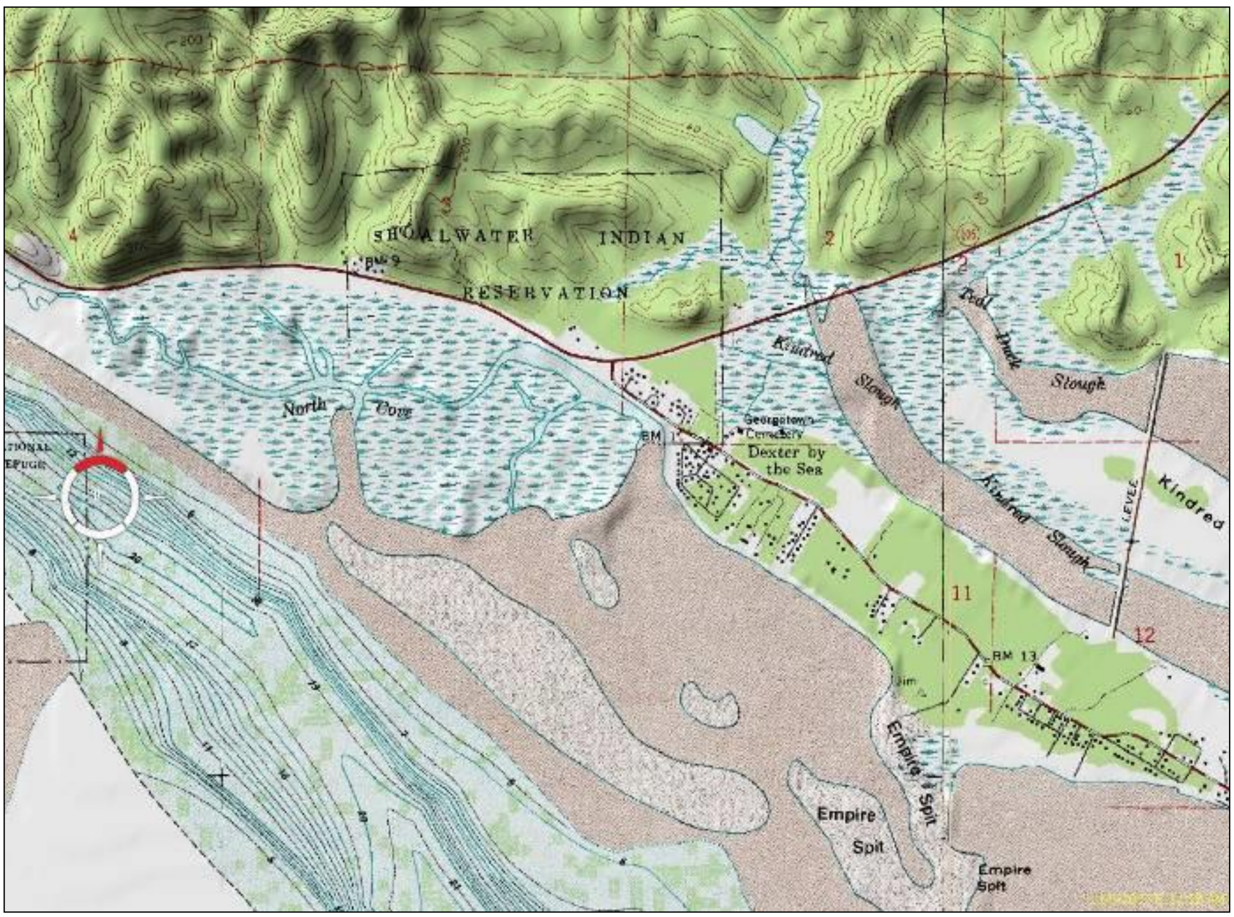


Figure 4-3. USGS Topographic Map of the Shoalwater Bay Indian Reservation

4.2 NATURAL RESOURCES

The natural resources of the Shoalwater Bay Tribe are of significant importance. From salmon recovery to reducing the impacts of climate change, several initiatives have been undertaken which are hoped to revitalize the vitality of the environment in the planning area to what it once was. Many of those programs are referenced in different areas throughout this planning document, but a few are mentioned below. It should be understood that preservation of natural resources is of the utmost importance to the members of the Shoalwater Bay Tribe, and their daily activities and manner in which they live support preservation and protection at all levels. Through completion of this updated mitigation plan, as well as the previous editions of the mitigation plan, the tribe has utilized and will continue to utilize the information contained within the risk assessments to enhance and modify, where appropriate, many of the programs discussed below through use of the data captured within those documents. As new hazards or hazard impact areas are identified, those factors are taken into consideration.

The Shoalwater Tribe Reservation is home to many wetlands, watersheds and sub-basins, all of which maintain cultural significance to its members. The Tribe has been very proactive over the years in protecting its various wetlands and watersheds, and has implemented many restoration projects to return the areas to their once pristine conditions. One such effort currently underway is a slop stabilization project on Eagle Hill Road, an area which has historically experienced several slides, causing increased sedimentation deposits and blocking ingress and egress to the Reservation.

Climate change is of significant concern to the Tribe with respect to its impact on flooding and increased storm activities, which have the potential to increase the flow of water through the various tributaries within its watersheds. This increased flow can also increase sedimentation.

While in general sediment load is a natural part of any watershed, the amount of sediment is what matters. Sediment occurs naturally in a water course from activities such as: natural landslides, seasonal storms, surface erosion, and channel bank erosion. Mankind, however, has increased the amount of sediment which results from these natural events due to road construction. Roads, by their very nature, increase surface erosion, cause water diversion problems, decrease slope stability, and place dirt in natural water courses. Only changes in land management practices can lead to reduced sediment and an improved ecosystem. Road construction should be subject to more rigid environmental impact standards and should be approached from an environmental point of view.

The Tribe takes very seriously the environmental protection and health of Indian Country by proactively participating in one of the first protective measures relating to pesticides and their use on Tribal lands. The U.S. EPA's 1984 Indian Policy (recently reaffirmed commemorating the 20th anniversary) entrusted EPA with the responsibility of supporting the role of Tribal governments in protecting the environment and public health in Indian Country by implementation of a pesticide program area. U.S. EPA's very first formal efforts in tribal environmental program development were in the development of tribal pesticide programs. The Shoalwater Bay Tribe is one of 32 Tribes nationwide (three of which are from Washington State) who are active members involved in Pesticide Enforcement Cooperative Agreements with the U.S. Environmental Protection Agency's Office of Enforcement and Compliance Assurance (OECA). Additional information on the Pesticide Enforcement Cooperative Agreement can be found on the EPA’s website, at: http://www.epa.gov/oppfead1/tribes/tppc.htm.

To further reduce its footprint with respect to human impact on climate change, the Tribe also has a Renewable Energy Program, which helps reduce carbon emissions. In addition, the Tribe is also a member of the Washington Coast Salmon Recovery Region, which includes the Confederated Tribes of the Chehalis Reservation, Hoh River Tribe, Makah Nation, Quileute Tribe, Quinault Indian Nation, Shoalwater Bay Tribe, Grays Harbor and portions of Clallam, Jefferson, Lewis, Mason, Pacific, and Thurston Counties, as well as the Washington State Department of Fish and Wildlife, Department of Natural Resources, Washington State Department of Ecology, as well as others. As a member of the Washington Coast Salmon Recovery Region, the Tribe works with other Tribes, state and federal agencies to protect its watersheds, thereby protecting various types of salmon through recovery efforts.

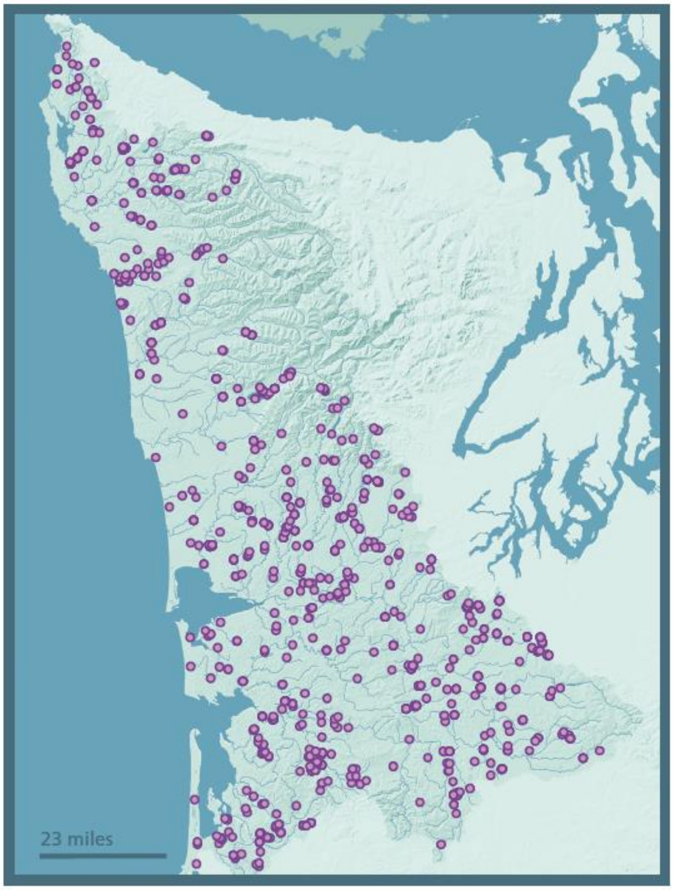


Figure 4-4. Fish Passage and Habitat Projects[5]

4.3 CLIMATE

The Shoalwater Bay Reservation is in an area of moderate temperatures and considerable precipitation. The coastal water temperature adjacent to Willapa Bay ranges from 48-58 degrees year round. Cooling breezes off the Pacific Ocean regulate the moderate temperatures along the coast, with average temperature ranging from 34.9 degrees to 72.4 degrees.

Precipitation in the planning area is of greater frequency and annual magnitude than other parts of the state. In most years, rainfall is experienced each month of the year, although amounts are somewhat more negligible from June through August. A large amount of the seasonal total rainfall falls from October through April. Most of this is associated with storm fronts that move in from the Pacific Ocean. Fog is also present along the coastline at various times throughout the year. The average annual rainfall within the planning area is approximately 87 inches annually. Average water temperature of the Pacific Ocean adjacent to Willapa Bay is 48-58 degrees Fahrenheit. Water temperature in the Bay is most likely similar to, and influenced by, ocean exchange.

5 http://www.rco.wa.gov/documents/gsro/2010_SOS_rpt/CoastRegion.pdf

4.4 MAJOR PAST HAZARD EVENTS

Presidential disaster declarations are typically issued for hazard events that cause more damage than state and local governments can handle without assistance from the federal government, although no specific dollar loss threshold has been established for these declarations. A presidential disaster declaration puts federal recovery programs into motion to help disaster victims, businesses and public entities. Some of the programs are matched by state programs. Table 4-1 lists disaster events which have occurred in Pacific and Grays Harbor Counties since 1955 for which presidential disaster declarations were issued, or in the case of fire, where the state issued an emergency. As the Reservation is in close proximity to both counties, incidents occurring within either jurisdiction must be taken into consideration, as disaster events are not impacted by geographic boundaries. Review of these events helps identify targets for risk reduction and ways to increase a community's capability to avoid large-scale events in the future. Still, many natural hazard events do not trigger federal disaster declaration protocol but have significant impacts on their communities. These events are also important to consider in establishing recurrence intervals for hazards of concern.

TABLE 4-1.
PRESIDENTIAL DISASTER DECLARATIONS FOR HAZARD EVENTS IN PLANNING AREA

Type of Event	Disaster Declaration #	Date
Flood, Wind	DR-137	October 1962
Flood	DR-185	December 1964
Severe Storms, Flooding	DR-322	February 1972
Flood (Grays Harbor County Dec)	DR-492	December 1975
Flood, Landslide	DR-545	December 1977
Flood	DR-784	November 1986
Flood	DR-883	November 1990
Wind	DR-981	January 1993
El Nino Effects	DR-1037	August 1994
Severe Storms, High Winds, Flood	DR-1079	Nov-Dec 1995
Ice, Wind, Snow, Landslide, Flood	DR-1159	Dec 1996-Feb 1997
Flood, Landslide	DR-1172	March 1997
Earthquake	DR-1361	February 2001
Severe Storms, Flooding, Tidal Surge, Landslides, and Mudslides	DR-1641	May 17, 2006 (Jan. 27 Feb 4, 2006 storm event)
Severe Storms, Flooding, Landslides, and Mudslides	DR-1671	Dec 12, 2006 (November 2-11, 2006 storm event)
Severe Winter Storm, Landslides, and Mudslides	DR-1682	February 14, 2007 (Dec 14-15, 2007 "Chanukah Eve" storm event)
Severe Storms, Flooding, Landslides, and Mudslides	DR-1734	December 8, 2007(storm event beginning Dec. 1, 2007)
Severe Winter Storm and Record/Near Record Snow	DR-1825	Declared March 2, 2009 (storm event beginning Dec 12, 2008-Jan 5, 2009)

**TABLE 4-1.
PRESIDENTIAL DISASTER DECLARATIONS FOR HAZARD EVENTS IN PLANNING AREA**

Type of Event	Disaster Declaration #	Date
Severe Storms, Flooding, Landslides, and Mudslides	DR-1817	January 30, 2009 (Storm event occurring Jan 6, 2009)
Severe Storms, Flooding, Landslides, and Mudslides (Grays Harbor Event)	DR-4056	March 5, 2012(January 14-23, 2012 Storm event; minimal impact to Tribe)

Chapter 5. DEMOGRAPHICS, DEVELOPMENT AND REGULATION

5.1 DEMOGRAPHICS

Some populations are at greater risk from hazard events because of decreased resources or physical abilities. Elderly people, for example, may be more likely to require additional assistance. Research has shown that people living near or below the poverty line, the elderly, the disabled, women, children, ethnic minorities and renters all experience, to some degree, more severe effects from disasters than the general population. These vulnerable populations may vary from the general population in risk perception, living conditions, access to information before, during and after a hazard event, capabilities during an event, and access to resources for post-disaster recovery. Indicators of vulnerability—such as disability, age, poverty, and minority race and ethnicity—often overlap spatially and often in the geographically most vulnerable locations. Information of this type will enhance the Tribe's ability to respond to needs for assistance as a result of disaster events.

5.1.1 Population Characteristics

Knowledge of the composition of the population and how it has changed in the past and how it may change in the future is needed for making informed decisions about the future. Information about population is a critical part of planning because it directly relates to land needs such as housing, industry, stores, public facilities and services, and transportation. The U.S. Census Bureau does not provide a current estimation of population living on the Reservation separate from that of Pacific County; however, the Tribe estimates that approximately 120 residents live on the Reservation, with a total of 310 members enrolled in the Tribe. The 2010 (U.S. Census, 2012)[6] does estimate an average household size of 2.96 individuals per residence, with an average family size of 4.75. The estimates of household size coincides with the values associated with the number of housing units and population on the Reservation as determined by the Tribe during this 2014 update process. During the risk assessment portion of this update, exposure will be based on 3 members per household/residence.

Population changes are useful socio-economic indicators. A growing population generally indicates a growing economy, while a decreasing population signifies economic decline. The Tribe has experienced slow growth since 2000. However, it is hoped that with the acquisition of the various enterprise systems over the course of the last 5 years, that population on the Reservation will steadily increase over the course of the next 10 years.

5.1.2 Income

In the United States, individual households are expected to use private resources to prepare for, respond to and recover from disasters to some extent. This means that households living in poverty are automatically disadvantaged when confronting hazards. Additionally, the poor typically occupy more poorly built and inadequately maintained housing. Mobile or modular homes, for example, are more susceptible to damage in earthquakes and floods than other types of housing. In urban areas, the poor often live in older houses and apartment complexes, which are more likely to be made of un-reinforced masonry, a building type that is particularly susceptible to damage during earthquakes. Furthermore, residents below the poverty level are less likely to have insurance to compensate for losses incurred from natural disasters. This means that residents below the poverty level have a great deal to lose during an event and are the least prepared to deal with potential losses. Personal household economics significantly impact people's

[6] http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_11_5YR_DP02&prodType=table

decisions on evacuation: those who cannot afford gas for their cars will likely decide not to evacuate; or, the fear of loss of what possession they have will cause them to remain in place rather than to evacuate.

U.S. Census Bureau estimates for per capita income for the Shoalwater Reservation does not exist. Therefore, U.S. Census Bureau data for Pacific County it utilized, with information supplemented from the Shoalwater Bay Tribe as available.

Employment throughout Pacific County is mainly concentrated in agriculture, manufacturing, government, tourism, and fishing. The manufacturing sector consists almost entirely of logging, sawmills, and food processing. The Shoalwater Bay Casino supports a large sector of the local economy, as does the hotel and RV Park. Of the total population in Pacific County, 49.7% are in the labor force over the age of 16 years, with approximately 8.5% unemployed. Of the workforce, 19.5% work within the services occupation, and 7.4% within the public administration sector. Median household income for the County as a whole is $40,599, with a per capita income of $23,193. Married couples with children under 5 years living below the poverty rate is approximately 36%.

A 2005 Bureau of Indian Affairs report illustrates the unemployment rate on the Reservation at that time at 61 percent. While somewhat dated for this 2014 update, that number remains fairly accurate in its estimations. Contributing factors to that level of unemployment include: the lack of land for economic development and community facilities; inadequate telecommunications and electrical infrastructure, and the very limited transportation system, all of which inhibit the opportunities for economic growth, thereby limiting job opportunities.

5.1.3 Age Distribution

As a group, the elderly are more apt to lack the physical and economic resources necessary for response to hazard events and are more likely to suffer health-related consequences making recovery slower. They are more likely to be vision, hearing, and/or mobility impaired, and more likely to experience mental impairment or dementia. Additionally, the elderly are more likely to live in assisted-living facilities where emergency preparedness occurs at the discretion of facility operators. These facilities are typically identified as "critical facilities" by emergency managers because they require extra notice to implement evacuation. Elderly residents living in their own homes may have more difficulty evacuating their homes and could be stranded in dangerous situations. This population group is more likely to need special medical attention, which may not be readily available during natural disasters due to isolation caused by the event. Specific planning attention for the elderly is an important consideration given the current aging of the American population.

Children under 14 are particularly vulnerable to disaster events because of their young age and dependence on others for basic necessities. Very young children may additionally be vulnerable to injury or sickness; this vulnerability can be worsened during a natural disaster because they may not understand the measures that need to be taken to protect themselves from hazards.

Based on U.S. Census[7] data estimates (2011 data) for Pacific County, 24.2 percent of the planning area's population is 65 or older. It is also estimated that 14 percent of the population is 14 or younger. According to U.S. Census data, 9.9 percent of the over-65 population have incomes below the poverty line. Children under 18 account for 26.3 percent of individuals who are below the poverty line.

5.1.4 Race, Ethnicity and Language

Research shows that minorities are less likely to be involved in pre-disaster planning and experience higher mortality rates during a disaster event. Post-disaster recovery can be ineffective and is often characterized by cultural insensitivity. Since higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability. According to the

[7] http://factfinder2.census.gov/faces/nav/jsf/pages/community_facts.xhtml#none

U.S. Census (available only at the County level) the predominant racial groups in the planning area are white, at 88.1 percent, with and American Indian at 1.4% percent. However, the Native American groups identified include only Cherokee, Chippewa, Navajo and Sioux Tribes – not the Shoalwater Indians. Almost 8 percent of the population is Hispanic. The planning-area populations includes 4.2 percent who report belonging to two or more races.

5.1.5 Disabled Populations

The 2010 U.S. Census Bureau estimates 54 million (non-institutionalized) Americans with disabilities in the U.S. This equates to about one-in-five persons. People with disabilities are more likely to have difficulty responding to a hazard event than the general population. Knowing that local government is the first level of response to assist individuals, coordination of efforts to meet the access and functional needs of individuals with disabilities is paramount to life safety efforts. In this respect, it is important for emergency managers to distinguish the differences between *functional* and *medical* needs to allow them to plan accordingly for incidents which require evacuations and sheltering needs. Pre-determining the percentage of population impacted with a disability will provide emergency management personnel and first responders the information necessary to pre-plan by having individuals available who can provide those services necessary to meet the requirements of those with access and functional needs.

The 2010 Census does not provide data on individuals with disabilities specific to the Shoalwater Reservation. However, the Tribe does maintain information for evacuation planning purposes of individuals with access and functional needs. Currently, there are 10 individuals on the Reservation with access and functional needs requirements living on the Reservation.

5.1.6 Economy

Employment Trends and Occupations

The planning area's economy is strongly based in the agricultural, retail trade, recreation, accommodation and food services industries, which employs approximately 33 percent of the employed population 16 or older within Pacific County, including the Shoalwater Bay Tribe. As indicated, the Shoalwater Bay Tribe, which includes the Casino, Hotel and RV Park is the single largest employer within Pacific County

5.2 DEVELOPMENT PROFILE

As a sovereign nation, decisions on land use are governed by Tribal Government, who maintain policy-making authority. At present, the Tribe does have limited land-use authority in place, and is in the process of developing a more robust land-use policy. Once complete, this plan will be utilized to support land use in the future by providing vital information on the risk associated with natural hazards in the planning area. The Tribe will incorporate by reference the Hazard Mitigation Plan in its comprehensive land use plan. This will assure that all future trends in development can be established with the benefits of the information on risk and vulnerability to natural hazards identified in this plan.

5.2.1 Age of Building Stock

Throughout Pacific County, approximately 51 percent of the housing stock was built pre-1972, which maintained lower building standards than the current codes in place. Much of the Tribe's current building stock is equally aged, also built to lower standards than the current codes in place. While new construction is built to higher standards, given the Tribe's limited resources, the age of Pacific and Grays Harbor Counties' building stock will have a direct impact on the Tribe with respect to shared fire and ambulance services, as well as the distance to hospital facilities. Should a significant event occur which impacts the entire county, the Tribe would be in a position of competing for these resources as the County's aging building stock would increase the potential for injuries countywide.

Historic Places

Figure 5-1. Historic Places on the Shoalwater Reservation

5.2.2 Land Use Principles

The Shoalwater Tribe has limited resources to construct essential community facilities, to install or replace eroding infrastructure, or to create a large amount of sustainable economic development on the Reservation due to financial constraints and limited land mass. While all of the Reservation is considered culturally sacred, there are specific areas which are particularly more significant, such as burial grounds and areas designated for archaeological preservation. These factors, when coupled with the large amount of land mass which are susceptible to the hazards of concern – particularly Tsunami and landslides - the amount of land available for additional housing, economic development and community facilities is significantly reduced.

The lack of road infrastructure is also a significant factor limiting growth and expansion, as are the limitations with respect to redundant power systems and limited communication infrastructure, such as cellular phones. Due to its remote location, power outages lasting hours in more populated areas can last days and weeks on the Reservation. While the Tribe is actively seeking opportunities to remedy these deficiencies, it lacks funding to be able to fully address the issues. While portions of the Tribe are able to make some advancements in growth, opportunities are limited and major moves forward are hampered.

As indicated, the Tribe has commenced development of land use regulations and guidelines. The Tribe makes it a point of practicing safe building development to protect its Tribal members. It is anticipated that within the lifecycle of this plan, the Tribe will have much of its land use regulations and guidelines in place. This will be a significant factor for the Tribe in helping to reduce risk from its hazards of concern. At present, new buildings funded with Federal funds are built to International Building Code (IBC) standards, but the development of regulatory guidelines which restrict or limit building in high-hazard areas, or requires a minimum amount of mitigation efforts, will greatly enhance the Tribe's resiliency. The Tribe is also an enrolled member of the National Flood Insurance Program, and regulates structural development to maintain compliance within the program.

5.2.3 Residential Development

Residential land use generally consists of single-family and multifamily dwellings, including manufactured housing, child care facilities, senior housing, and some assisted housing. According to Tribal GIS data, there are an estimated 40 single, residential buildings in the planning area, and two multi-family housing units on the Reservation. As previously indicated, the year of construction is significant in determining the potential impact from various hazards due to construction standards in place at the time. While built to existing codes at the time, many of these structures are built to lower building code standards than currently exist, making them more susceptible to damage from disaster events, especially as they related to earthquake and flooding. As of this 2014 update, the Tribe is in the process of building several new residential structures within the Dexter Development. All of the new construction occurring is built to current codes, including NFIP required elevations.

5.2.4 Non-Residential Development

At present, there is some construction occurring on the Reservation, although it is limited in nature. The cause for this, in part, is due to the economic downtrend, as well as the very limited infrastructure within much of the Reservation to support large amounts of growth. While the economy is rebounding more quickly in the populated areas of our Nation, that factor has not yet fully reached the Reservation. The Tribe is diligently pursuing every avenue possible to obtain new and modify existing infrastructure to allow for expansion of the Tribe, but the general lack of building space is hampering this effort. While the size of the Reservation has increased since the last plan was completed in 2008, given the hazards to which the Reservation is susceptible, the newly acquired land allows for construction of some new residential structures, but when the hazard areas are viewed and relocation of existing structures considered, there is little room for expansion.

5.2.5 Critical Facilities and Infrastructure

Critical facilities and infrastructure are those that are essential to the health and welfare of the population. These become especially important after a hazard event. Critical facilities typically include police and fire stations, schools and emergency operations centers. Critical infrastructure can include the roads and bridges that provide ingress and egress and allow emergency vehicles access to those in need, and the utilities that provide water, electricity and communication services to the community. Also included are "Tier II" facilities and railroads, which hold or carry significant amounts of hazardous materials with a potential to impact public health and welfare in a hazard event.

As defined for this hazard mitigation plan, critical facilities include local facilities in the public or private sector that provide essential products and services to the general public or are essential for use during public safety, emergency response, and disaster recovery functions. On the Shoalwater Reservation, loss of a single critical facility would result in a severe economic or catastrophic impact. As a result, critical facilities for the purposes of this planning effort include, but are not limited to the following:

- Tribal owned facilities such as department, agency, and administrative offices that provide essential services to the Shoalwater people.
- Emergency response facilities needed for disaster response and recovery including, but not limited to public safety buildings, emergency services buildings, emergency operations centers (including alternate site EOC locations) and emergency supply storage facilities.
- Medical and public health facilities used during emergency response such as medical clinics.
- Facilities that may be used to house or shelter disaster victims such as gymnasiums, churches or other large gathering facilities.
- Public and private utilities and infrastructure vital to maintaining or restoring normal services to the areas damaged by the disaster such as power lines, roads and highways, public works facilities, and docks.
- Community gathering places, including culturally significant areas, parks, community centers, and gymnasiums and meeting halls.
- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic, and/or water-reactive materials.
- Cultural sites or facilities that are vitally important to maintaining the Tribe's cultural history, language, and traditions such as archaeological sites and artifact storage facilities.
- Connex boxes on the various evacuation sites which provide resources for evacuated tribal members.
- All residential structures on the Reservation due to the limited number available. Should a residential structure be damaged or destroyed, replacing such structure would be extremely difficult and would, undoubtedly, cause Tribal members to experience significant displacement away from the Reservation, their family and culture.

A database of Tribal facilities within the Reservation was created to identify vulnerabilities to each hazard addressed by this plan. The risk assessment for each hazard discusses facilities with regard to that hazard. Figure 5-2 shows the location of Tribal facilities assessed by this plan. It should be noted that the number of facilities addressed include tribal members' residents and tribal facilities that fall outside of the existing tribal boundary, but for which the Tribe provides emergency response activities. Those properties and facilities are within the ancestral boundaries, and are part of the reason why the Tribe is attempting to gain ownership of those areas, as many tribal members and culturally sensitive areas fall within those boundaries.

5.3 RELEVANT REGULATIONS

Pertinent federal laws are described below. It should be noted that as a sovereign nation, the Tribe is not required to adhere to any local or state planning regulations; however, in an effort to be a good steward and neighbor, the Tribe does strive to plan in conjunction with state and local requirements. The Tribe must fulfill any federal regulations, such as those administered by HUD and EPA, as well as other federal agencies. This places a significant burden upon the Tribe as it is doubly impacted in its efforts when developing land use authority and other regulatory statutes.

5.3.1 Federal

Disaster Mitigation Act

The DMA is the current federal legislation addressing hazard mitigation planning. It emphasizes planning for disasters before they occur. It specifically addresses planning at the local level, requiring plans to be in place before Hazard Mitigation Grant Program funds are available to communities. This plan is designed to meet the requirements of DMA, improving eligibility for future hazard mitigation funds.

Endangered Species Act

The federal Endangered Species Act (ESA) was enacted in 1973 to conserve species facing depletion or extinction and the ecosystems that support them. The act sets forth a process for determining which species are threatened and endangered and requires the conservation of the critical habitat in which those species live. The ESA provides broad protection for species of fish, wildlife and plants that are listed as threatened or endangered. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species. The ESA outlines procedures for federal agencies to follow when taking actions that may jeopardize listed species and contains exceptions and exemptions. Criminal and civil penalties are provided for violations of the ESA.

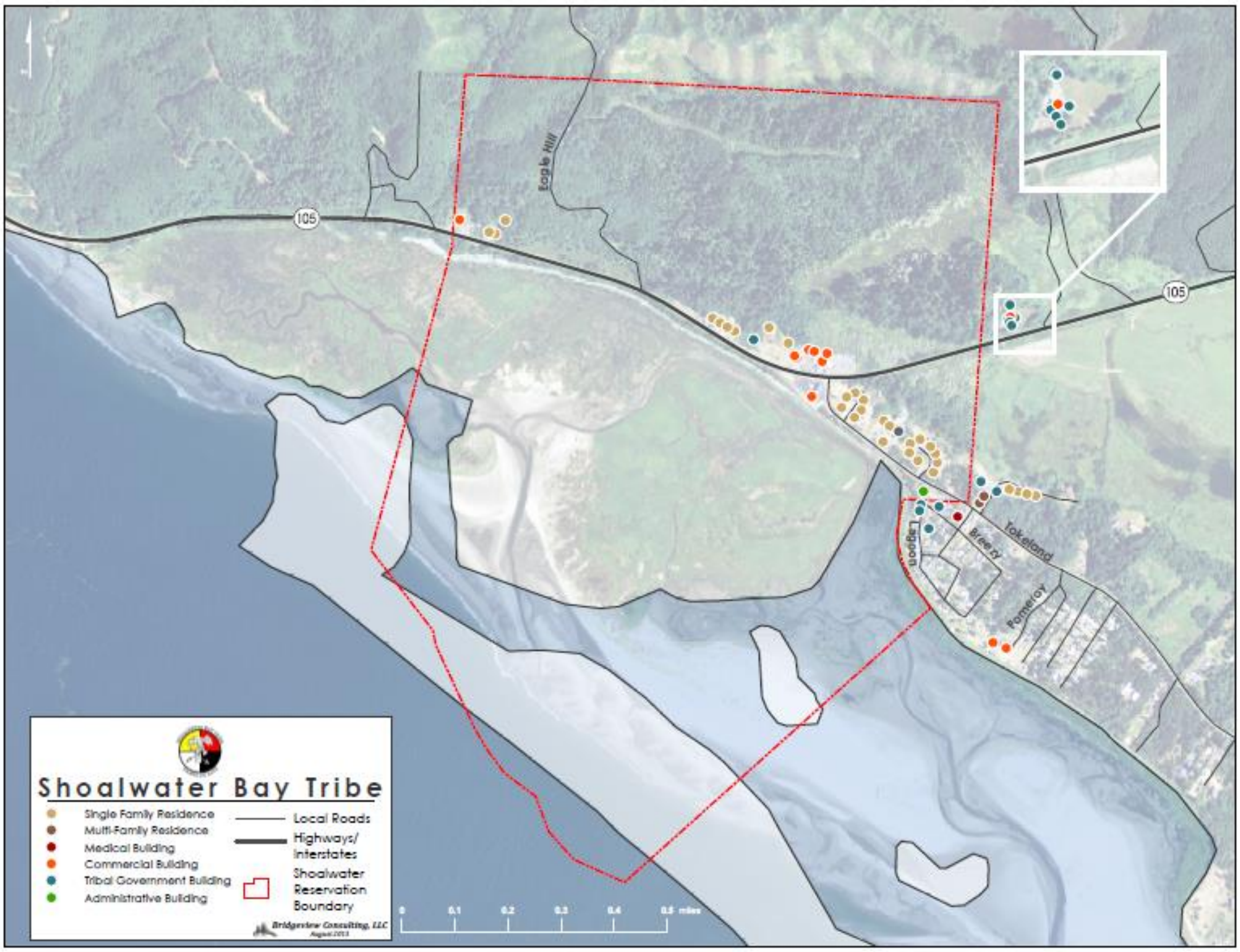


Figure 5-2. Tribal Facilities

Federal agencies must seek to conserve endangered and threatened species and use their authorities in furtherance of the ESA's purposes. The ESA defines three fundamental terms:

- **Endangered** means that a species of fish, animal or plant is "in danger of extinction throughout all or a significant portion of its range." (For salmon and other vertebrate species, this may include subspecies and distinct population segments.)

- **Threatened** means that a species "is likely to become endangered within the foreseeable future." Regulations may be less restrictive for threatened species than for endangered species.
- **Critical habitat** means "specific geographical areas that are…essential for the conservation and management of a listed species, whether occupied by the species or not."

Five sections of the ESA are of critical importance to understanding it:

- **Section 4: Listing of a Species**—The National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries) is responsible for listing marine species; the U.S. Fish and Wildlife Service is responsible for listing terrestrial and freshwater aquatic species. The agencies may initiate reviews for listings, or citizens may petition for them. A listing must be made "solely on the basis of the best scientific and commercial data available." After a listing has been proposed, agencies receive comment and conduct further scientific reviews for 12 to 18 months, after which they must decide if the listing is warranted. Economic impacts cannot be considered in this decision, but it may include an evaluation of the adequacy of local and state protections. Critical habitat for the species may be designated at the time of listing.
- **Section 7: Consultation**—Federal agencies, in protection of their fiduciary responsibilities to all Tribes, must ensure that any action which they authorize, fund, or carry out, which has the potential to impact any trust resource(s), is not likely to jeopardize or impact the continued existence of a listed or proposed species or adversely modify its critical habitat. This includes private and public actions that require a federal permit. Once a final listing is made, non-federal actions are subject to the same review, termed a "consultation." If the listing agency finds that an action will "take" a species, it must propose mitigation or "reasonable and prudent" alternatives to the action; if the proponent rejects these, the action cannot proceed.
- **Section 9: Prohibition of Take—**It is unlawful to "take" an endangered species, including killing or injuring it or modifying its habitat in a way that interferes with essential behavioral patterns, including breeding, feeding or sheltering.
- **Section 10: Permitted Take**—Through voluntary agreements with the federal government that provide protections to an endangered species, a non-federal applicant may commit a take that would otherwise be prohibited as long as it is incidental to an otherwise lawful activity (such as developing land or building a road). These agreements often take the form of a "Habitat Conservation Plan."
- **Section 11: Citizen Lawsuits**—Civil actions initiated by any citizen can require the listing agency to enforce the ESA's prohibition of taking or to meet the requirements of the consultation process.

With the listing of salmon and trout species as threatened or endangered, the ESA has impacted most of the Pacific Coast states. Although some of these areas have been more impacted by the ESA than others due to the known presence of listed species, the entire region has been impacted by mandates, programs and policies based on the presumption of the presence of listed species. Most West Coast jurisdictions must now take into account the impact of their programs on habitat.

Coastal Zone Management Act

All states with federally approved coastal programs delineate a coastal zone consistent with the general standards act set forth in the Coastal Zone Management Act of 1972 (CZMA). According to the CZMA, the coastal zone area should encompass all important coastal resources including transitional and intertidal areas, salt marshes, beaches, coastal waters, and adjacent shorelines where activities could have the potential to impact the coastal waters. Federal land is excluded from the state coastal zone by the CZMA. Washington State has established the Washington State Coastal Zone Management Program, which was approved by the federal government in 1976, making it the first to be approved, applying to 15 coastal counties which front on salt water.

Clean Water Act

The federal Clean Water Act (CWA) employs regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's surface waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water."

Evolution of CWA programs over the last decade has included a shift from a program-by-program, source-by-source, and pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the watershed approach, equal emphasis is placed on protecting healthy waters and restoring impaired ones. A full array of issues are addressed, not just those subject to CWA regulatory authority. Involvement of stakeholder groups in the development and implementation of strategies for achieving and maintaining water quality and other environmental goals is a hallmark of this approach.

The EPA recognizes that Indian Tribes face serious human health and environmental problems, and are working with the Indian Tribes to protect the health and environment of waters in Indian Country. Presently, the Shoalwater Bay Tribe has undertaken several watershed restoration projects in its efforts to return the watersheds to a healthy state.

Water Quality Standards

Currently, the Shoalwater Bay Tribe, in conjunction with the Washington State Department of Health, monitors water quality on a bi-monthly basis in accordance with the Clean Water Act Section 303 (Water Quality Standards). The Shoalwater Bay Tribe had adopted water quality control standards which sets tribally approved water quality standards for surface and ground waters within the Reservation. The WPCO applies to all federal, state, county and Tribal government actions that have the potential to affect waters of the Reservation. The WPCO prohibits certain activities and requires compliance with any water quality certification issued under the WPCO. The WPCO authorizes the Tribe to enforce its provisions.

Presidential Disaster Declarations

Presidentially declared disasters are disaster events that cause more damage than state and local governments/resources can handle without federal assistance. There is not generally a specific dollar threshold that must be met. 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. A Presidential Emergency Declaration can also be declared, but assistance is limited to specific emergency needs.

Non-FEMA Disaster Declarations

Unique to Tribes is the fact that disaster declarations can also be granted by other federal agencies other than FEMA, such as the Department of Housing and Urban Design and the Bureau of Indian Affairs. In such cases, similar to a Presidentially Declared event, funds are designated to help the Tribes recover from the impact of disaster events, and customarily carry a match requirement. Those funds are limited to specific needs, and are limited in nature.

5.3.2 State-Level Planning Initiatives

The Shoalwater Tribe must comply with all Federal regulations established, which many times are much more stringent than those regulations which state or local jurisdictions must address. This places a much heavier burden on the Tribe as they continue to grow and develop tribal lands. As a sovereign nation, the

Tribe is not subject to state or local requirements; however, in the spirit of being a good neighbor and in partnership with the surrounding jurisdictions, the Tribe does consider its local communities in all of its planning initiatives and does complete several of the planning documents requested by the State.

Comprehensive Plan

The Tribe currently is in the process of developing its comprehensive plan, which is anticipated to be in force during the life cycle of this mitigation plan update (2014-2019). Information contained within this document will be utilized in determining zoning and regulatory authority so as to reduce the impacts of disasters on Tribal members, while still taking into consideration the Tribe's ultimate goal of protecting its members, its cultural heritage, and the environment. Additionally, information from this plan will also be utilized with respect to funding opportunities as the Tribe continues to expand its land mass and tribal membership living on the Reservation.

Coastal Zone Management Program

Washington State has established the Washington State Coastal Zone Management Program in conjunction with the federal Coastal Zone Management Act, which was approved by the federal government in 1976, making it the first to be approved, applying to 15 coastal counties which front on salt water.

Tribal Code

The Tribe does have a Tribal Code in place, the majority of which are civil related issues. At present, law enforcement utilizes federal, state or county code for enforcement activities. The Tribe is in the process of developing land use authority, which when completed will be adopted by Tribal Council.

Capability Assessment

The planning team performed an inventory and analysis of existing authorities and capabilities called a "capability assessment." A capability assessment creates an inventory of an agency's mission, programs and policies, and evaluates its capacity to carry them out. Table 5-1 summarizes the legal and regulatory capability of the Shoalwater Bay Tribe. Table 5-2 summarizes the administrative and technical capability. Table 5-3 summarizes fiscal capability.

Emergency Management and Public Safety Capabilities

The Shoalwater Bay Emergency Management Department and Police Department (assisted by the Pacific County Sheriff's Office, and the North Cove Fire Department in Tokeland) administer public safety on the Reservation.

The Shoalwater Bay Tribe Department of Emergency Services assists with hazards planning, grant writing, disaster relief training and NIMS compliance tracking. The Department has taken proactive steps to enhance the Reservation's capabilities with respect to emergency response and recovery efforts for both pre-and post-disaster efforts. Currently, the Tribe's gymnasium is designated as the Reservation's Shelter, providing protection and shelter for Tribal members and visitors to the Reservation when needed. This is a fully-operational facility, with kitchen and bathroom facilities, and has a back-up generator if needed. In addition through assistance and guidance from the Emergency Management Director, the Enterprise System which owns the Casino has also obtained provisions for emergency use for guests and employees of the Casino facility, greatly enhancing the capacity of the Tribe to take care of not only its own members, but also those individuals using those facilities.

The development of this Hazards Mitigation Plan helps determine where priorities should be placed with respect to response and recovery efforts is a clear demonstration of the Tribe's efforts to enhance its emergency management capabilities.

The purpose of the Shoalwater Bay Tribe's Emergency Management Department is to provide:

- A leadership role in facilitating and coordinating a regional approach to emergency planning and response on the Reservation (and surrounding communities);
- Guidance and coordination in the planning, mitigation, response and recovery of efforts of the Reservation before, during and after an emergency or disaster;
- Acquire, allocate and coordinate the appropriate resources in response to emergencies of disasters.

In an effort to support these activities, the Tribe's Emergency Management Department has provided training for in excess of 300 CERT members, 39 of which assist during times of activation in response to disaster or emergency events.

**TABLE 5-1.
LEGAL AND REGULATORY CAPABILITY**

REGULATORY TOOL (Codes, Ordinances, Plans, Policies, Procedures, Site Assessments, Studies)	County (C) Local (L), Tribal (T) State (S), Federal (F)	Mandate :No/Local (L) State (S)/Federal (F)	Potential Funding Source Y/N	Effect on Loss Reduction (X): Support	Effect on Loss Reduction (X): Facilitate	Effect on Loss Reduction (X): Hinder	Hazards Impacted: Coastal Erosion	Hazards Impacted: Drought/Extreme Heat (Severe Weather)	Hazards Impacted: Earthquake	Hazards Impacted: Flood	Hazards Impacted: Landslide	Hazards Impacted: Severe Winter Storm	Hazards Impacted: Tsunami	Hazards Impacted: Wildfire	Hazards Impacted: Man-Made	Hazards Impacted: Technological	Date of Adoption or Development	Description
Hazardous Materials Site Assessment	T		Y	X	X										X		2012	HazMat Response Plan
Soil Resource Reconnaissance & Drainfield Site Assessment and Preliminary Geotechnical Assessment	S	N	N	X	X				X		X	X	X		X			Includes various USGS data
Comprehensive Emergency Management Plan	T	N															2006	Under review
Highway/Roadway Safety Improvements Design Report	T	N		X	X		X	X	X	X	X	X	X	X			2013	BIA funding was used to complete the report. The effort supports capital funding of projects.
Engineering Report for Water System (Improvement)	T	F		X			X	X	X	X	X	X	X	X	X		Various	The SBIT does have water storage tanks and Tribal wells for which engineered studies have been completed. During the 2006-2007 timeframe, Dept. of Heath also conducted assessments on water quality on Reservation.
Feasibility Study – Casino	T	N	N	X	X													Through Enterprise System

**TABLE 5-1.
LEGAL AND REGULATORY CAPABILITY**

				Effect on Loss Reduction (X)			Hazards Impacted											
REGULATORY TOOL (Codes, Ordinances, Plans, Policies, Procedures, Site Assessments, Studies)	County (C) Local (L), Tribal (T) State (S), Federal (F)	Mandate :No/Local (L) State (S)/Federal (F)	Potential Funding Source Y/N	Support	Facilitate	Hinder	Coastal Erosion	Drought/Extreme Heat (Severe Weather)	Earthquake	Flood	Landslide	Severe Winter Storm	Tsunami	Wildfire	Man-Made	Technological	Date of Adoption or Development	Description
Trading Store (Business Plan)	T	N	N	X	X													Feasibility study conducted to determine placement and viability of Tribe's casino. Study included elements such as infrastructure review, economic outlook and tourism.
Tribal Codes (Civil)	T/F	Y	N	X	X		X	X	X	X	X	X	X	X				Limited number currently in place, but the Tribe is also in the process of developing new, additional civil codes.
Tribal Code (Criminal)	S/F	N	Y	X	X									X	X	X	Updated 02-2014	Provides enforcement against criminal acts, under federal, county and state codes.
Tribal Fishing and Hunting Ordinance	F/T	F																The Tribe is not a Treaty Tribe and do not have fishing rights as other Washington Tribes. The Fish and Wildlife Commission is working on adopting documents produced in June 2012 for regulations concerning hunting on the Reservation.

TABLE 5-1.
LEGAL AND REGULATORY CAPABILITY

REGULATORY TOOL (Codes, Ordinances, Plans, Policies, Procedures, Site Assessments, Studies)	County (C) Local (L), Tribal (T) State (S), Federal (F)	Mandate :No/Local (L) State (S)/Federal (F)	Potential Funding Source Y/N	Effect on Loss Reduction (X)			Hazards Impacted										Date of Adoption or Development	Description
				Support	Facilitate	Hinder	Coastal Erosion	Drought/Extreme Heat (Severe Weather)	Earthquake	Flood	Landslide	Severe Winter Storm	Tsunami	Wildfire	Man-Made	Technological		
Land Use Code and NFIP Ordinance	T			X	X		X	X	X	X	X	X	X	X	X	X	Under Develop-ment 2014	Land Use is currently under development; however, an NFIP compliant ordinance and some initial building codes were adopted in 1987, with an updated Resolution adopting newer codes in 2009. The Tribe does utilize some of Pacific County's land use authority.
Forest Practices Act	T/F	Y	Y	Y				X	X	X	X			X			1983 Federal	Covers tribal, private and state forest lands. The Tribe does have a forest plan in place.
Coastal Zone Management	T/F/S	Y	Y	X	X		X	X	X	X	X	X	X				Various	Requires projects funded by or implemented by any federal agency must adhere to coastal zone management regulations, policies and programs.
Watershed Analysis	T/S	N	Y	X	X		X	X	X	X		X	X	X			Various studies in place	Watershed analysis conducted Reservation wide
Habitat Conservation Plan	T/F																	Various plans address habitat conservation throughout the reservation

TABLE 5-1.
LEGAL AND REGULATORY CAPABILITY

				Effect on Loss Reduction (X)			Hazards Impacted											
REGULATORY TOOL (Codes, Ordinances, Plans, Policies, Procedures, Site Assessments, Studies)	County (C) Local (L), Tribal (T) State (S), Federal (F)	Mandate :No/Local (L) State (S)/Federal (F)	Potential Funding Source Y/N	Support	Facilitate	Hinder	Coastal Erosion	Drought/Extreme Heat (Severe Weather)	Earthquake	Flood	Landslide	Severe Winter Storm	Tsunami	Wildfire	Man-Made	Technological	Date of Adoption or Development	Description
Spill Prevention or Response Plan	T/S/C	F	Y	X	X		X		X	X				X	X	X	2013	Hazmat Response Plan; Environmental Dept. administers various hazmat and response initiatives.
Emergency Response Plans	T		T	X	X		X	X	X	X	X		X				Various	Varying in nature; some based on County plans; Tribe will review to determine accuracy based on HMP
Building Codes	F/S/C	F/S	N	X	X				X	X	X	X						2014 - Under development by Tribe. The SBIT adheres to codes mandated by federal funding; and utilizes current IBC adopted by State and County.
Growth Management Plan	T	N	N	X	X		X	X	X	X	X	X	X	X				2014 Under current development; will utilize existing data from HMP
Economic Development Plan	T	N	N	X													Various	Casino/Hotel; other plans to support efforts to enhance business

**TABLE 5-1.
LEGAL AND REGULATORY CAPABILITY**

				Effect on Loss Reduction (X)			Hazards Impacted											
REGULATORY TOOL (Codes, Ordinances, Plans, Policies, Procedures, Site Assessments, Studies)	County (C) Local (L), Tribal (T) State (S), Federal (F)	Mandate :No/Local (L) State (S)/Federal (F)	Potential Funding Source Y/N	Support	Facilitate	Hinder	Coastal Erosion	Drought/Extreme Heat (Severe Weather)	Earthquake	Flood	Landslide	Severe Winter Storm	Tsunami	Wildfire	Man-Made	Technological	Date of Adoption or Development	Description
Cultural Resources Preservation documents	T	N	Y	X	X		X	X	X	X	X	X	X	X	X	X	Several at various stages	Protected Document. Reviewed by Tribal personnel during plan development to determine areas of impact from hazard assessment.
Post Disaster Recovery Plan(s)		N	Y	X			X	X	X	X	X	X	X	X	X	X	2014 – Debris Plan	Strategy in HMP for development of recovery annex/plan during life-cycle of HMP. As of 2014, limited planning in place.
Post Disaster Recovery Ordinance		N	Y	X	X		X	X	X	X	X	X	X	X	X	X		Strategy in HMP
COOP or COG																	2012	Will be reviewed once 2014 HMP completed to ensure accuracy.
GIS Data	T	N	Y	X	X		X	X	X	X	X	X	X	X			Various	Various types of GIS layers in place; additional HMGP funding may be sought to continue data-enhancement; GIS layers will be reviewed to incorporate new data discovered during HMP update process

**TABLE 5-1.
LEGAL AND REGULATORY CAPABILITY**

REGULATORY TOOL (Codes, Ordinances, Plans, Policies, Procedures, Site Assessments, Studies)	County (C) Local (L), Tribal (T) State (S), Federal (F)	Mandate :No/Local (L) State (S)/Federal (F)	Potential Funding Source Y/N	Effect on Loss Reduction (X): Support	Facilitate	Hinder	Hazards Impacted: Coastal Erosion	Drought/Extreme Heat (Severe Weather)	Earthquake	Flood	Landslide	Severe Winter Storm	Tsunami	Wildfire	Man-Made	Technological	Date of Adoption or Development	Description
Air Quality Monitoring/Studies	F	Y	N	X	X									X			Various	EPA regulated standards. Tribe does not regulate or enforce.
Water Quality Monitoring/Studies	F	Y	N	X	X		X			X		X	X	X			Various	EPA regulated standards. 2006-2007, Dept. of Health conducted study; Tribe also conducted study when it built water storage tank. Tribe tests water quality every other month.
Transportation Plan																		Plans are updated annually utilizing BIA Roads Grants.

**TABLE 5-2.
ADMINISTRATIVE AND TECHNICAL CAPABILITY**

Staff/Personnel Resources	Available?	Department/Agency/Position
Planners, scientists or engineers with knowledge of land development and land management practices	Y	Land Use Planners (tribal and contracted), Environmental Planners (various types), Water Quality Assessors
Engineers or professionals trained in building or infrastructure construction practices	Y	The Tribe abides by Federal/County/State building codes. However, at present, it does not possess the manpower to staff an individual to inspect or enforce specific levels of construction practices
Planners or engineers with an understanding of natural hazards	Y	Land Use Planners, Environmental Planners (various types), Water and Air Quality Planners
Staff with training in benefit/cost analysis	Y	The Tribe does have the ability to conduct benefit-cost analysis through contracted personnel.
Floodplain Manager	N	At present, the Tribe is a member of the NFIP, but works under the Pacific County Floodplain Manager.
Surveyors (contracted)	Y	Surveyor list established.
Personnel skilled or trained in GIS applications	Y	The Tribe has GIS capabilities.
Scientist familiar with natural hazards in local area	Y	The Tribe has several departments which are specific to the impacts of natural hazards.
Emergency Manager	Y	The Tribe has various departments which include public safety components, including: emergency management (and CERT), law enforcement, and public health departments.
Grant Writers	Y	Several employees in various departments within Tribal Government are skilled grant writers. The Tribe also has the capabilities to contract this task out to various vendors.

**TABLE 5-3.
FISCAL CAPABILITY**

Financial Resources	Accessible or Eligible to Use?
1. Community Development Block Grants	Y
2. Capital Improvements Project Funding	Y
3. Authority to Levy Taxes for Specific Purposes	Y
4. User Fees For Water, Sewer, Gas or Electric Service. (The Tribe previously collected fees for water use, but does not presently do so.)	N

TABLE 5-3.
FISCAL CAPABILITY

Financial Resources	Accessible or Eligible to Use?
5. Impact Fees for Buyers or Developers of New Development/Homes (Not at present, but potentially may occur during life-cycle of HMP)	N
6. Incur Debt through General Obligation Bonds (Previously, but no longer does so.)	N
7. Incur Debt through Special Tax Bonds	N
8. Incur Debt through Private Activity Bonds	N
9. Could Withhold Public Expenditures in Hazard-Prone Areas	N
10. State-Sponsored Grant Programs	Y
11. Bureau of Indian Affairs Sponsored Grant	Y
12. Indian Health Services Grant	Y
13. U.S. Dept. of Agriculture, Rural Development Agency	Y
14. U.S. Environmental Protection Agency	Y
15. U.S. Fire Administration	Y
16. Tribal Homeland Security Grants	Y
17. U.S. Army Corps of Engineers	Y
18. Stafford Act Grants	Y
19. Other	

During 2008-2013, the Tribe has developed or taken part in a number of exercises in an effort to enhance the preparedness of the Reservation, as follows:

- Ten (10) mandatory Reservation-wide earthquake exercises which included an evacuation element for the Reservation. This has provided emergency management with the knowledge needed to plan for the evacuation of the Reservation with respect to those individuals requiring assistance during evacuation, as well as determining the most appropriate area in which to evacuate the Tribe. .
- A hazmat exercise.
- Kids Preparedness Fair
- Map Your Neighborhood
- Annual Tsunami evacuation dills
- May 2014 Table Top Exercise with the Tribal Health Department

Additionally, the Tribe has also activated emergency response activities as a result of two tsunami threats (2010 and 2011), and hazardous materials incidents and issues occurring on and around the Tribe. The Tribe has also conducted extensive evacuation planning. Currently, the Tribe has approximately 314 trained CERT members, including 25 which represent the Core Team and 14 trained youth. Having trained personnel to assist during disaster incidents will enable the Tribe to more quickly respond to incidents occurring on the Reservation, including those non-tribal members who reside within the planning area or who are tourists passing through the Reservation.

This updated mitigation plan will help provide additional information with respect to safe harbors for evacuation purposes, and will further support preparedness by providing information with respect to the areas of impact from the hazards of concern.

While many of the activities discussed above have been grant funded through various federal programs, policy development to enhance resilience of the Reservation have been funded through Tribal Discretionary Funds. Given the current economic condition of the Tribe, this demonstrates the Tribe's commitment to developing a robust and applicable *all hazards* emergency management program.

A significant change occurring since completion of the 2008 plan is new legislation which allows Tribes to go directly to FEMA for Disaster Declarations. In response to this, the Tribe will attempt to also develop a recovery framework, which will help establish protocols and procedures necessary to assist tribal members in the best way possible. This, again, will be dependent upon funding opportunities, but is something which the Tribe feels is very important, and is something which will further enhance the Tribe's resiliency to disasters.

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PART 3 —
RISK ASSESSMENT

Chapter 6. RISK ASSESSMENT INTRODUCTION

A hazard is an act or phenomenon that has the potential to produce harm or other undesirable consequences to a person or thing. Natural hazards can exist with or without the presence of people and land development. However, hazards can be exacerbated by societal behavior and practice, such as building in a floodplain, along a sea cliff, or on an earthquake fault. Natural disasters are inevitable, but the impacts of natural hazards can, at a minimum, be mitigated or, in some instances, prevented entirely.

The purpose of the following section is to describe each hazard that affects the Tribe, the likely location of natural hazard impact, the severity of the impact, previous occurrences, and the probability of future hazard events are also included.

This risk assessment provides risk-based information to assist the Tribe in determining priorities for implementing mitigation measures. The risk assessment approach used for this plan entailed using geographic information system (GIS) and Hazus software and data to develop vulnerability models for people, structures, critical facilities, and evaluating those vulnerabilities in relation to hazard profiles that model where hazards exist. This type of approach to risk assessment is dependent on the detail and accuracy of the data used during the analysis. Additionally, some types of hazards are extremely difficult to model. Data limitations are described in the various hazard profiles.

To fulfill the planning guidelines outlined in the Disaster Mitigation Act of 2000 (DMA), this Tribal Hazard Mitigation Plan focuses on the risk assessment, analysis, and recommendations for natural hazards mitigation; however non-natural (man-made) hazards are identified and profiled to remain consistent and to allow for coordination with all other emergency plans and agencies not only on the Reservation, but in the surrounding jurisdictions.

DMA 2000 requires measuring potential losses to critical facilities and property resulting from natural hazards by assessing the vulnerability of these facilities to natural hazards. In addition to the requirements of DMA 2000, the risk assessment approach taken in this study evaluated risks to vulnerable populations and also examines the risk presented by several man-made hazards. The goal of the risk assessment process is to determine which hazards present the greatest risk and what areas are the most vulnerable to hazards.

The Shoalwater Bay Indian Reservation is exposed to many hazards both natural and man-made. The risk assessment and vulnerability analysis was completed to help identify where mitigation measures could reduce loss of life or damage to property on the Reservation.

The Natural Hazard Profiles within the 2014 Updated Hazard Mitigation Plan describe and document the impact of past hazard events, and identifies the areas most at risk to that hazard. This is accomplished by presenting several elements which, when combined, provide a clear picture of the risk associated with each hazard. As such, it is important to understand the terminology and intent with respect to the fundamentals of hazards, risk and vulnerability, as terminology related to hazards and risks can vary between disciplines. To ensure a single set of terminology to describe the methodology and results of this analysis, the following is provided as the foundation for the standardized risk terminology.

- ✓ Hazard: Natural (or human caused) source or cause of harm or damage, demonstrated as actual (deterministic/historic events) or potential (probabilistic) events.
- ✓ Risk: The potential for an unwanted outcome resulting from a hazard event, as determined by its likelihood and associated consequences. In the case of the 2014 plan update, where possible, risk includes the potential future losses from the effects of combining probability, severity and vulnerability, expressed, when possible in dollar losses. In some instances, the dollar losses are based on actual demonstrated impact, such as through the use of the Hazus model, while in other

cases, it is demonstrated through exposure analysis due to the inability to determine the extent to which a structure is impacted.

- ✓ Location: The area of potential or demonstrated impact within the area in which the analysis is being conducted. In some instances, such as with flood, the area of impact is many times within a geographically defined area, such as a floodplain. In other instances, such as for severe weather, there is no established geographic boundary associated with the hazard, as it can impact the entire Reservation.
- ✓ Probability: In the case of this document, the term is used as a synonym for likelihood, or the estimation of the potential of an incident to occur.
- ✓ Severity/Magnitude: The extent or magnitude upon which a hazard is ranked, demonstrated in various means, e.g., Richter Scale.
- ✓ Vulnerability: The degree or level of damage, e.g., building performance/damage or the number of people injured.

Chapter 7.
COASTAL EROSION

7.1 GENERAL BACKGROUND

7.1.1 How Coastal Erosion Happens

Coastal erosion is the loss or displacement of land along the coastline due to the action of waves, currents, tides, wind-driven water, waterborne ice, or other impacts associated with storms. It is also the loss or displacement of land due to the action of wind, runoff of surface waters, or groundwater seepage.

Coastal erosion is often attributed to major storm events and in particular to those storm events where high wave energy, strong on-shore winds, and heavy rainfall coincide with a high tide. Large storm-generated waves often expedite coastal erosion processes, when wave action is high and water levels and coastal currents rapidly increase. Coastal erosion may change the shoreline over time through the long-term losses of sediment and rocks, or in other cases, may temporarily redistribute coastal sediments; erosion in one location may result in accretion (deposition of sediments) nearby. Deposition is the placement of sediment transported by wind, water, or ice.

The impact that waves have along the coastline is dependent on storm surge, which are most severe if the surge coincides with high tide. Storm surge is an elevation of water levels, including tides due to lower barometric pressure and wind stress in front of such strong storms which pushes water toward the shoreline. Storm surges contribute substantially to the coastal erosion process.

The three most important factors contributing to beach and dune erosion during storms are:

(1) storm surge heights,

(2) storm surge duration, and

(3) wave steepness (ratio of wave height to length).

Other contributing factors that can significantly increase erosion of a natural protective feature include length of fetch (length of water over which a given wind has blown), wind direction and speed, wave length, height and period, nearshore water depth, tidal influence, increased lake or sea levels, overall strength and duration of storm events and variability in sediment supply to the littoral zone. Combinations of these factors and events can exacerbate the effects of these processes by increasing water levels, storm rise, wave run up and wind setup, and producing damaging

DEFINITIONS

Beach Erosion - A beach is the accumulation of sand, gravel, silt or clay located at the transition zone between land and water. Beach erosion occurs through the removal of beach sediment caused by wind, wave action and longshore currents, causing offshore movement of sand from the sub-aerial beach.

Dune Erosion/Scarping - A dune is a hill of sand built by wind-related or man-made processes found in deserts or near lakes and oceans. Dune erosion is caused by wave-attack during a storm or a large swell or by wind action. This process, generally known as scarping, releases sand that was stored in the dune to the active beach or to the zone just landward of the dune. attenuate incoming wave energy and can assist in post storm low profile beach recovery.

Overwash/Washover - Overwash/ washover are terms related to the transport of sediment landward of the active beach, which occurs from coastal flooding during a tsunami, high wind events, or other event with extreme waves. Overwash occurs where the flow of water (from wave and storm surge) over the upper part of the beach profile causes beach sediment, to advance over the crest of the beach, dune or berm and where this beach sediment does not

Tidelands - Tidelands, also known as riparian lands, are the lands now or formerly flowed by the mean high tide of a natural waterway.

waves along the shore scouring beaches and bluff areas, reducing sand from beaches, and allowing water and wave action further inland that intensifies erosion of dunes and bluffs (USACE 2009).

In addition, erosion can be exacerbated by man-made influences, such shoreline hardening, seawalls, groins, jetties, navigation inlets, boat wakes, dredging and other interruptions of physical coastal processes which reduce or interrupt longshore sediment transport.

7.2 HAZARD PROFILE

Primary forms of coastal erosion include beach erosion, dune scarping/dune erosion, overwash, and bluff erosion, as described below:

- Beach Erosion: A beach is the accumulation of sand, gravel, silt or clay located at the transition zone between land and water. Beach erosion occurs through the removal of beach sediment caused by wind, wave action and longshore currents, causing offshore movement of sand from the sub-aerial beach during storms. Beach erosion is a recurring, long-term problem and it is a precursor of dune erosion, dune overwash, bluff erosion, failure of shoreline protection structures and destruction of shoreline development.

- Dune Erosion/Scarping: A dune is a hill of sand built by wind-related or man-made processes found in deserts or near lakes and oceans. Dune erosion is caused by wave-attack during a storm or a large swell or by wind action. This process, generally known as scarping, releases sand that was stored in the dune to the active beach or to the zone just landward of the dune. The influx of this dune sand to the active beach is often carried offshore to build temporary sand bars, which help attenuate incoming wave energy and can assist in post storm low profile beach recovery.

- Overwash/Washover: Overwash/washover are terms related to the transport of sediment landward of the active beach, which occurs from coastal flooding during a tsunami, severe wind, or other event with extreme waves. Overwash occurs where the flow of water (from wave and storm surge) over the upper part of the beach profile causes beach sediment, to advance over the crest of the beach, dune or berm and where this beach sediment does not directly return to the generating water body such as ocean, sea, bay or lake after water level fluctuations return to normal. There are two kinds of overwash: overwash by run up and overwash by inundation. Overwash begins when the run up level of waves, usually coinciding with a storm surge, exceeds the local beach or dune crest height. As the water level in the ocean rises such that the beach or dune crest is inundated, a steady sheet of water (called sheetwash) and sediment runs over (overwashes) the barrier. Washover is the sediment deposited inland of a beach by overwash. Washover can be deposited onto the berm crest or as far as the back barrier bay, estuary, or lagoon.

- Bluff Erosion: A bluff is a cliff with a broad face, or a relatively long strip of land rising abruptly above surrounding land or water. Typically, it rises at least 25 feet above the water body at an average slope of 30 percent or greater. Bluff erosion is the erosion of these cliffsides or broad faces as a result of high waves, wind, groundwater or surface runoff and can lead to significant loss of land to the sea. Bluff erosion takes place from the top of the bluff down to the sea. Several processes can lead to erosion on bluffs. Groundwater can leak out the face of a bluff to create wet areas that wash sediments down the bluff face. Surface water may flow directly over the face of a bluff or down a gully on a bluff and carry soil and sediment to the sea. Seasonal freeze-thaw cycles can loosen sediment in a bluff that slumps downhill in the spring. At the base of the bluff, high tides, coastal flooding and wave action can scour the bluff toe to remove sediment and undercut the slope. Over steepened slopes can move downward under the pull of gravity. Coastal bluffs can be affected by all of these processes to some extent. The rate of bluff erosion may vary from one location to the next. Over time, erosion is often episodic with significant land loss one year and less the next. Bluff erosion leads to net land loss and the landward migration of the shoreline as well as the top of the bluff. Actively eroding bluffs are unstable and potentially unsafe for development near the bluff top.[8]

Figure 7-1. Shoalwater Bay Indian Reservation

7.2.1 Past Events

Washaway Beach, Cape Shoalwater, at the north side of the mouth of Willapa Bay (one of the largest inlets on the coast of the continental United States) is the most rapidly eroding beach on the United States[9]. The Cape has been eroding an average of 100 feet per year for the last century. Between 1890 and 1965, the cape eroded 12,303 feet (3750 meters) at about 124 feet per year (37 meters). At one point, Cape Shoalwater provided protection to the shallow North Cove area of the Shoalwater Bay Reservation on the landward side from the full onslaught of winter storms and waves.

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.

[8] USACE 2009

[9] American Society of Civil Engineers http://ascelibrary.org/doi/abs/10.1061/40926%28239%29101

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.

The Shoalwater Reservation has had a history of flooding and storm damage which has further exacerbated the coastal erosion. On March 3, 1999, a combined storm and high tide caused severe flooding of the Shoalwater Reservation shoreline and surrounding community. The Reservation also experienced severe flooding and debris damage from winter storms in February 2006 and December 2007. The flooding is believed to be a direct result of the erosion and breaching of the barrier dune on Empire Spit that fronts the Tokeland Peninsula. With continued coastal erosion, the limited wave protection currently afforded by the eroded barrier dune will continue to decrease, and flooding of the Shoalwater Reservation and adjoining lands will occur at increasingly frequent intervals.

7.2.2 Location

Erosion can impact beaches, dunes, bluffs, barriers, bays, cliffsides, wetlands, marshes, parks, and other natural landforms and can lead to destructive forces upon nearby manmade structures. One of the major impacts of erosion processes is the permanent breaching or creation of inlets along barrier beaches and islands. Impacts associated with new inlets could include (1) increased flooding and erosion on the mainland shoreline due to increased water levels and wave action in the bays, (2) changes in shoaling patterns, water circulation, temperature and salinity that could significantly alter existing bay ecosystems, and (3) disruption of the longshore transport of sand along the ocean shoreline that would result in increased downdrift erosion. It has been noted that stabilized inlets do provide benefits for recreational and commercial navigation.

Willapa Bay is one of the largest inlets on the coast of the continental United States[10]. At the mean maximum tidal flow of 2.5 knots, the primary Willapa channel closest to the Shoalwater Reservation transports about 400,000 cubic feet per second, or about twice the average annual discharge rate of the Columbia River at The Dalles (Richey et al., 1966). Figure 7-2[11] illustrates the topography and potential area flooded by coastal erosion within the planning region.

The sand spits and barrier islands just offshore of the Shoalwater Bay Reservation are the areas being affected by Coastal Erosion.

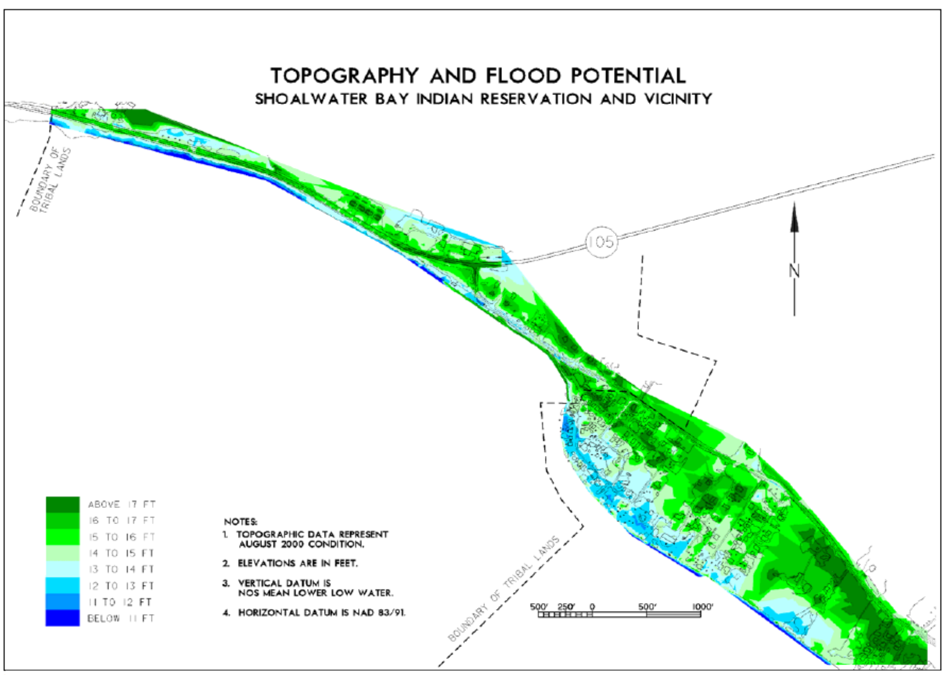


Figure 7-2. Topography and flood potential of the Shoalwater Reservation and Vicinity from Coastal Erosion

[10] The spring diurnal range tidal prism of Willapa Bay is more than 10 billion cubic feet (Jarrett 1976).
[11] USACE 2009

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.

The massive tidal flow at the bay's entrance, combined with energetic waves, historically created one of most actively eroding coasts in the United States. The northern shoreline of Willapa Bay drastically changed since the Shoalwater Reservation was established in 1866 (Terich and Levensellar, 1986). Over the last century, portions of the Cape Shoalwater shoreline have retreated more than three miles. According to a 2009 UASCE Environmental Assessment Report, by the 1990's, the Shoalwater Reservation's only remaining protection from storm wave attack was a barrier dune that is located on Empire Spit and the islands fronting the Tokeland Peninsula. At that time, tidal currents and storm waves associated with coastal storms continued to erode the dune, which consequently exposed the Tokeland Peninsula shoreline to increasing levels of flooding from wave overtopping during periods of high tides.

7.2.3 Effects of Human Activities

Human intervention is another contributing factor to erosion-related problems. Even though natural events play a major role in the erosion process, human actions can intensify or exacerbate the effects of these processes speeding the erosion process through poor land use methods, dredging operations, vegetation removal, construction of shoreline structures (for example, homes, boardwalks, piers, recreational structures), and misguided erosion control efforts. The desire to live along coast lines is a significant factor in increased coastal growth. As a result, there has been a coastal building boom of all types of structures, which can increase the potential for coastal erosion by disturbing the natural coastline and also increases the inventory exposed to the coastal erosion hazard.

Humans contribute to the erosion process by removing vegetation which then allows wind and precipitation to directly erode the soil, directing runoff from streets, parking lots, roofs, and other locations (e.g., over a bluff and causing erosion). Humans also alter the coastline by constructing "hardened" structures on the shore, which blocks littoral processes and can reflect wave energy onto adjacent shoreline areas or cause deepening of the near shore area. Many development activities damage or alter natural protective features and the protection that these features afford the upland area from erosion and storm damage. These problems are contributed by:

- Building without considering the potential for damage to property,
- Activities which destroy natural protective features such as dunes or bluffs, and their vegetation are undertaken,
- Building structures intended for erosion prevention actually serve to exacerbate erosion conditions on adjacent or nearby properties, and
- Wakes from boats producing erosive action on the shoreline

Engineered structures can halt, retard, mitigate or accelerate shoreline erosion. Erosion and accretion of beaches, inlet opening and closing, alterations in bay environments, bluff slumping, dune loss, wetland loss and other changes to coastal environments have been occurring naturally on a routine basis since the glacial retreat. These events, whether occurring incrementally or in a single storm event, are part of a natural system. The placement of hard structures (e.g., groins, jetties, bulkheads, revetments, seawalls) or soft structures (e.g., beach nourishment, vegetation, beach scraping, dune building) on dynamic landforms and in flood plains adjacent to coastal waters may not always comply with the dynamic nature of the landform to produce the desired results of erosion control. Through human intervention of these natural coastal processes, coastal erosion in some areas has been mitigated, as is the case on the Shoalwater Reservation (discussed below).

7.2.4 Frequency

As indicated in the FEMA Multi-Hazard Identification and Risk Assessment Report, coastal erosion is measured as the rate of change in the position or horizontal displacement of a shoreline over a specific period of record, measured in units of feet or meters per year. Erosion rates vary as a function of shoreline type and are influenced primarily by episodic events. Monitoring of shoreline change based on a relatively short period of record does not always reflect actual conditions and can misrepresent long term erosion rates. Shorelines that are accreting, stable or experiencing mild rates of erosion over a long-term period are generally considered as not subject to erosion hazard. However, short-term and daily erosion can expose a segment of coast to an episodic storm event and associated erosion damages at any given time. Detailed methods of determining return periods and frequencies of occurrence of coastal erosion are very difficult to determine due to limited information and the relatively short period of recorded data in most areas. The long-term patterns of coastal erosion are also difficult to detect because of substantial and rapid changes in coastlines in the short-term (that is, over days or weeks from storms and natural tidal processes). It is usually severe short-term erosion events, occurring either singly or cumulatively over a few years, that cause concern and lead to attempts to influence the natural processes. Analysis of both long- and short-term shoreline changes are required to determine which is more reflective of the potential future shoreline configuration (FEMA, 1997).

Coastal erosion can occur from rapid, short-term daily, seasonal, or annual natural events such as waves, storm surge, wind, coastal storms, and flooding or from human activities including boat wakes and dredging. The most dramatic erosion often occurs during storms, particularly because the highest energy waves are generated under storm conditions (Alaska Division of Homeland Security and Emergency Management, 2007). As presented in an abstract by Keqi Zhang, Bruce Douglas, and Stephen Leatherman, in a few hours or days, scores of meters of beach width can be lost due to a severe storm.

According to the 2009 USACE Environmental Impact Study, coastal erosion within the planning area has occurred for centuries. Figure 7-3 illustrates the coastal changes from 1994-2003[12].

[12] http://www.nws.usace.army.mil/Missions/CivilWorks/ProgramsandProjects/Projects/shoalwater.aspx

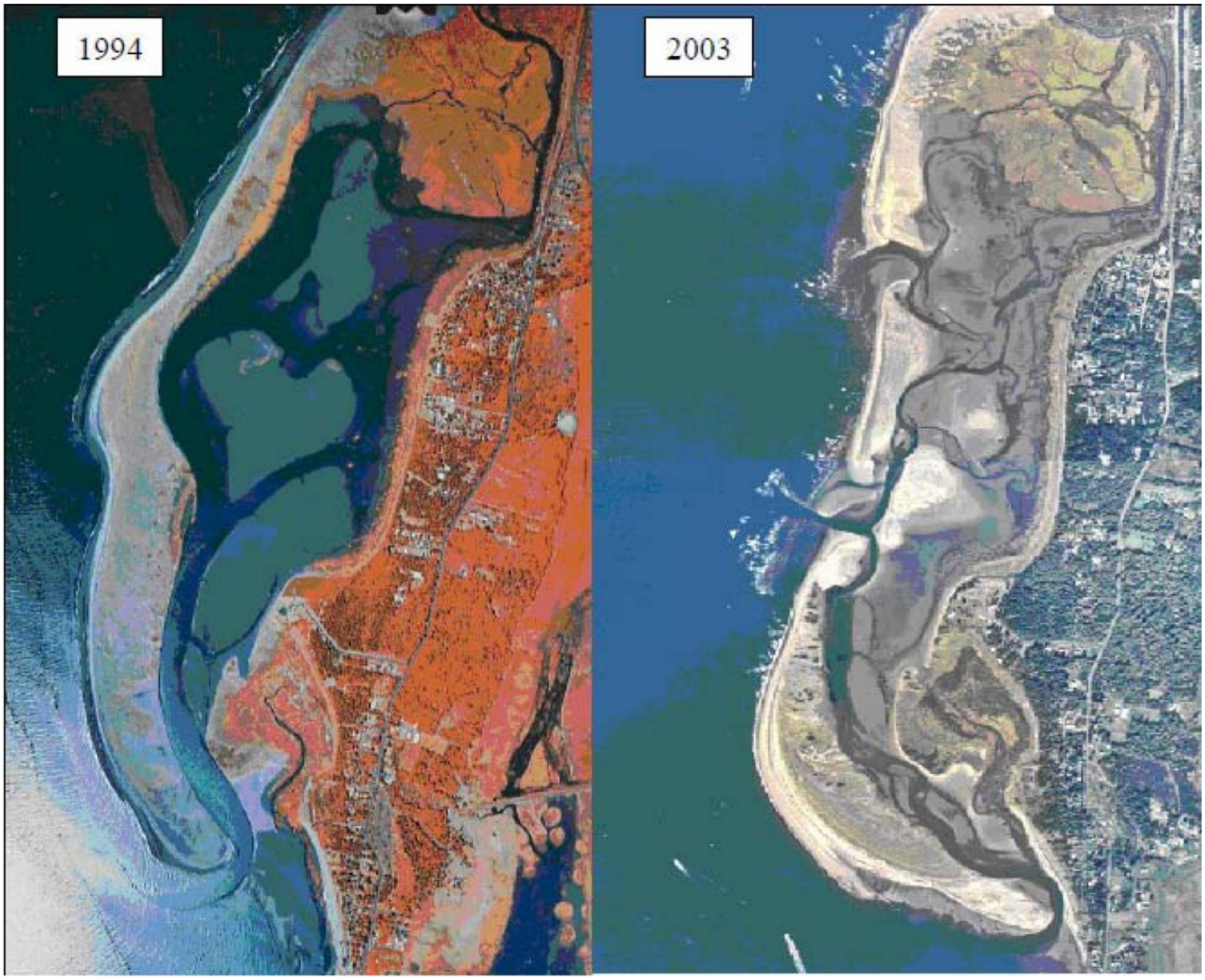


Figure 7-3. Changes in Coastline 1994-2003

Severity

Coastal erosion hazards and the vulnerability of development and infrastructure vary significantly by geographic region in the U.S. There are five distinct coastal regions in the U.S.: the Atlantic and Gulf, Pacific, Great Lakes, Hawaii, and Alaska. The Shoalwater Bay Indian Reservation is within the Pacific region, and has been identified by the American Society of Civil Engineers as one of the areas experiencing "the most severe erosion in the United States".[13]

Comprehensive geologic studies found that the erosion processes along the coastline of the Shoalwater Reservation, driven by the channel migration, has undergone a profound change. Along the coastline of the Shoalwater Reservation, Empire Spit fronts Tokeland Peninsula and helps protect it from direct exposure to waves from the Pacific Ocean. Historically, this barrier island was fed by sand from the eroding beach plain to the northwest. However, a major breach formed through Empire Spit into North Cove in 1995, and a second, smaller breach developed in 2003. These breaches divide Empire Spit into three narrow islands. However, for the majority of the 20th century, Empire Spit was a continuous feature. The breaches allow more waves to enter North Cove during storm surges. The development of these breaches has also resulted in less tidal flow moving through the south channel of North Cove

[13] American Society of Civil Engineers Library http://ascelibrary.org/doi/abs/10.1061/40926%28239%29101

between the Tokeland Peninsula and the south end of Empire Spit (Corps, 2007). Currently water is conveyed through four inlets into North Cove, with the widest channel located between the Empire Spit Islands.

Immense volumes of sand are moved by tidal currents in the vicinity of the Willapa Bar and entrance. Data analyzed from bathymetric surveys collected between 1998 and 2003 indicate that the average annual rate of erosion in the accessible portions of the entrance channel was 23 million cy/yr, while the annual accretion volume exceeded 30 million cy/yr. Data analyzed between 2000 and 2003 indicate that the area immediately seaward of the dune restoration site in the channel was shoaling at a rate of greater than one million cy/yr, while on the south side of the North Channel, sediment was eroding at a rate of over 3.5 million cy/yr (USACE, 2007).

7.2.5 Warning Time

Coastal erosion is a gradual process, so structures threatened by coastal erosion usually 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, but in some instances, due to the severity of the storm, structures may be impacted more suddenly during severe weather events.

7.3 SECONDARY HAZARDS

Coastal Flooding is the secondary hazard most intensified by coastal erosion. However, erosion can also cause landslides and mudslides. Likewise, river valleys may also become vulnerable to slope failure as a result of erosion, often as a result of loss of cohesion in clay-rich soils. Building and road foundations lose load-bearing strength and may collapse as the ground beneath is washed away, Hazardous materials can also be released as a result of structural integrity being compromised, causing significant damage to the environment and people.

7.4 CLIMATE CHANGE IMPACTS

Coastal erosion may be a result of multi-year impacts and long-term climatic change such as sea-level rise, lack of sediment supply, subsidence, or long-term human factors such as the construction of shore protection structures and dams or aquifer depletion. As the sea-level rises, the shoreline is displaced inland, except in those areas where sufficient sediment is accumulating to building the shoreline seaward. In coastal locations where a local shortage of sediment is accompanied by sea-level rise, the problem is compounded and the result is an increased rate of shoreline displacement.

Sea-level rise can lead to the flooding of low-lying coastal areas; extension of flood zone areas inland; loss and/or displacement of coastal wetlands and other types of coastal habitats; accelerated erosion of beaches; dune line recession; saltwater contamination of drinking water; decreased longevity of low-lying roads, causeways, and bridges; displacement of coastal habitats; and decreases in the ability of the natural barrier, bay, and wetland systems to maintain themselves, especially in light of present human shoreline alterations. As sea-level rise continues over the next century, it is expected to contribute significantly to physical changes along open-ocean shorelines. While it is widely believed that changes in sea-level over the last century have had some role in shoreline change and land-loss along the coast, it has been difficult to quantify this relationship. The difficulty is due to the range of processes that affect coastal areas, the frequency at which coastal changes occur.

7.5 EXPOSURE

7.5.1 Population

Population counts for exposure to sea level rise would encompass the entire Reservation, whether from direct impact or secondary impact from loss of services or critical facilities. As indicated within the 2009 USACE study, in addition to portions of the Reservation falling within the 100 year floodplain, there is additional hazard associated with high velocity wave action (FEMA,1985) as it relates to erosion of the barrier dune, which exposes the Shoalwater Reservation uplands, increasing levels of flooding due to storm overwash of the eroded dune and resultant wave run-up and overtopping of the low-lying Tribal uplands (p. 22).

7.5.2 Property

Structures

Table 7-1 summarizes the structures at risk from coastal erosion as determined by the US Army Corps of Engineers.

Exposed Value

FEMA's How-To 386-2 discusses the loss estimation process for hazard mitigation planning. For erosion damage, FEMA states "Unfortunately, current standard loss estimation models and tables for erosion damages are not available. As a result, you may wish to simplify your consideration of structure damage so that buildings are assumed to be either undamaged or severely damaged due to erosion. Although slight or moderate damage can occur due to erosion, the likelihood of this level of damage is considered small. Your estimated structure loss from erosion should be based on past experience, the location of the structure within the hazard area, rate of erosion, and the structure replacement value."

Therefore, the planning team elected to utilize the list of structures previously identified by USACE in Table 7-1 as the base of estimating exposure of buildings in the planning area. Based on that, dollar losses are estimated to be approximately $27,377,508 (building and content).

TABLE 7-1.
AREA AND STRUCTURES IN THE FLOODPLAIN

STRUCTURE NAME	CLASSIFICATION	QUANTITY
Land	Uplands	440 Acres
Marine	Intertidal	700 Acres
Tribal Community Center/ Tribal Police	Tribal Community	1
Tribal Cemetery	Tribal Community	1
Tribal Court	Tribal Community	1
Tribal Education Center & Library	Tribal Community	1
Tribal Wellness Center (Medical/Dental/Mental Health)	Tribal Community	1
Tribal Social and Family Services	Tribal Community	1
Tribal Counseling / Interview Facility	Tribal Community	1
Tribal Cultural Repository Building	Tribal Community	1
Tribal Gymnasium and Assembly Hall	Tribal Community	1
Tribal Emergency & Backup Generators	Tribal Community	4
Tribal Water Storage Tank	Tribal Community	1
Tribal Water Treatment / Pump House	Tribal Community	1
Tribal Storage and Maintenance	Tribal Community	2
Emergency Evacuation Complex (under development)	Tribal Community	1
Tribal Environmental Complex	Tribal Community	1
> Office Buildings		2
> Laboratory Buildings		2
> Storage and Maintenance Building		1
Tribal Casino Complex	Tribal Commercial	1
Tribal Recreational Vehicle Park	Tribal Commercial	1
Tribal Businesses (privately owned and operated)	Tribal Commercial	14
Single Family Residence (includes 6 outside Reservation)	Tribal Residential	36
Duplex Family Residence	Tribal Residential	12
Mobile Home Residence	Tribal Residential	4
State Highway 105	Public / State	-----------
Old Tokeland Road	Public / Pacific County	-----------

7.5.3 Critical Facilities and Infrastructure

All structures on the Reservation as critical, including those identified by UACE in Table 7-1.

7.5.4 Environment

Environmental vulnerability accompanying coastal erosion is associated with the narrowing and lowering of the barrier dune that extends southward on Empire Spit, which is exposing the entire Shoalwater Bay Indian Reservation and the Tokeland Peninsula shoreline to increased potential flooding and landslides due to storm wave run-up and overtopping of the shoreline during periods of extreme high tides. Natural habitats, wildlife and aquatic life are all exposed and risk major impact. Severe weather events and high tides can increase the rate of erosion and redistribute sediment loads.

7.6 VULNERABILITY

7.6.1 Population

Vulnerable populations are the elderly, low income or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Coastal erosion can increase the risk of flooding and landslide activity, which can result in power outages which are life threatening to those dependent on electricity for life support. Isolation is a significant concern, as wave action can undercut roadways, or cause flooding which impacts evacuation.

7.6.2 Property

The Shoalwater Tribe is making significant investments in infrastructure and facilities to better serve the needs of its growing population. Tribal uplands, the area in which development must take place, exists along a narrow band of the shoreline, including State Route 105, which traverses the Reservation. Due to significantly diminished dune protection, the Shoalwater Reservation uplands is vulnerable to shoreline erosion and flooding associated with storm-generated ocean waves due to erosion of the barrier dune, particularly during periods of elevated water conditions. Erosion of the barrier dune also exposes the Shoalwater Reservation uplands to shoreline erosion due to storm overwash of the eroded dune and resultant wave run-up and overtopping of the low-lying Tribal uplands. As of the 2009 USACE report, what had been only nuisance flooding (resulting in approximately one foot of water on roads, parking lots and yards) and deposition of logs and debris, was "predicted to be serious flooding with damage to Tribal facilities and potential for loss of life. With each winter storm, the eroded barrier dune offers diminishing wave protection to North Cove and the Shoalwater Reservation" (USACE, 2009).

Of concern is that any materials that erode will continue to be carried into the inter-tidal area behind the dunes, eventually filling and significantly altering the ecosystem in what remains of the North Cove embayment. Continued narrowing and lowering of the dune will expose the Shoalwater Reservation shoreline to increasing shoreline erosion, thereby increasing the frequency of flooding of uplands due to storm-generated ocean wave overwash during periods of elevated water conditions.

Also at impact are the Tribal cemetery, and a well-documented village site that will be exposed to storm wave attack and flooding. In addition to the safety and flooding issues posed by erosion of the barrier dune, the productive subsistence shellfish growing and harvesting habitat of North Cove, representing 700 acres of the Shoalwater Reservation, is rapidly being lost to in-filling with sand due to storm waves overwashing the eroding barrier dune and depositing sand in the North Cove embayment. The degradation of the North Cove habitat also adversely affects the ability of the cove to support harvest of local native plant species traditionally used by Tribal members for Tribal crafts and for cultural and spiritual uses.

7.6.3 Critical Facilities and Infrastructure

Incapacity and loss of roads are the primary transportation failures resulting from coastal erosion. Secondary hazards resulting from erosion including flooding and landslides, which can cause significant damage, including to power lines, as well as blocking roads with debris, incapacitating transportation, isolating population, and disrupting ingress and egress, impacting the transportation system and the availability of public safety services. Of particular concern are roads providing access to isolated areas and to the elderly, reducing the ability to evacuate the Reservation.

7.7 FUTURE TRENDS IN DEVELOPMENT

All future development has the potential to be affected by coastal erosion storms. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. The Shoalwater Bay Tribe utilizes the International Building Code in an effort to keep its citizens as safe as possible from the impacts of the flooding hazard associated with coastal erosion. The

Tribe is currently in the process of developing its own land use policies, and once completed, those plans will also address the impacts of coastal erosion. With these tools, the Tribe will be well equipped to deal with future growth and the associated impacts of coastal erosion.

The Shoalwater Tribe recognizes that they must comprehensively address the serious and growing issue of loss of their Reservation lands and habitat to coastal erosion due to Pacific Ocean storms. In recent decades, they witnessed considerable coastal erosion, damage, and loss along the Washington coast, particularly in an area to the west of the Shoalwater Reservation known as Cape Shoalwater.

The erosion has taken on a new importance for the Tribe in that the protective sand dunes and storm wave barrier that previously protected the Tribe's reservation lands were eroded, and there is less and less protection with each passing coastal storm event. Protecting their land and heritage is the quest the Tribe initiated in 1999 when they approached Congress and the Corps for assistance. The Tribe's objective has also been to implement long-term solutions, and their 1999 effort was no different. The outcome of that effort was a mitigation project (Figure 7-4[14]) lead by the Tribe and the U.S. Army Corps of Engineers to restore the deteriorating barrier dune system which had previously been protecting the Shoalwater Reservation. While recent studies have demonstrated that the rate of erosion has diminished, the hazard is still of great concern to the Shoalwater Tribe, especially in light of climate change and the resulting sea level rise.

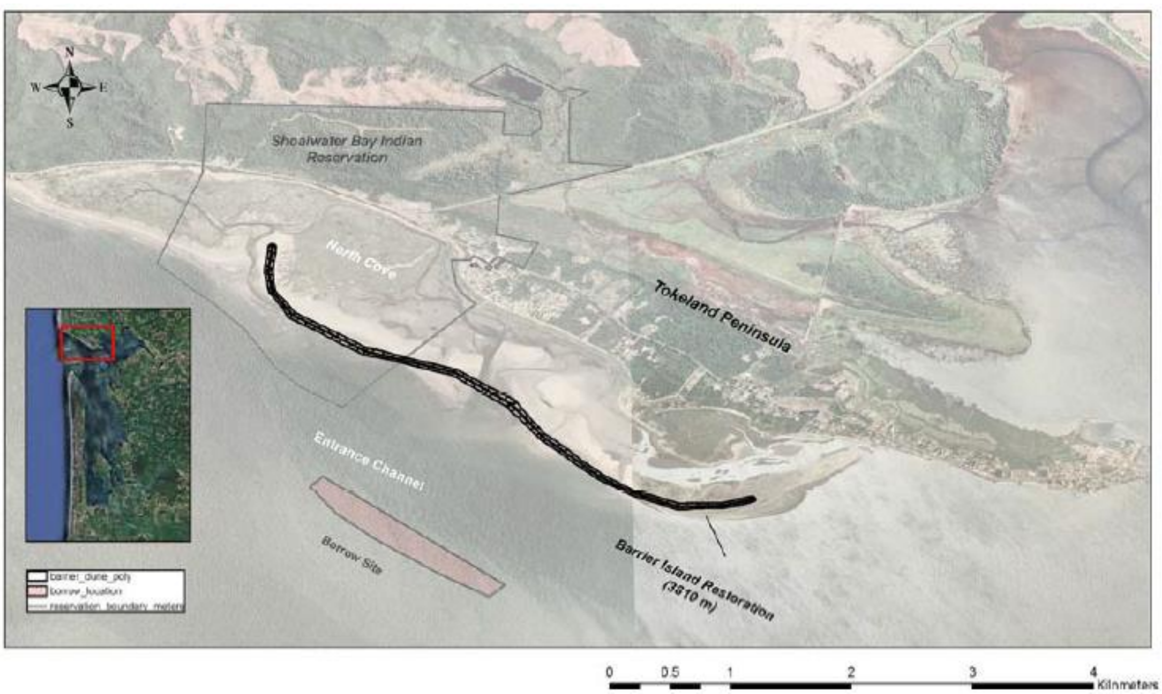


Figure 7-4. Barrier Island Restoration at Willapa Bay, Washington

7.8 SCENARIO

A worst-case event would involve prolonged high winds during a winter storm. Such an event would have both short-term and longer-term effects. Some areas would experience limited ingress and egress as a result of potential flooding due to overwash. Prolonged rain would further increase flooding, overtopping culverts with increased levels of ponded water on roads. Wave action would increase landslides,

[14] USACE, 2009

especially in the Eagle Hills Road area, further increasing the severity associated with the event, especially as it relates to evacuation routes.

7.9 ISSUES

Important issues associated with the potential impacts from coastal erosion in the planning area include the following:

- Climate change and the associated sea level rise increases the area eroded by wave action.
- Older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to the impacts of coastal erosion through increased potential for flooding.
- Redundancy of power supply must be evaluated.
- Isolated population centers.

Chapter 8.
EARTHQUAKE

8.1 GENERAL BACKGROUND

8.1.1 How Earthquakes Happen

An earthquake is the vibration of the earth's surface following a release of energy in the earth's crust. This energy can be generated by a sudden dislocation of the crust or by a volcanic eruption. Most destructive quakes are caused by dislocations of the crust. The crust may first bend and then, when the stress exceeds the strength of the rocks, break and snap to a new position. In the process of breaking, vibrations called "seismic waves" are generated. These waves travel outward from the source of the earthquake at varying speeds.

> **DEFINITIONS**
>
> **Earthquake**—The shaking of the ground caused by an abrupt shift of rock along a fracture in the earth or a contact zone between tectonic plates.
>
> **Epicenter**—The point on the earth's surface directly above the hypocenter of an earthquake. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth.
>
> **Fault**—A fracture in the earth's crust along which two blocks of the crust have slipped with respect to each other.
>
> **Focal Depth**—The depth from the earth's surface to the hypocenter.
>
> **Hypocenter**—The region underground where an earthquake's energy originates
>
> **Liquefaction**—Loosely packed, water-logged sediments losing their strength in response to strong shaking, causing major damage during earthquakes.

Earthquakes tend to reoccur along faults, which are zones of weakness in the crust. Even if a fault zone has recently experienced an earthquake, there is no guarantee that all the stress has been relieved. Another earthquake could still occur.

Geologists classify faults by their relative hazards. Active faults, which represent the highest hazard, are those that have ruptured to the ground surface during the Holocene period (about the last 11,000 years). Potentially active faults are those that displaced layers of rock from the Quaternary period (the last 1,800,000 years). Determining if a fault is "active" or "potentially active" depends on geologic evidence, which may not be available for every fault. Although there are probably still some unrecognized active faults, nearly all the movement between the two plates, and therefore the majority of the seismic hazards, are on the well-known active faults.

Faults are more likely to have earthquakes on them if they have more rapid rates of movement, have had recent earthquakes along them, experience greater total displacements, and are aligned so that movement can relieve accumulating tectonic stresses. A direct relationship exists between a fault's length and location and its ability to generate damaging ground motion at a given site. In some areas, smaller, local faults produce lower magnitude quakes, but ground shaking can be strong, and damage can be significant as a result of the fault's proximity to the area. In contrast, large regional faults can generate great magnitudes but, because of their distance and depth, may result in only moderate shaking in the area.

It is generally agreed that three source zones exist for Pacific Northwest quakes: a shallow (crustal) zone; the Cascadia Subduction Zone; and a deep, intraplate "Benioff" zone. These are shown in Figure 8-1. More than 90 percent of Pacific Northwest earthquakes occur along the boundary between the Juan de Fuca plate and the North American plate. Scientists agree that the Cascadia Subduction Zone earthquake is the type of earthquake most likely to cause damage on the Shoalwater Bay Indian Reservation, although all three types of earthquakes are possible within the planning region.

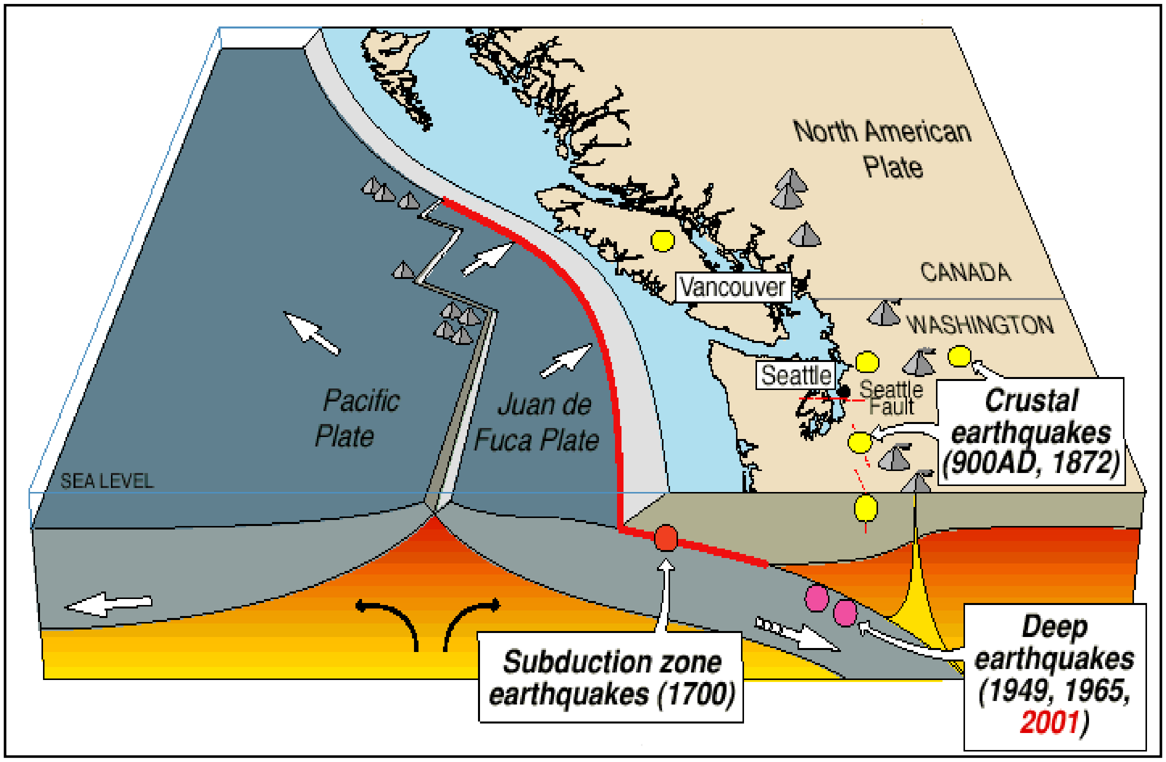


Figure 8-1. Earthquake Types in the Pacific Northwest

Cascadia Subduction Zone:

This zone is the megathrust area that forms the collisional plate boundary between the subducting Explorer, Juan de Fuca, and Gorda Plates and the overriding North America Plate. The Cascadia subduction zone extends from offshore northern California to northern Vancouver Island. Subduction is driven by westward migration of the North America Plate and eastward migration of the Explorer, Juan de Fuca, and Gorda Plates due to spreading of the Gorda-Juan de Fuca-Explorer Ridge System. The latter three plates are the remnants of the Farallon Plate, which originally underlay much of the eastern Pacific and has been converging with the North America Plate since at least the Jurassic (Atwater, 1970 #1199; Duncan and Kulm, 1989 #4242).

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) Earthquake 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, 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 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 Earthquake Zone

The third source zone, known as shallow earthquakes, is the crust of the North American plate. 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 8-2 identifies additional faults in the area of the Reservation.

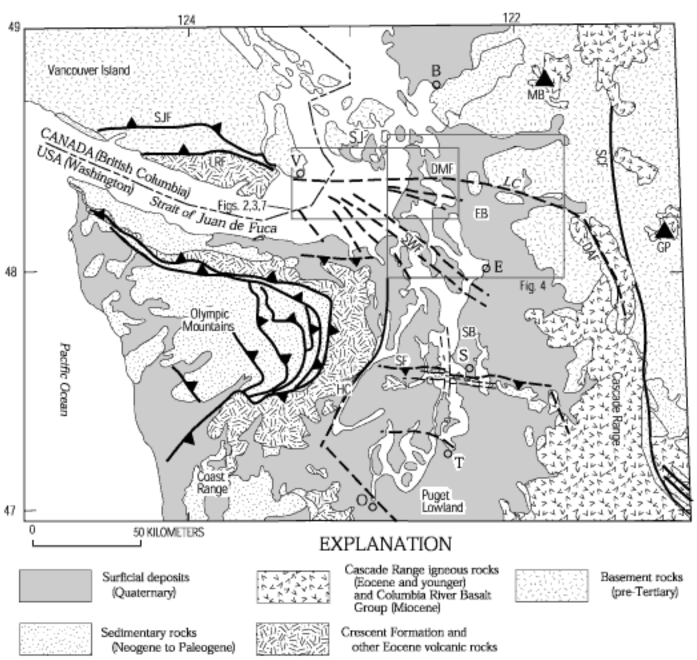


Figure 8-2. Faults near Shoalwater Bay Reservation

8.1.2 Earthquake Classifications

Earthquakes are typically classified in one of two ways: By the amount of energy released, measured as magnitude; or by the impact on people and structures, measured as intensity.

Magnitude

Currently the most commonly used magnitude scale is the moment magnitude (M_W) scale, with the classifications of magnitude:

- Great—$M_W \geq 8$
- Major—M_W = 7.0—7.9
- Strong—M_W = 6.0—6.9
- Moderate—M_W = 5.0—5.9
- Light—M_W = 4.0—4.9
- Minor—M_W = 3.0—3.9
- Very minor —M_W = 2.0—2.9
- Micro—$M_W < 3$

Estimates of moment magnitude roughly match the local magnitude scale (ML) commonly called the Richter scale. One advantage of the moment magnitude scale is that, unlike other magnitude scales, it does not saturate at the upper end. That is, there is no value beyond which all large earthquakes have about the same magnitude. For this reason, moment magnitude is now the most often used estimate of large earthquake magnitudes.

Intensity

Currently the most commonly used intensity scale is the modified Mercalli intensity scale, with ratings defined as follows (USGS, 1989):

TABLE 8-1.
EARTHQUAKE MAGNITUDE AND INTENSITY

Magnitude (Mw)	Intensity (Modified Mercalli Scale)	Description
1.0-3.0	I	I Not felt except by a very few under especially favorable conditions
3.0-3.9	II-III	II. Felt only by a few persons at rest, especially on upper floors of buildings. III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it is an earthquake. Standing cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
4.0-4.9	IV-V	IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like a heavy truck striking building. Standing cars rocked noticeably. V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
5.0-5.9	VI-VII	VI. Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. VII. Damage negligible in buildings of good design and construction; slight in well-built ordinary structures; considerable in poorly built or badly designed structures.

TABLE 8-1.
EARTHQUAKE MAGNITUDE AND INTENSITY

Magnitude (Mw)	Intensity (Modified Mercalli Scale)	Description
		Some chimneys broken.
6.0-6.9	VII-IX	VIII. Damage slight in specially designed structures; considerable damage in ordinary buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
7.0 and higher	VIII and higher	X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly. XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

8.1.3 Ground Motion

Earthquake hazard assessment is also based on expected ground motion. This involves determining the annual probability that certain ground motion accelerations will be exceeded, then summing the annual probabilities 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 soil or rock type. Instruments called accelerographs record levels of ground motion due to earthquakes at stations throughout a region. These readings are recorded by state and federal agencies that monitor and predict seismic activity.

Maps of PGA values form the basis of seismic zone maps that are included in building codes such as the International Building Code. 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" (e.g. single-family dwellings). Longer period response components determine the lateral forces that damage larger structures with longer natural periods (apartment buildings, factories, high-rises, bridges). Table 8-2 lists damage potential and perceived shaking by PGA factors, compared to the Mercalli scale.

8.1.4 Effect of Soil Types

The impact of an earthquake on structures and infrastructure is largely a function of ground shaking, distance from the source of the quake, and liquefaction, a secondary effect of an earthquake in which soils lose their shear strength and flow or behave as liquid, thereby damaging structures that derive their support from the soil. Liquefaction generally occurs in soft, unconsolidated sedimentary soils. A program called the National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics to help identify locations subject to liquefaction. Table 8-3 summarizes NEHRP soil classifications. NEHRP Soils B and C typically can sustain ground shaking without much effect, dependent on the earthquake magnitude. The areas that are commonly most affected by ground shaking have NEHRP Soils D, E and F. In general, these areas are also most susceptible to liquefaction.

TABLE 8-2.
MERCALLI SCALE AND PEAK GROUND ACCELERATION COMPARISON

Modified Mercalli Scale	Perceived Shaking	Potential Structure Damage: Resistant Buildings	Potential Structure Damage: Vulnerable Buildings	Estimated PGA[a] (%g)
I	Not Felt	None	None	<0.17%
II-III	Weak	None	None	0.17%—1.4%
IV	Light	None	None	1.4%—3.9%
V	Moderate	Very Light	Light	3.9%—9.2%
VI	Strong	Light	Moderate	9.2%—18%
VII	Very Strong	Moderate	Moderate/Heavy	18%—34%
VIII	Severe	Moderate/Heavy	Heavy	34%—65%
IX	Violent	Heavy	Very Heavy	65%—124%
X—XII	Extreme	Very Heavy	Very Heavy	>124%

a. PGA measured in percent of g, where g is the acceleration of gravity
Sources: USGS, 2008; USGS, 2010

TABLE 8-3.
NEHRP SOIL CLASSIFICATION SYSTEM

NEHRP Soil Type	Description	Mean Shear Velocity to 30 m (m/s)
A	Hard Rock	1,500
B	Firm to Hard Rock	760-1,500
C	Dense Soil/Soft Rock	360-760
D	Stiff Soil	180-360
E	Soft Clays	< 180
F	Special Study Soils (liquefiable soils, sensitive clays, organic soils, soft clays >36 m thick)	

8.1.5 Fault Classification

The U.S. Geologic Survey defines four fault classes based on demonstrable evidence of tectonic movement associated with large-magnitude earthquakes during the Quaternary period, which is the period from about 1.6 million years ago to the present:

- Class A—Geologic evidence demonstrates the existence of a Quaternary fault of tectonic origin, whether the fault is exposed by mapping or inferred from liquefaction or other deformational features.
- Class B—Geologic evidence demonstrates the existence of Quaternary deformation, but either (1) the fault might not extend deeply enough to be a potential source of significant

earthquakes, or (2) the currently available geologic evidence is too strong to confidently assign the feature to Class C but not strong enough to assign it to Class A.

- Class C—Geologic evidence is insufficient to demonstrate (1) the existence of tectonic faulting, or (2) Quaternary slip or deformation associated with the feature.
- Class D—Geologic evidence demonstrates that the feature is not a tectonic fault or feature; this category includes features such as joints, landslides, erosional or fluvial scarps, or other landforms resembling fault scarps but of demonstrable non-tectonic origin.

8.2 HAZARD PROFILE

8.2.1 Past Events

Table 8-4 lists seismic events with a magnitude of 5.0 or larger that were felt within the planning area.

TABLE 8-4.
HISTORICAL EARTHQUAKES IMPACTING THE PLANNING AREA

Year	Magnitude	Epicenter	Type
2/28/2001	6.8	Olympia (Nisqually)	Benioff
6/10/2001	5.0	Matlock	Benioff
7/3/1999	5.8	8.0 km N of Satsop	Benioff
6/23/1997	4.7	Bremerton	Shallow Crustal
5/3/1996	5.5	Duvall	Shallow Crustal
1/29/1995	5.1	Seattle-Tacoma	Shallow Crustal
2/14/1981	5.5	Mt. St. Helens (Ash)	Crustal
4/29/1965	6.6	18.3 KM N of Tacoma (Sea Tac)	Benioff
1/13/1949	7.0	12.3 KM ENE of Olympia	Benioff
6/23/1946	7.3	Strait of Georgia	Benioff

There have been numerous earthquakes experienced in the Willapa Bay area for hundreds of generations of people. The list above is by no means exhaustive, as many more earthquakes have occurred within the region. One of the most significant, however, is the 1700 Cascadia Subduction Earthquake, which is the basis on which much of the predictions for future Cascadia-type earthquake events is made.

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.

The Pacific Northwest Seismic Network[15] published a compilation of past earthquake events in Southwest Washington that was produced by Pacific County Historical Society and Museum "Columbia River

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

Chronology Historical Dates" www.pacificcohistory.org/columbia.htm Additional information on historical events is available within that document.

8.2.2 Faults

Several faults are identified by the USGS[16] within the planning area, although the list is not inclusive of every known fault. Those Class A faults are listed in Table 8-5:

TABLE 8-5.
USGS IDENTIFIED FAULTS IN PACIFIC COUNTY

NUMBER	NAME	CLASS
588	SADDLE HILL FAULT ZONE	A
589	GRAYS HARBOR FAULT ZONE	A
590	UNNAMED FAULT SET OFFSHORE OF MOUTH OF WILLAPA BAY	A
591	UNNAMED FAULT ZONE OFFSHORE OF CAPE SHOALWATER	A
592	WILLAPA BAY FAULT ZONE	A
593	UNNAMED OFFSHORE FAULT SET NEAR GRAYS CANYON	A
595	SOUTH NINITAT FAULT ZONE	A
781	CASCADIA SUBDUCTION ZONE	A
788	FAULT J	A

Additional information regarding the faults identified in Table 8.5 above is available at: http://geohazards.usgs.gov/cfusion/qfault/qf_web_search_res.cfm

8.2.3 Location

Identifying the extent and location of an earthquake is not as simple as it is for other hazards such as flood, landslide or wildfire. The impact of an earthquake is largely a function of the following components:

- Ground shaking (ground motion accelerations)
- Liquefaction (soil instability)
- Distance from the source (both horizontally and vertically).

[16] http://earthquake.usgs.gov/hazards/qfaults/wa/cpd.html

Mapping that shows the impacts of some of these components was used to assess the risk of earthquakes within the planning area. While the impacts from each of these components can build upon each other during an earthquake event, the mapping looks at each component individually. The mapping used in this assessment is described below.

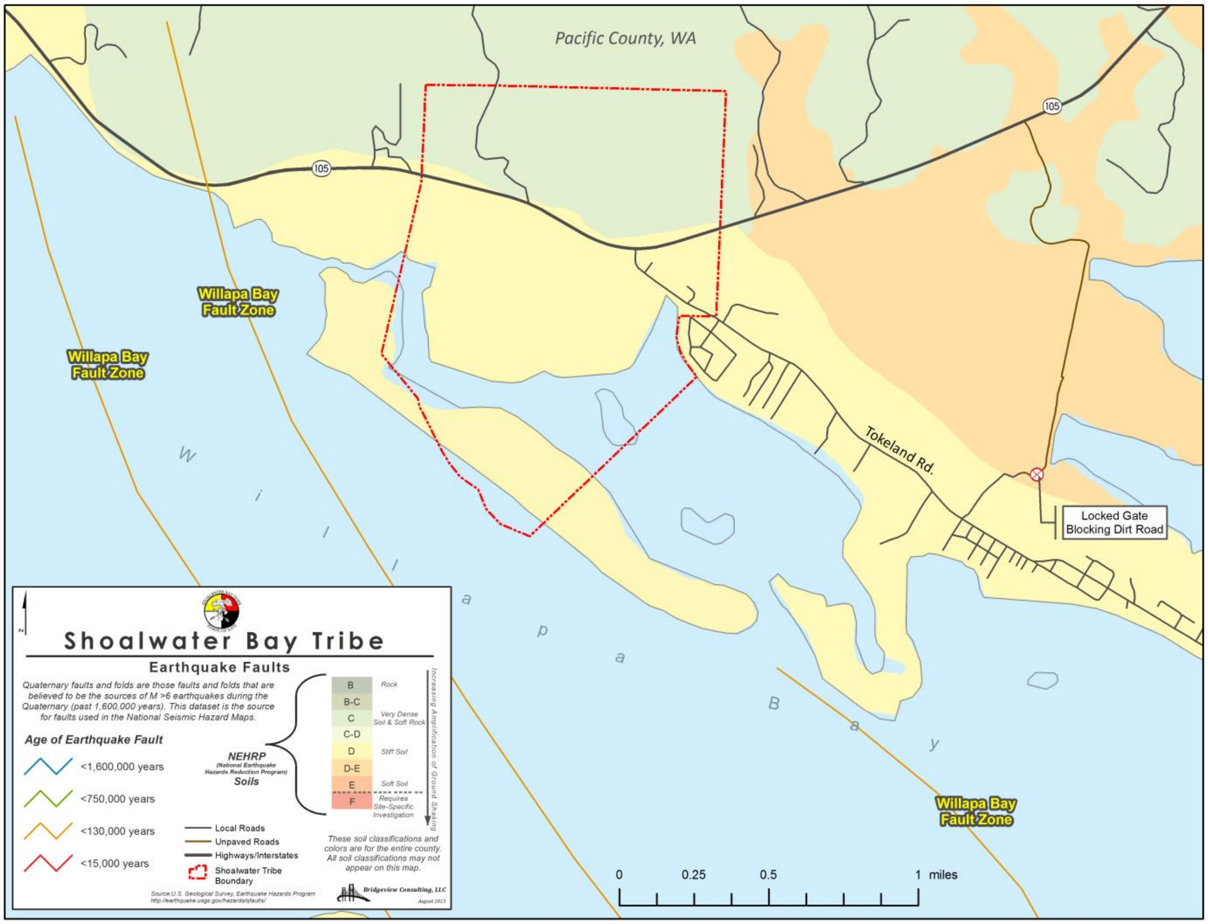


Figure 8-3. Earthquake Faults on the Shoalwater Reservation

Shake Maps

A shake map is a representation of ground shaking produced by an earthquake. The information it presents is different from the earthquake magnitude and epicenter that are released after an earthquake because shake maps focus on the ground shaking resulting from the earthquake, rather than the parameters describing the earthquake source. An earthquake has only one magnitude and one epicenter, but it produces a range of ground shaking at sites throughout the region, depending on the distance from the earthquake, the rock and soil conditions at sites, and variations in the propagation of seismic waves from the earthquake due to complexities in the structure of the earth's crust. A shake map shows the extent and variation of ground shaking in a region immediately following significant earthquakes.

Ground motion and intensity maps are derived from peak ground motion amplitudes recorded on seismic sensors (accelerometers), with interpolation based on estimated amplitudes where data are lacking, and site amplification corrections. Color-coded instrumental intensity maps are derived from empirical relations between peak ground motions and Modified Mercalli intensity. Two types of earthquake scenarios are typically generated from the data:

- A *probabilistic seismic hazard map* shows the hazard from earthquakes that geologists and seismologists agree could occur. The maps are expressed in terms of probability of exceeding a certain ground motion, such as that demonstrated in Figure 8-4, which demonstrates the 2-percent probability of exceedance in 50 years (further discussed in the Severity section of the profile). This level of ground shaking has been used for designing buildings in high seismic areas. Figure 8-5 shows the estimated ground motion on the Reservation for the 100-year probabilistic earthquake; Figure 8-6 shows results for the 500-year earthquake.
- *Earthquake scenario maps* describe the expected ground motions and effects of hypothetical large earthquakes for a region. Maps of these scenarios can be used to support all phases of emergency management. One scenario was chosen for this plan:
  - 2011 Cascadia Scenario—A Magnitude 9.0 event with an epicenter off the coast of Oregon, 60 miles west/northwest of Tillamook. See Figure 8-7.

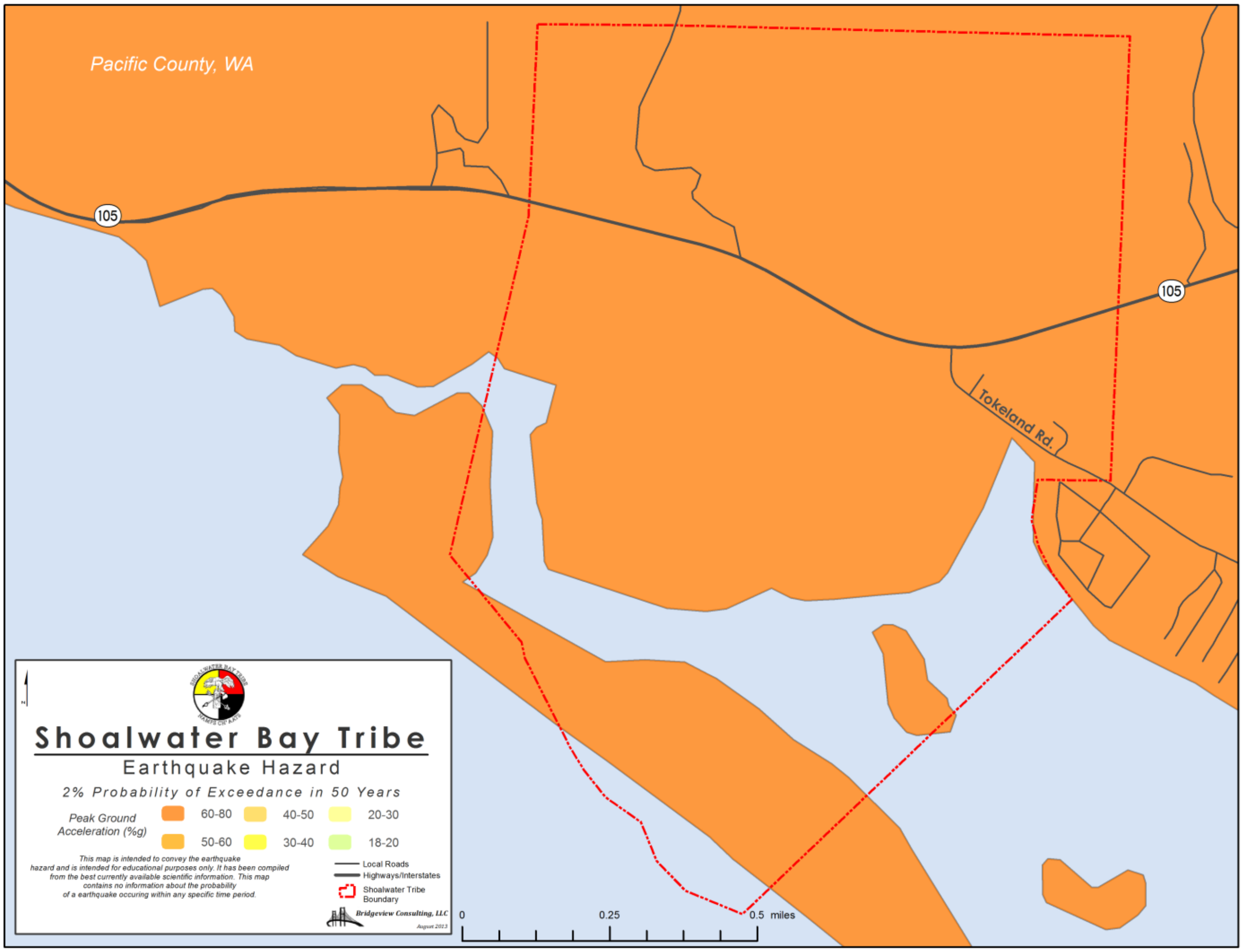


Figure 8-4. 2% Chance of Exceedance in 50 years on the Shoalwater Reservation

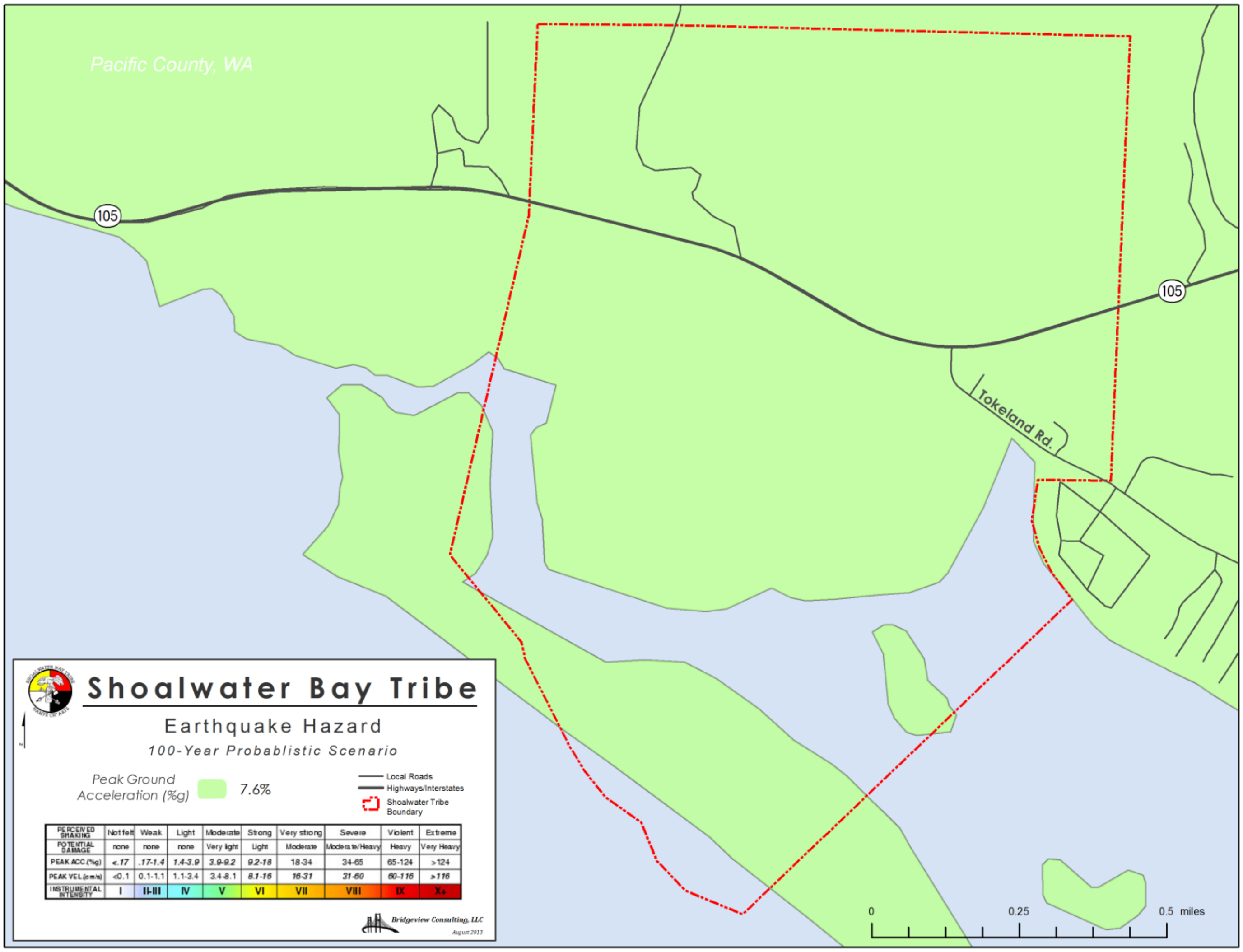


Figure 8-5. 100 Year Probabilistic Ground Motion Map for the Shoalwater Reservation

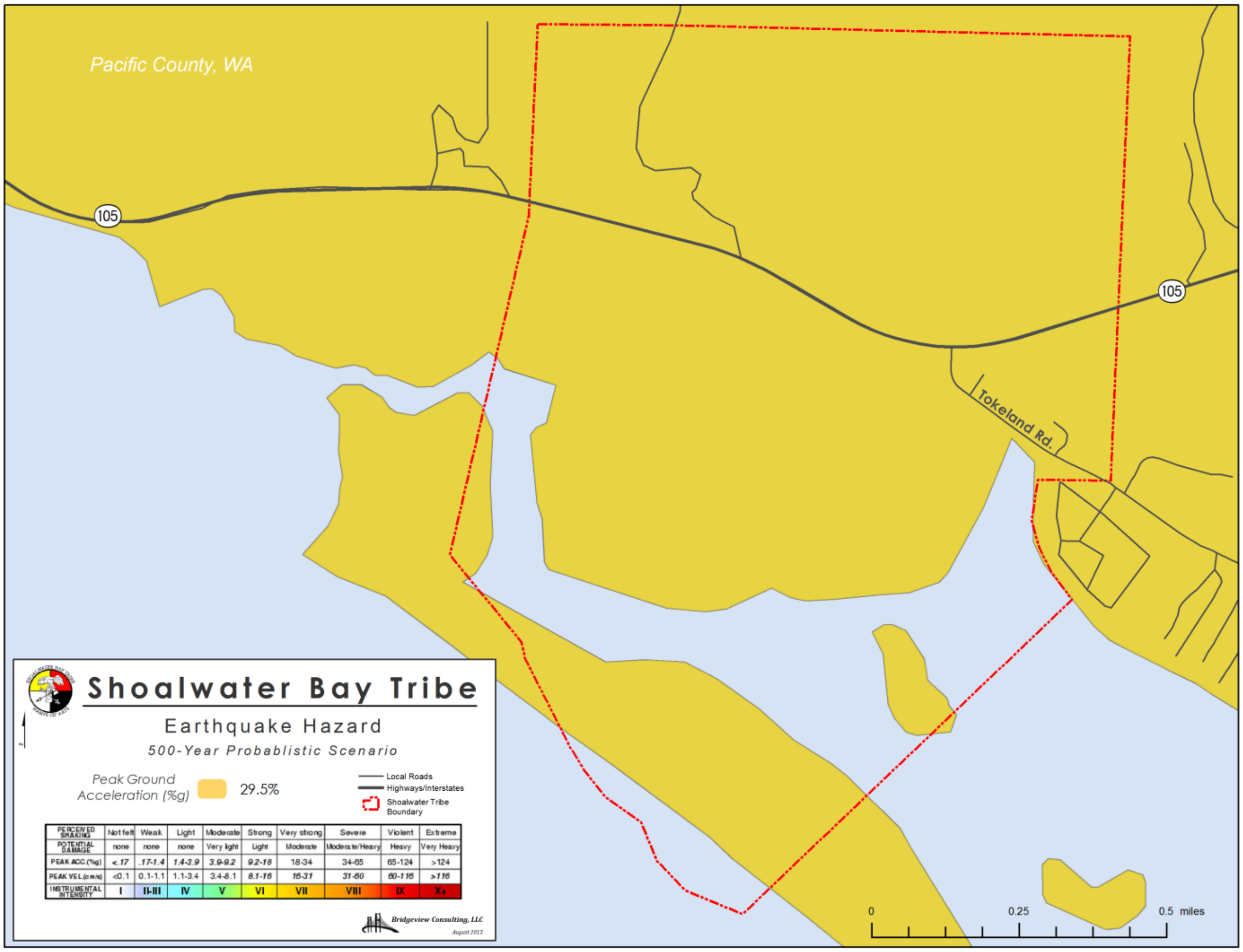
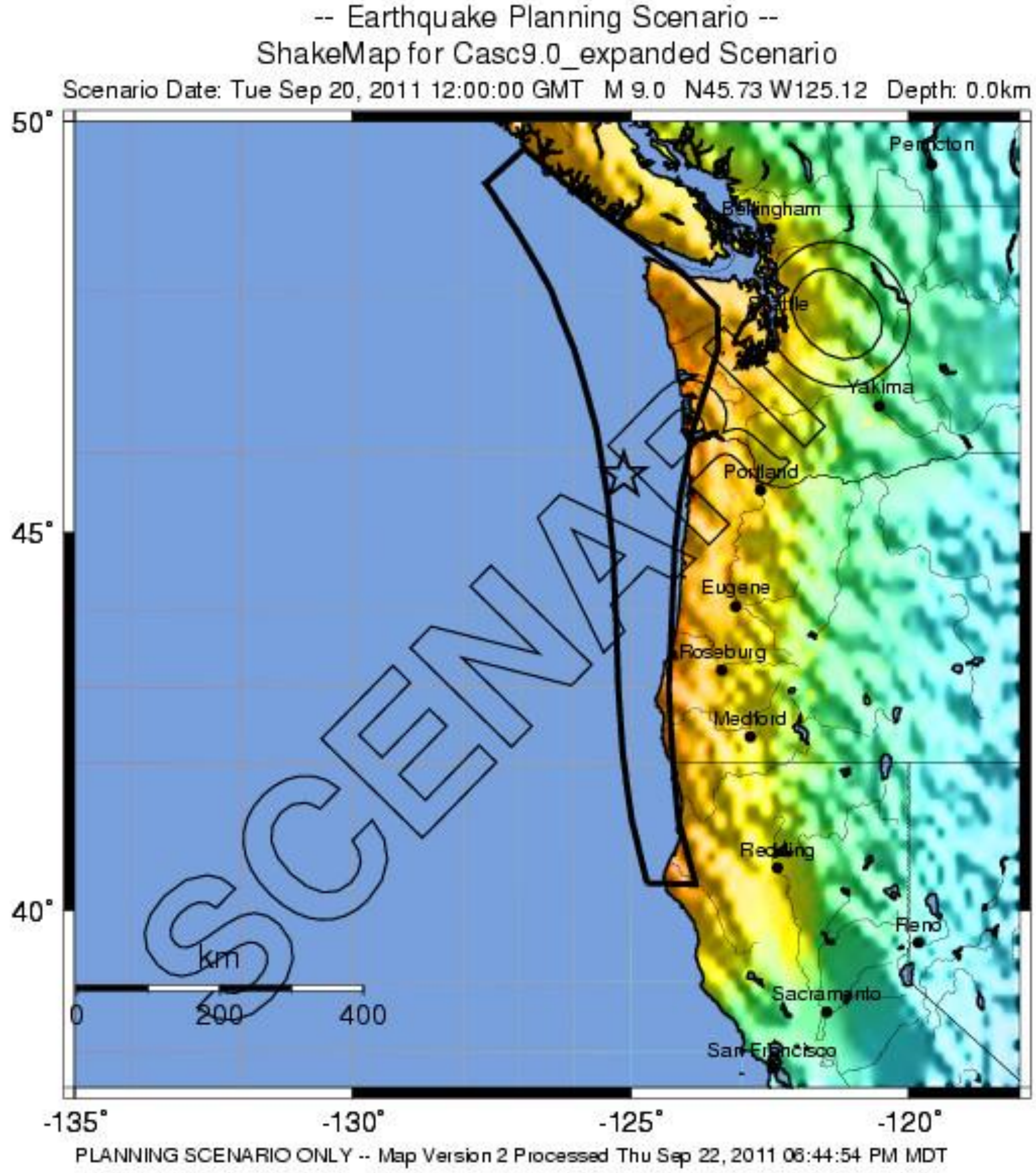


Figure 8-6. 500 Year Probabilistic Ground Motion Map for the Shoalwater Reservation



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Figure 8-7. Cascadia 9.0M Scenario Event Ground Motion for the Shoalwater Bay Reservation

NEHRP Soil Maps

NEHRP soil types define the locations that will be significantly impacted by an earthquake. NEHRP Soils B and C typically can sustain low-magnitude ground shaking without much effect. The areas that are most commonly affected by ground shaking have NEHRP Soils D, E and F. Figure 8-8 shows NEHRP soil classifications for the Shoalwater Reservation.

Liquefaction Maps

Soil liquefaction maps are useful tools to assess potential damage from earthquakes. When the ground liquefies, sandy or silty materials saturated with water behave like a liquid, causing pipes to leak, roads and airport runways to buckle, and building foundations to be damaged. In general, areas with NEHRP Soils D, E and F are also susceptible to liquefaction. If there is a dry soil crust, excess water will sometimes come to the surface through cracks in the confining layer, bringing liquefied sand with it, creating sand boils. Figure 8-9 and Figure 8-10 shows the liquefaction susceptibility for the Shoalwater Bay Tribe, both on the reservation and structures owned by the Tribe that are off the reservation boundary.

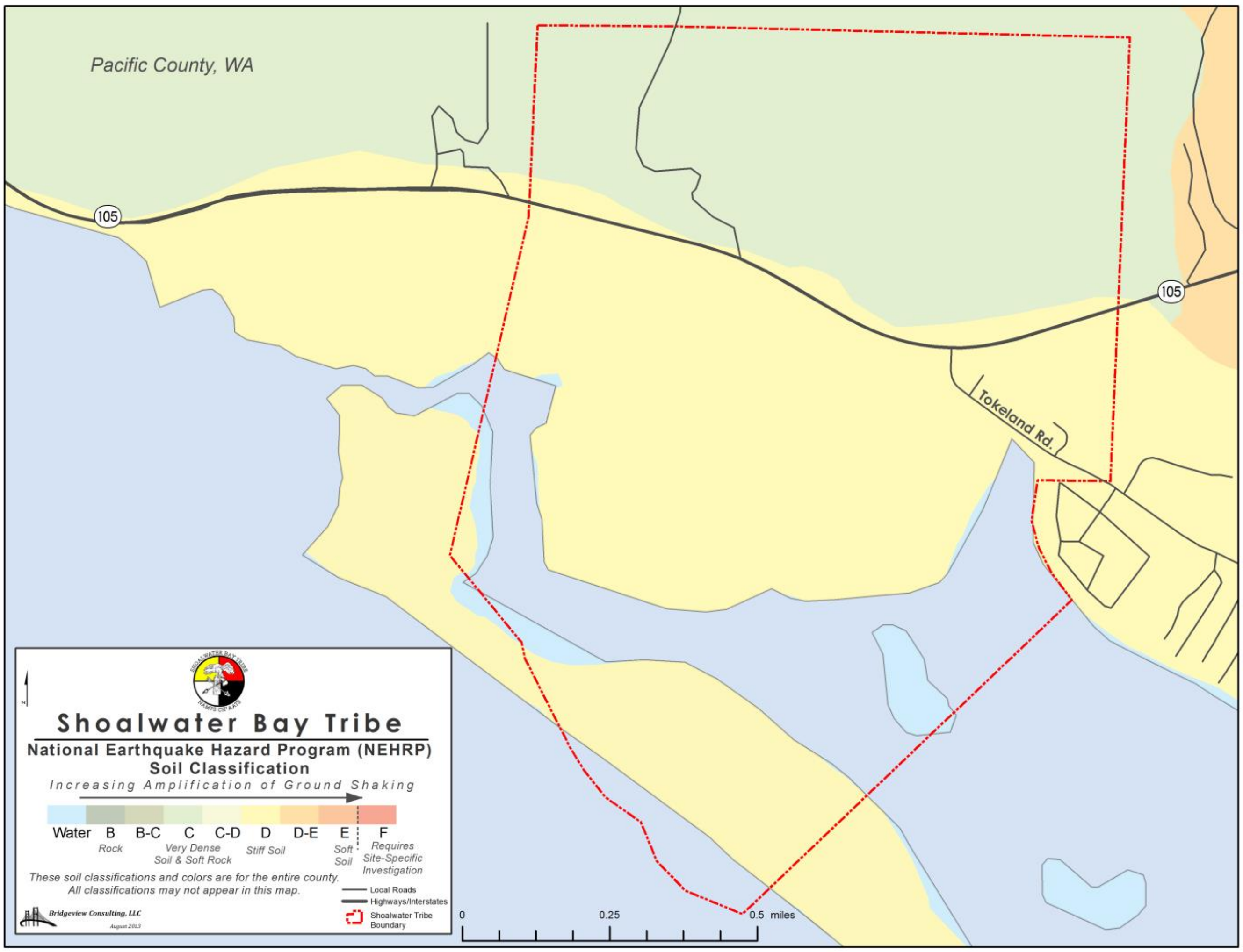


Figure 8-8. NEHRP Soil Classifications for the Shoalwater Bay Reservation

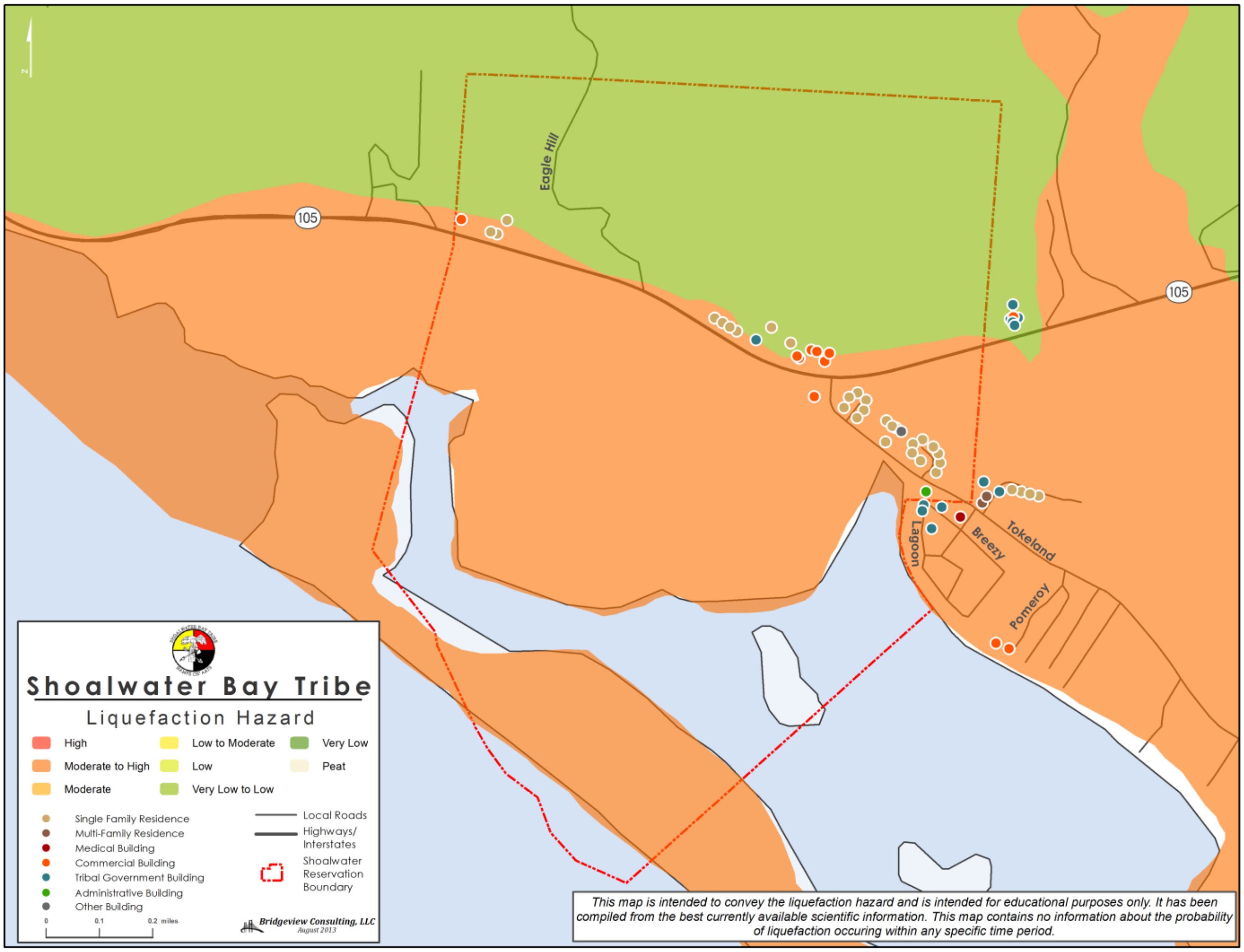


Figure 8-9. Liquefaction Hazard on Shoalwater Reservation (on-Reservation)

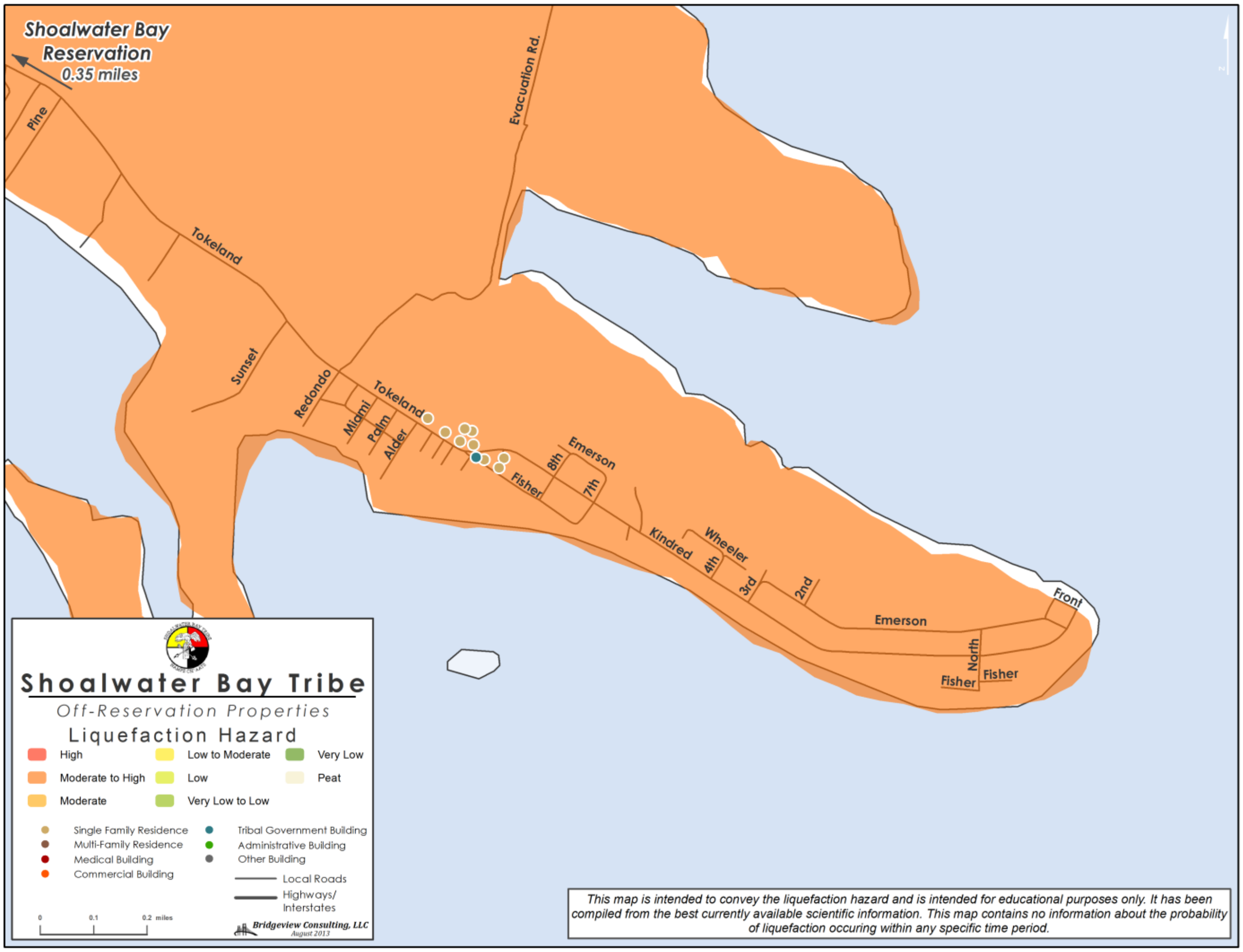


Figure 8-10. Liquefaction Hazard of Shoalwater Bay Tribe Structures Below Reservation Boundary

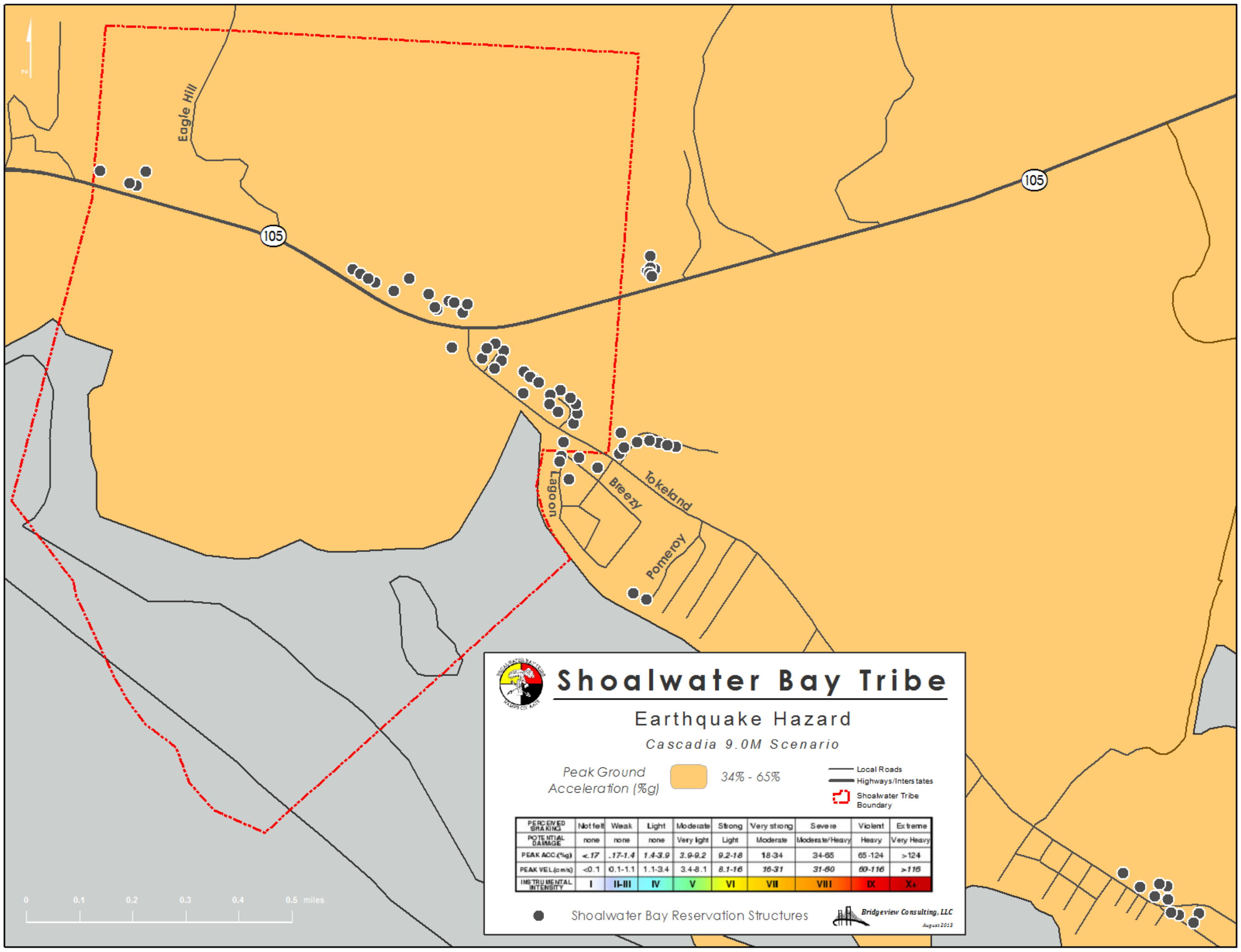


Figure 8-11. Cascadia 9.0M Scenario Event Ground Motion for the Shoalwater Bay Reservation

8.2.4 Frequency

The USGS estimated that a Cascadia Subduction Zone earthquake (Figure 8-7 and Figure 8-11) has a 10 to 15 percent probability of occurrence in 50 years, and a crustal zone earthquake has a recurrence interval of about 500 to 600 years. In general, it is difficult to estimate the probability of occurrence of crustal earthquake events. Earthquakes on the South Whidbey Island and Seattle Faults have a 2-percent probability of occurrence in 50 years. A Benioff zone earthquake has an 85 percent probability of occurrence in 50 years, making it the most likely of the three types.

Historically, the following has occurred within the planning region:

- ✓ Benioff or Deep Earthquake: Five magnitude 6 earthquakes; one magnitude 7 since 1900.
- ✓ Shallow or Crustal: Four magnitude 7 or greater known in the last 1,100 years; including two since 1918 on Vancouver Island

- ✓ Cascadia Subduction Zone Earthquake: Every 400-600 years; intervals between events are irregular. The most recent was in 1700 (discussed above).

8.2.5 Severity

Earthquakes can last from a few seconds to over five minutes; they may also occur as a series of tremors over several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties generally result from falling objects and debris, because the shocks shake, damage or demolish buildings and other structures. Disruption of communications, electrical power supplies and gas, sewer and water lines should be expected. Earthquakes may trigger fires, dam failures, landslides or releases of hazardous material, compounding their disastrous effects.

Small, local faults produce lower magnitude quakes, but ground shaking can be strong and damage can be significant in areas close to the fault. In contrast, large regional faults can generate earthquakes of great magnitudes but, because of their distance and depth, they may result in only moderate shaking in an area.

Past events suggest that earthquakes typical for the planning area caused light to moderate damage. However, severity can increase based on soil type and proximity to the hypocenter of the event. There are soft soils in the area that have a high degree of vulnerability to earthquakes.

The USGS has created ground motion maps based on current information about several fault zones. These maps show the PGA that has a certain probability (2 percent or 10 percent) of being exceeded in a 50-year period. The PGA is measured in numbers of *g*'s (the acceleration associated with gravity). Figure 8-12 shows the PGAs with a 2-percent probability of exceedance in 50 years in the planning area vicinity.

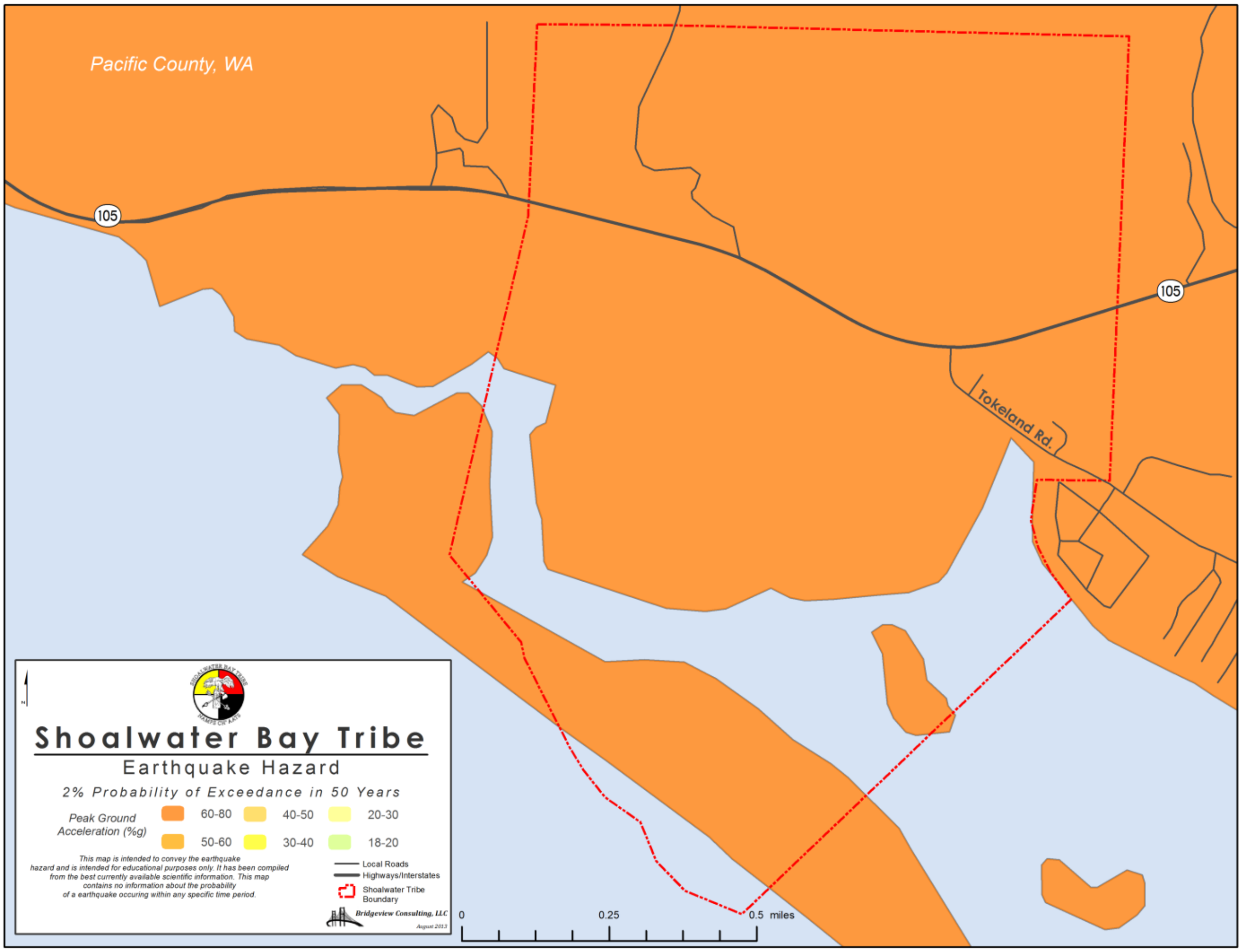


Figure 8-12. PGA with 2-Percent Probability of Exceedance in 50 Years, Shoalwater Bay Reservation

As stated, magnitude is related to the amount of seismic energy released at the hypocenter of an earthquake. It is determined by the amplitude of the earthquake waves recorded on instruments. Whereas intensity varies depending on location with respect to the earthquake epicenter, magnitude is represented by a single, instrumentally determined value for each earthquake event.

In simplistic terms, the severity of an earthquake event can be measured in the following terms:

- How hard did the ground shake?
- How did the ground move? (Horizontally or vertically)
- How stable was the soil?
- What is the fragility of the built environment in the area of impact?

According to the 2005 CREW report, impacts to the coastal communities, including Shoalwater Bay Reservation from a Cascadia Subduction Zone event would be significant, if not catastrophic. The 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" (p. 2)[17]

8.2.6 Warning Time

There is currently no reliable way to predict the day or month that an earthquake will occur at any given location. Research is being done with warning systems that use the low energy waves that precede major earthquakes. 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 a hazardous material they are working with, or shut down a computer system.

8.3 SECONDARY HAZARDS

Earthquakes can cause large and sometimes disastrous landslides, mudslides and tsunamis. River valleys are 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 sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people. Earthen dams and levees are highly susceptible to seismic events and the impacts of their eventual failures can be considered secondary risks for earthquakes.

8.4 CLIMATE CHANGE IMPACTS

The impacts of global climate change on earthquake probability are unknown. Some scientists say that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth's crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity according to research into prehistoric earthquakes and volcanic activity. NASA and USGS scientists found that retreating glaciers in southern Alaska may be opening the way for future earthquakes (NASA, 2004).

Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms could experience liquefaction during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events. There are currently no models available to estimate these impacts.

8.5 EXPOSURE

8.5.1 Population

The entire population of the planning area is potentially exposed to direct and indirect impacts from earthquakes. The degree of exposure is dependent on many factors, including the age and construction type of the structures people live in, the soil type their homes are constructed on, their proximity to fault location, etc. Whether directly impacted or indirectly impact, the entire population will have to deal with the consequences of earthquakes to some degree. Business interruption could keep people from working, road closures could isolate populations, and loss of functions of utilities could impact populations that suffered no direct damage from an event itself.

[17] CREW. (2005). Cascadia Subduction Zone Earthquakes.

8.5.2 Property

Building Age

Structures that are in compliance with the Uniform Building Code (UBC) of 1970 or later are generally less vulnerable to seismic damage because 1970 was when the UBC started including seismic construction standards based on regional location. This stipulated that all structures be constructed to at least seismic risk Zone 2 standards.

The State of Washington adopted the UBC as its state building code in 1972, so it is assumed that buildings in the planning area built after 1972 were built in conformance with UBC seismic standards and have less vulnerability. Issues such as code enforcement and code compliance could impact this assumption, as currently the Tribe does not have code enforcement or code compliance personnel in place to verify the level to which structures are built. Construction material is also important when determining the potential risk to a structure. However, for planning purposes, establishing this line of demarcation can be an effective tool for estimating vulnerability. In 1994, seismic risk Zone 3 standards of the UBC went into effect in Washington, requiring all new construction to be capable of withstanding the effects of 0.3 times the force of gravity. More recent housing stock is in compliance with Zone 3 standards. In July 2004, the state again upgraded the building code to follow International Building Code Standards. While the Shoalwater Bay Indian Tribe is not required to adhere to state or county-level regulatory authority, the Tribe does in fact utilize some of the established guidelines in force within Pacific County. Unfortunately, very little assessor's data is captured by the Pacific County Assessor's office, so determining the age of the building stock for planning purposes has been limited.

Table 8-6 identifies the milestones of code development throughout Washington. As more specific data is identified, this table will be updated with relevant information

TABLE 8-6.
AGE OF STRUCTURES WITHIN PLANNING AREA

Time Period	Number of Current Structures Building within Identified Period	Code Significance for Identified Time Period
Pre-1972	Unknown	No standardize earthquake requirements in building codes. Washington State law did not require the issuance of any building permits, or require actual building officials.
1972-1994	Unknown	UBC seismic construction standards were adopted in Washington.
1994-2004	Unknown	Seismic Risk Zone 3 was established within the Uniform Building Code in 1994, requiring higher standards
2004-Present	Unknown	Washington State upgraded the building codes to follow the International Building Code Standard. As upgrades occur, the state adopts said standards.
Total		

For planning purposes, since all structures in the planning area are susceptible to earthquake impacts to varying degrees, it was determined that all structures would be considered at risk. There are 75 buildings in the planning area (69 structures and 6 storage sheds), with a total assessed value of $27.4 million. This total represents the reservation-wide property exposure to seismic events. Most of the buildings (63 percent) are residential.

8.5.3 Critical Facilities and Infrastructure

All critical facilities in the planning area are exposed to the earthquake hazard. Hazardous materials releases can occur during an earthquake from fixed facilities or transportation-related incidents. Transportation corridors can be disrupted during an earthquake, leading to the release of materials to the surrounding environment. Facilities holding hazardous materials are of particular concern because of possible isolation of neighborhoods surrounding them. During an earthquake, structures storing these materials could rupture and leak into the surrounding area or an adjacent waterway, having a disastrous effect on the environment.

8.5.4 Environment

Secondary hazards associated with earthquakes will likely have some of the most damaging effects on the environment. Earthquake-induced landslides can significantly impact surrounding habitat. It is also possible for streams to be rerouted after an earthquake. This can change the water quality, possibly damaging habitat and feeding areas. There is a possibility of streams fed by groundwater drying up because of changes in underlying geology.

8.6 VULNERABILITY

Earthquake vulnerability data was generated using a Level 2 HAZUS-MH analysis. Once the location and size of a hypothetical earthquake are identified, HAZUS-MH estimates the intensity of the ground shaking, the number of buildings damaged, the number of casualties, the damage to transportation systems and utilities, the number of people displaced from their homes, and the estimated cost of repair and clean up.

8.6.1 Population

The most vulnerable populations to a disaster incident are the young and elderly residents. Both of these age groups represent a fairly high percentage of the tribal membership. Isolation of the Reservation due to an earthquake incident causing a landslide or otherwise restricting access is of considerable concern. Likewise, with both the high rate of unemployment and income levels below state average, households may lack the financial resources to improve their homes to make them more resistant to earthquakes, and also lack the financial resources to be self-sustaining for any length of time with respect to food, water and medications.

8.6.2 Property

Property losses were estimated through the Level 2 HAZUS-MH user defined facility analysis for the 100-year and 500-year earthquakes and the two scenario events. Table 8-7 shows the results for the potential economic losses associated with the building values.

TABLE 8-7.
ESTIMATED EARTHQUAKE-CAUSED ECONOMIC BUILDING DAMAGE

	Building Economic Impact
100-Year Probabilistic Earthquake (5.0M)	$103,936
500-Year Probabilistic Earthquake (5.0M)	$1,980,190
Cascadia 9.0M Scenario	$3,544,774
Cascadia 8.3M Scenario	$1,911,317

8.6.3 Critical Facilities and Infrastructure

As previously indicated, all of the facilities on the Reservation are considered critical due to the lack of infrastructure, inability to rebuild, and potential isolation which potentially can occur requiring the Tribe to be self-sustaining for an extended period of time. While damage from the previous Nisqually earthquake did not result in an extensive amount of damage, future events may be much worse. Most construction on the Reservation is fairly old (pre-1974) and does not meet increased design standards intended to prevent collapse under a maximum credible earthquake. In addition, liquefaction may result in sinking, tilt, distortion or destruction of structures, roadways and bridges which provide access onto and off of the Reservation.

Level of Damage

HAZUS-MH classifies the vulnerability of buildings to earthquake damage in five categories: no damage, slight damage, moderate damage, extensive damage, or complete damage. The model was used to assign a vulnerability category to each facility in the planning area. The analysis was performed for the 100-year probabilistic, 500-year probabilistic, and the Cascadia earthquake events. Table 8-8 through Table 8-10 summarize the results.

TABLE 8-8.
ESTIMATED DAMAGE TO FACILITIES FROM 100-YEAR PROBABLISTIC EARTHQUAKE

Category	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage
Tribal Facility	33.8%	32.6%	26.3%	5.9%	1.4%
Commercial	34.4%	32.9%	25.8%	5.7%	1.3%
Industrial	43.3%	35%	18.4%	3.1%	0.3%
Residential	4.7%	34.9%	18.2%	3%	0.2%
Average	**40.9%**	**34.3%**	**20.4%**	**3.8%**	**0.5%**

TABLE 8-9.
ESTIMATED DAMAGE TO FACILITIES FROM 500-YEAR PROBABLISTIC EARTHQUAKE

Category	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage
Tribal Facility	33.8%	32.6%	26.3%	5.9%	1.4%
Commercial	34.4%	32.9%	25.8%	5.7%	1.3%
Industrial	43.3%	35%	18.4%	3.1%	0.3%
Residential	43.7%	34.9%	18.2%	3%	0.2%
Average	**40.9%**	**34.3%**	**20.4%**	**3.8%**	**0.5%**

TABLE 8-10.
ESTIMATED DAMAGE TO FACILITIES FROM CASCADIA 9.0M EARTHQUAKE

Category	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage
Tribal Facility	4.9%	35.2%	50%	9.2%	0.6%
Commercial	4.2%	34.3%	51.8%	9.1%	0.6%
Industrial	6.5%	45.5%	44.8%	3.1%	0.1%
Residential	7.5%	47.5%	42.3%	2.6%	0.0%
Average	**6.6%**	**43.7%**	**45%**	**4.5%**	**0.2%**

ESTIMATED DAMAGE TO FACILITIES FROM CASCADIA 8.3M EARTHQUAKE

Category	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage
Tribal Facility	21.3%	48.1%	28.8%	1.7%	0.1%
Commercial	23.3%	50.6%	25.1%	1.1%	0.0%
Industrial	29.2%	55.0%	15.5%	0.3%	0.0%
Residential	29.8%	54.8%	15.2%	0.3%	0.0%
Average	**27.6%**	**53.3%**	**18.5%**	**0.6%**	**0.0%**

Time to Return to Functionality

Hazus-MH estimates the time to restore critical facilities to fully functional use. Results are presented as probability of being functional at specified time increments: 1, 3, 7, 14, 30 and 90 days after the event. For example, Hazus-MH may estimate that a facility has a 5 percent chance of being fully functional at Day 3, and a 95-percent chance of being fully functional at Day 90. The analysis of critical facilities in the planning area was performed for the 100-year probabilistic (5.0M) and Cascadia 9.0M Scenario earthquake events. Table 8-11 and Table 8-12 summarizes the results.

TABLE 8-11.
FUNCTIONALITY OF CRITICAL FACILITIES FOR 100-YEAR PROBABLISTIC (5.0M) EVENT

	# of Critical Facilities	Probability of Being Fully Functional (%)					
		at Day 1	at Day 3	at Day 7	at Day 14	at Day 30	at Day 90
Tribal Facility	10	33.7	35.3	66.2	66.3	92.6	98.6
Commercial	11	34.3	35.9	67	67.1	92.9	98.7
Industrial	8	43.2	44.9	78.1	78.2	96.6	99.7
Residential	46	43.6	45.3	78.4	78.5	96.7	99.7
Total/Average	**75**	**40.85**	**42.5**	**75.1**	**75.2**	**95.6**	**99.4**

TABLE 8-12.
FUNCTIONALITY OF CRITICAL FACILITIES FOR CASCADIA 9.0M EVENT

	# of Critical Facilities	Probability of Being Fully Functional (%)					
		at Day 1	at Day 3	at Day 7	at Day 14	at Day 30	at Day 90
Tribal Facility	10	4.9	6.6	40	40.1	90.1	99.3
Commercial	11	4.1	5.8	38.4	38.4	90.2	99.4
Industrial	8	6.4	8.6	51.9	52	96.7	99.9
Residential	46	7.5	9.8	54.9	55	97.3	99.9
Total/Average	**75**	**6.5**	**8.6**	**50.1**	**50.3**	**95.2**	**99.7**

8.6.4 Environment

The environment vulnerable to earthquake hazard is the same as the environment exposed to the hazard.

8.7 FUTURE TRENDS IN DEVELOPMENT

Currently, the Tribe adheres to those land use development codes which are imposed by agencies that provide federal funding for construction of infrastructure and buildings on the Reservation. The Tribe also currently utilizes some of the standards established by Pacific County, although as a sovereign nation, this is a selective process for the Tribe. The Tribe is also currently developing its first land use authority, which will further establish standards for construction of residential and commercial buildings through adoption of the 2009 International Building Code. As the Tribe moves forward with its land use development, it will begin capturing data with respect to building stock age, which will enhance the ability to determine impact to the various structures on the Reservation.

The information in this plan provides the Tribe with tools to ensure that there is no increase in exposure in areas of high seismic, tsunami or flood risk. Development in the planning area will be regulated through building standards and performance measures so that the degree of risk will be reduced.

8.8 SCENARIO

With the abundance of fault exposure in Washington, the potential scenarios for earthquake activity are many. An earthquake does not have to occur within the planning area to have a significant impact on the people, property and economy of the planning area, especially in cases such as the isolated Shoalwater Bay Indian Reservation.

Any seismic activity of 6.0 or greater on faults within the planning area would have significant impacts throughout the Reservation. Potential warning systems could give approximately 40 seconds notice that a major earthquake is about to occur. This would not provide adequate time for preparation. Earthquakes of this magnitude or higher would lead to massive structural failure of property on NEHRP C, D, E, and F soils. Levees or revetments built on these poor soils would likely fail, representing a loss of critical infrastructure. These events could cause secondary hazards, including landslides and mudslides that would further damage structures. Soil liquefaction would occur in water-saturated sands, silts or gravelly soils. Areas of ingress and egress for the Reservation could be significantly impacted.

8.9 ISSUES

Important issues associated with an earthquake include, but are not limited to the following:

- More information is needed on the exposure and performance of soft-story construction within the planning area.
- A large percent of the planning area's building stock was built prior to 1974, when seismic provisions became uniformly applied through building code applications. Pre-1974 building codes increase the risk associated to structural damage.
- Based on the modeling of critical facility performance performed for this plan, a high number of facilities in the planning area are expected to have complete or extensive damage from scenario events. These facilities are prime targets for structural retrofits.
- The Tribe should create or enhance continuity of operations plans using the information on risk and vulnerability contained in this plan.
- Geotechnical standards should be established that take into account the probable impacts from earthquakes in the design and construction of new or enhanced facilities.
- Earthquakes could trigger other natural hazard events such as landslides, which could severely impact the planning area.
- A worst-case scenario would be the occurrence of a large seismic event during a flood or high-water event, impacting multiple locations with inundating and further increasing the impacts of the individual events.

Chapter 9.
FLOOD

9.1 GENERAL BACKGROUND

A floodplain is the area adjacent to a river, creek or lake that becomes inundated during a flood. Floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a canyon.

When floodwaters recede after a flood event, they leave behind layers of rock and mud. These gradually build up to create a new floor of the floodplain. Floodplains generally contain unconsolidated sediments (accumulations of sand, gravel, loam, silt, and/or clay), often extending below the bed of the stream. These sediments provide a natural filtering system, with water percolating back into the ground and replenishing groundwater. These are often important aquifers, the water drawn from them being filtered compared to the water in the stream. Fertile, flat reclaimed floodplain lands are commonly used for agriculture, commerce and residential development.

Connections between a river and its floodplain are most apparent during and after major flood events. These areas form a complex physical and biological system that not only supports a variety of natural resources but also provides natural flood and erosion control. When a river is separated from its floodplain with levees and other flood control facilities, natural, built-in benefits can be lost, altered, or significantly reduced.

DEFINITIONS

Flood—The inundation of normally dry land resulting from the rising and overflowing of a body of water.

Floodplain—The land area along the sides of a river that becomes inundated with water during a flood.

100-Year Floodplain—The area flooded by a flood that has a 1-percent chance of being equaled or exceeded each year. This is a statistical average only; a 100-year flood can occur more than once in a short period of time. The 1-percent annual chance flood is the standard used by most federal and state agencies.

Return Period—The average number of years between occurrences of a hazard (equal to the inverse of the annual likelihood of occurrence).

Riparian Zone—The area along the banks of a natural watercourse.

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.

9.1.1 Measuring Floods and Floodplains

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the 100-year discharge has a 1-percent chance of being equaled or exceeded in any given year. The "annual flood" is the greatest flood event expected to occur in a typical year. These measurements reflect statistical averages only; it is possible for two or more floods with a 100-year or higher recurrence interval to occur in a short time period. The same flood can have different recurrence intervals at different points on a river.

The extent of flooding associated with a 1-percent annual probability of occurrence (the base flood or 100-year flood) is used as the regulatory boundary by many agencies. Also referred to as the special flood hazard area (SFHA), this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the elevation of water that will result from a given discharge level, which is one of the most important factors used in estimating flood damage.

9.1.2 Floodplain Ecosystems

Floodplains can support ecosystems that are rich in plant and animal species. A floodplain can contain 100 or even 1,000 times as many species as a river. Wetting of the floodplain soil releases an immediate surge of nutrients: those left over from the last flood, and those that result from the rapid decomposition of organic matter that has accumulated since then. Microscopic organisms thrive and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage. The production of nutrients peaks and falls away quickly, but the surge of new growth endures for some time. This makes floodplains valuable for agriculture. Species growing in floodplains are markedly different from those that grow outside floodplains. For instance, riparian trees (trees that grow in floodplains) tend to be very tolerant of root disturbance and very quick-growing compared to non-riparian trees.

9.1.3 Effects of Human Activities

Because they border water bodies, floodplains have historically been popular sites to establish settlements due to the sustenance they provide. Human activities on the built environment creates often localized flooding problems outside natural floodplains by altering or confining drainage channels. Growth many times tends to concentrate in floodplains for a number of reasons: water is readily available; land is fertile and suitable for farming; transportation by water is easily accessible; and land is flatter and easier to develop. But human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream's capacity to contain flows, and it increases flow rates or velocities downstream during all stages of a flood event. Since 1980, federal, state and local governments have invested well in excess of $550 million to repair public facilities, help individuals recover from flood disasters, and pay for measures to prevent future flood damage. Human activities can interface effectively with a floodplain as long as steps are taken to mitigate the activities' adverse impacts on floodplain functions.

9.1.4 Federal Flood Programs

National Flood Insurance Program

The NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in participating communities. For most participating communities, FEMA has prepared a detailed Flood Insurance Study (FIS). The study presents water surface elevations for floods of various magnitudes, including the 1-percent annual chance flood and the 0.2-percent annual chance flood (the 500-year flood). Base flood elevations and the boundaries of the 100- and 500-year floodplains are shown on Flood Insurance Rate Maps (FIRMs), which are the principle tool for identifying the extent and location of the flood hazard. FIRMs are the most detailed and consistent data source available with respect to flood information, and for many communities they represent the minimum area of oversight under their floodplain management program. FEMA previously completed a flood insurance study for Pacific County, dated 1985.

Participants in the NFIP must, at a minimum, regulate development in floodplain areas in accordance with NFIP criteria. Before issuing a permit to build in a floodplain, participating jurisdictions must ensure that three criteria are met:

- New buildings and those undergoing substantial improvements must, at a minimum, be elevated to protect against damage by the 100-year flood.

- New floodplain development must not aggravate existing flood problems or increase damage to other properties.
- New floodplain development must exercise a reasonable and prudent effort to reduce its adverse impacts on threatened salmonid species.

The Shoalwater Bay Tribe does participate in the NFIP program, one of the few tribes within Washington State that are members of the federal program.[18] The Tribe (CID #530341) joined the NFIP January 4, 2002, adopting Pacific County's (CID # 530126) FIRM Panel No. 0016, the effective date of which was 9/27/1985. Figure 9-1 provides a snapshot of the panel.

Pacific County, including the Shoalwater Reservation, are currently in the process of FEMA map revisions through the Risk MAP program, with anticipated new maps being available during the life cycle of this updated mitigation plan, but not available for use in this 2014 update. As coastal erosion and sea level change has affected the accuracy of the map, it is anticipated that future flood analysis will be more accurate once the new maps are received and adopted. The Shoalwater Bay Indian Tribe affirms continued compliance with the requirements of the National Flood Insurance Program during the life cycle of this plan update.

Presently, no claims have been filed against the Tribe's existing insurance policies in place since joining the NFIP. Review of FEMA's website (http://bsa.nfipstat.fema.gov/reports/1011.htm#WAT) provides no insurance data for the Shoalwater Reservation as of June 2014.

Repetitive Loss Properties:[19]
Repetitive loss properties are those properties 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.

At present, the tribe does not have any repetitive or severe repetitive loss properties within the boundary of the Reservation.

[18] Tribal information from The NFIP Community Status Book, WA State http://www.fema.gov/cis/WA.pdf
[19] Definition from FEMA: http://www.fema.gov/nfip/replps.shtm

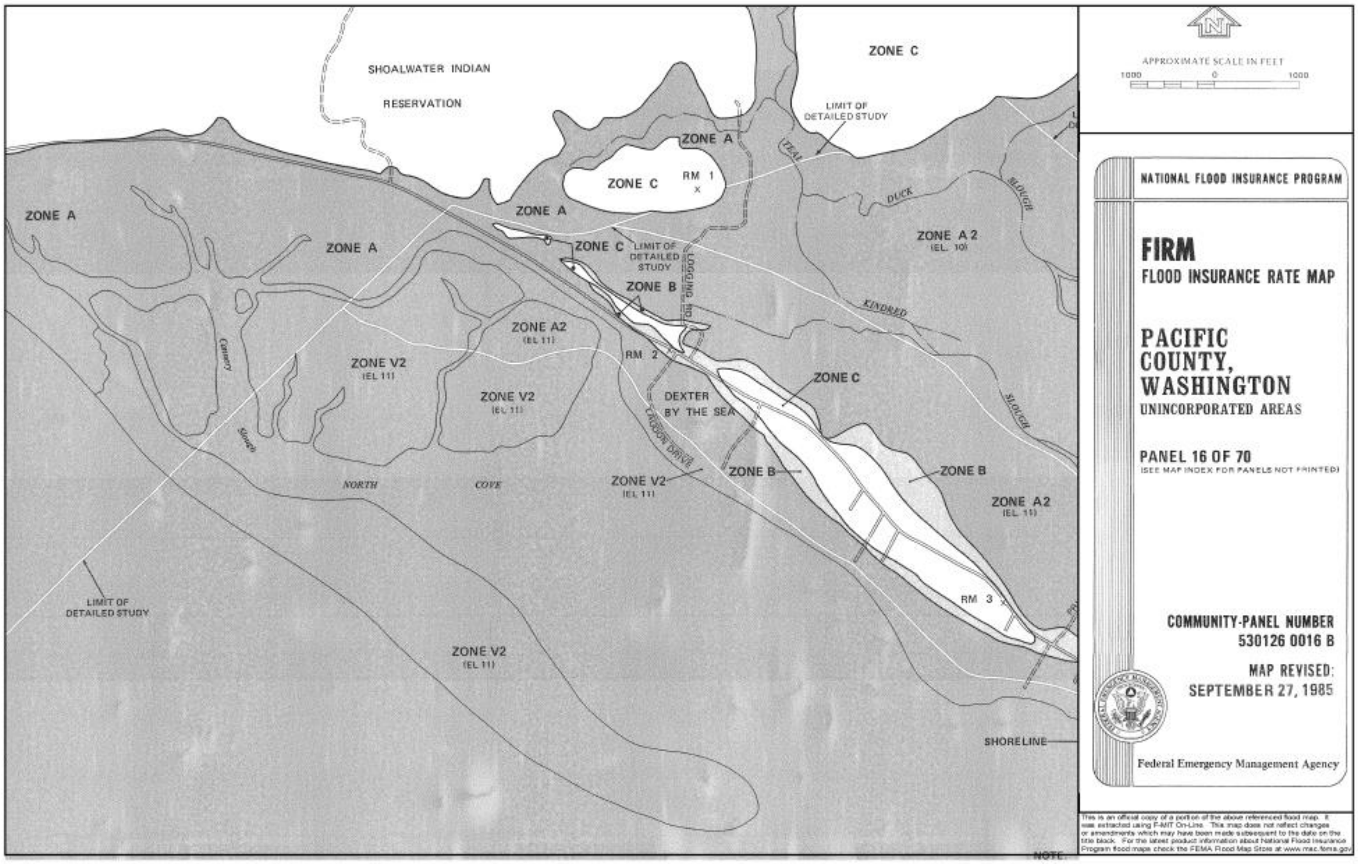


Figure 9-1. Pacific County DFRIM Panel Depicting Shoalwater Bay Reservation

9.2 HAZARD PROFILE

The principal cause of flooding on the Shoalwater Bay Indian Reservation is Coastal Flooding caused by tidal and storm surge. The Reservation is generally not affected by riverine or surface flooding. Erosion and transported sediment are major secondary hazards of flooding, as well as the increased potential for landslides. Intense runoff can strip away topsoil and deposit it elsewhere, usually where it is impeded, such as at culverts or bridge abutments. Sediment deposits have been a major effect of flooding on the Reservation depending on where the sediments are deposited. In addition, erosion can also deposit sediment in river and creek beds, decreasing their capacity to transport water.

Empire Spit fronts Tokeland Peninsula and helps protect it from direct exposure to waves from the Pacific Ocean, which have the potential to cause flooding on the Reservation. Historically, this barrier island was fed by sand from the eroding beach plain to the northwest. However, according to a 2009 UASCE report, this source of sand has been significantly compromised due to the extreme erosion that occurred with the migration of the Willapa Channel (p. 22). As a consequence, the barrier dune is no longer accreting and in fact, continues to erode as a result of wave action and storm washover. This continued erosion is compromising the barrier dune's historical function as a wave/flood barrier for the Tokeland Peninsula (Corps, 2007). Although the portion of the Shoalwater Reservation that abuts North Cove lies within the 100 year floodplain and is documented as having additional hazards associated with high velocity wave action (FEMA, 1985), erosion of the barrier dune is exposing the Shoalwater Reservation uplands to increasing levels of flooding due to storm overwash of the eroded dune and resultant wave run-up and overtopping of the low-lying Tribal uplands.

Portions of the shoreline that are not protected by the flood berm (installed by Corps of Engineers after the 1999 Storm Surge event), and the tribal infrastructure located on along the shoreline will continue to be impacted 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)[20]. This is about 6 feet above mean higher high tide.

9.2.1 Past Events

Major floods on the Reservation have resulted from intense rainstorms, usually between October and April. Flooding on the Reservation has not been well documented because they have been minor in nature with the exception of storm surge events. No damage surveys exist documenting impact, and most information is from personal accounts, news articles and photographs. Table 9-1 summarizes flood events in the planning area since 1980, based primarily on FEMA data. Because limited independent data is available for the Shoalwater Bay Tribe, county data was used for this table. In many instances, the Tribe was not impacted, or only in a minor capacity, but the data of damages was utilized within the County's declaration. In the future, the Tribe will begin a system for maintaining data specific to the Reservation. Since 1980, there have been nine (9) presidential-declared flood events in the county. The cost of property damage on the Reservation is unknown

TABLE 9-1.
SHOALWATER BAY TRIBE FLOOD EVENTS

Date	Declaration #	Type of event	Estimated Damage
November 1986	784	Flood	N/A
November 1990	883	Flood	N/A
Nov/Dec 1995	1079	Flood	N/A
Dec 96-Feb 97	1159	Ice, Wind, Snow, Landslide, Flood	N/A
March 1997	1172	Flood, Landslide	N/A
December 1999*		Flooding	
Jan-Feb 2006	1641	Severe Winter Storm, Flood, Landslide, Mudslide, Tidal Surge	N/A
November 2006	1671	Severe Winter Storm, Flood, Landslide, Mudslide, Wind	N/A
December 2007	1734	Severe Winter Storm, Flood, Landslide, Mudslide, Wind	N/A
January 2009	1817	Severe Winter Storm, Flood, Landslide, Mudslide	N/A

Source: Spatial Hazard Events and Losses Database for the United States (SHELDUS) and FEMA website.

N/A = Information is not available

*1999 Flood event not declared, but caused significant damage to shoreline of Reservation, ultimately resulting in USACE Shoreline Project

The Flood Insurance Study for Pacific County also identifies several past historical flooding events, including "[m]ajor coastal and tidal floods, in order of highest water, have occurred in 1934, 1933, 1973, 1969, 1972 and 1960."[21]

In addition to those declarations listed above, the Reservation was also impacted by a 1999 storm surge event, which did not rise to the level of a Presidential Declaration, but which caused significant damage to

[20] Engineering Analysis and Design, Shoalwater Bay Shoreline Erosion Study, p.9, available by request to SBIT.
[21] Pacific Co FIS, p. 6

the Reservation. 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. Within the planning region, 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.

9.2.2 Location

The flooding that has occurred in portions of the planning area has been isolated and not as significant as other areas throughout the County. Figure 9-2 and Figure 9-3 demonstrate the impact to the Reservation for structures owned by the Tribe both on and off Reservation. The Reservation has not generally been impacted by riverine or surface flooding. The exception to the flooding hazard is the coastal flooding caused by a combination of tidal and storm surge.

As indicated in Figure 9-4, those portions of the shoreline that are not protected by the flood berm installed after the 1999 event by the Army Corps of Engineers, will continue to be impacted 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)[22]. This is about 6 feet above mean higher high tide.

[22] Engineering Analysis and Design, Shoalwater Bay Shoreline Erosion Study, p.9 available by request from SBIT

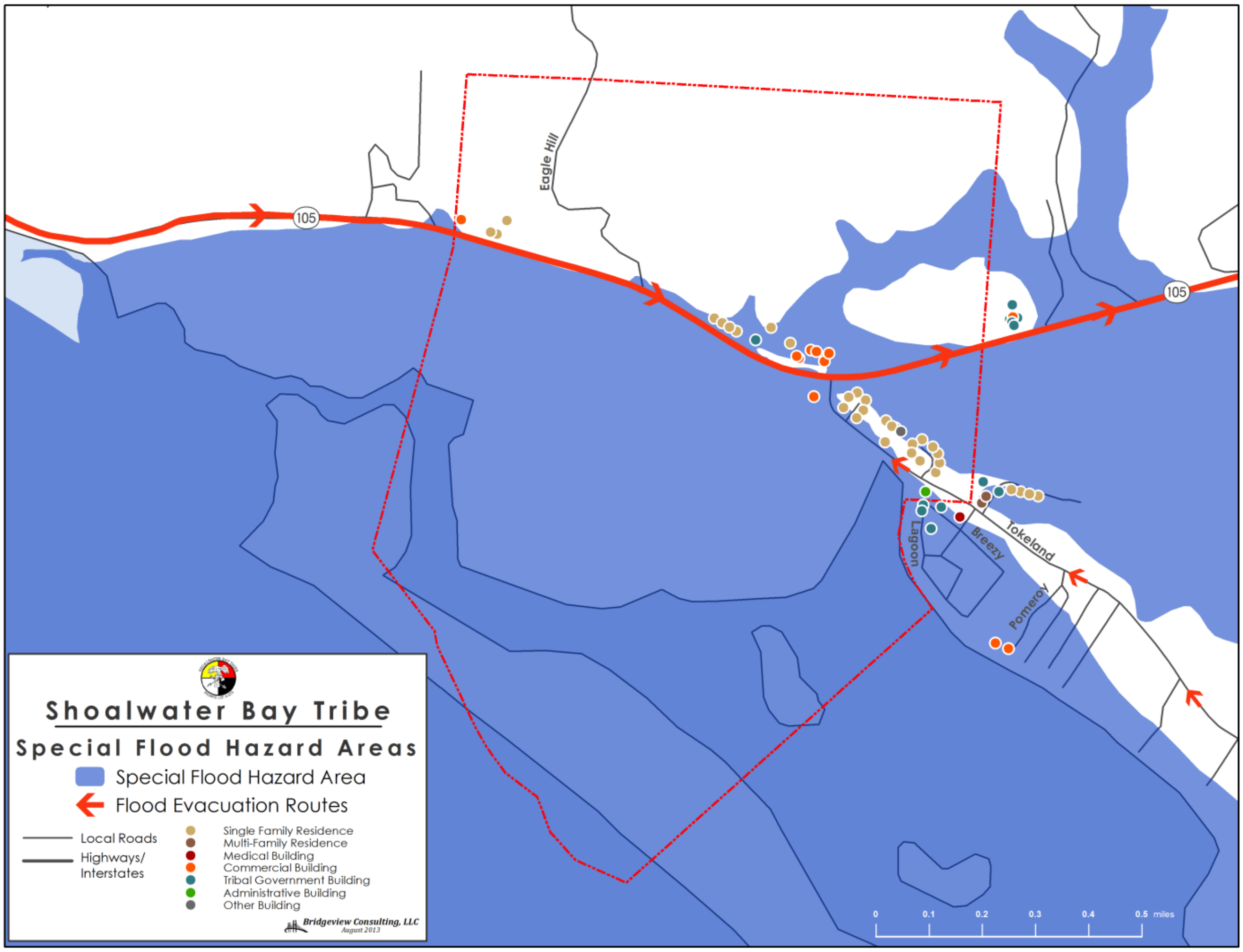


Figure 9-2. Shoalwater Bay Reservation 100 Year Flood Hazard Area

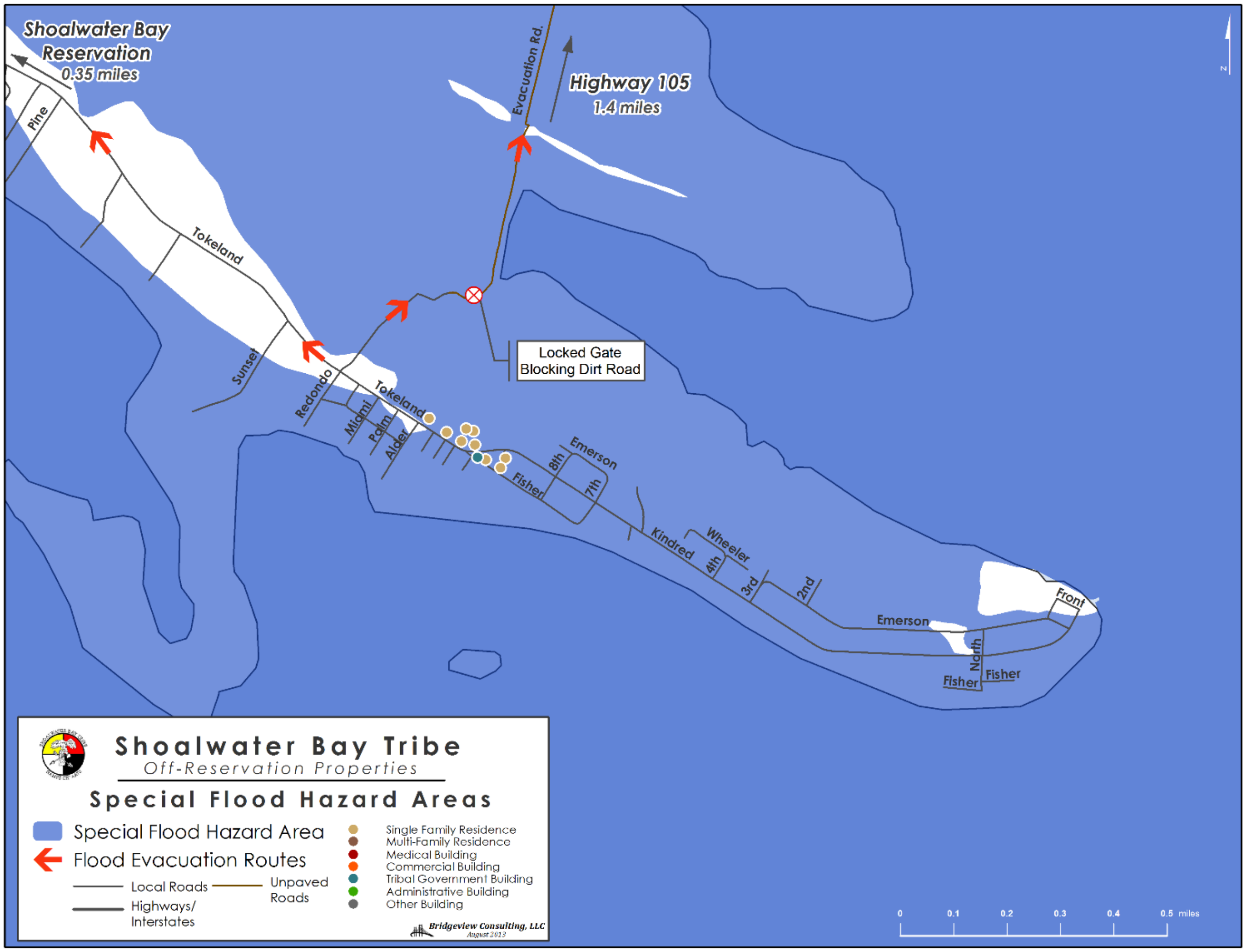


Figure 9-3. Shoalwater Bay Tribe Off Reservation Structures within 100 Year Flood Hazard Area

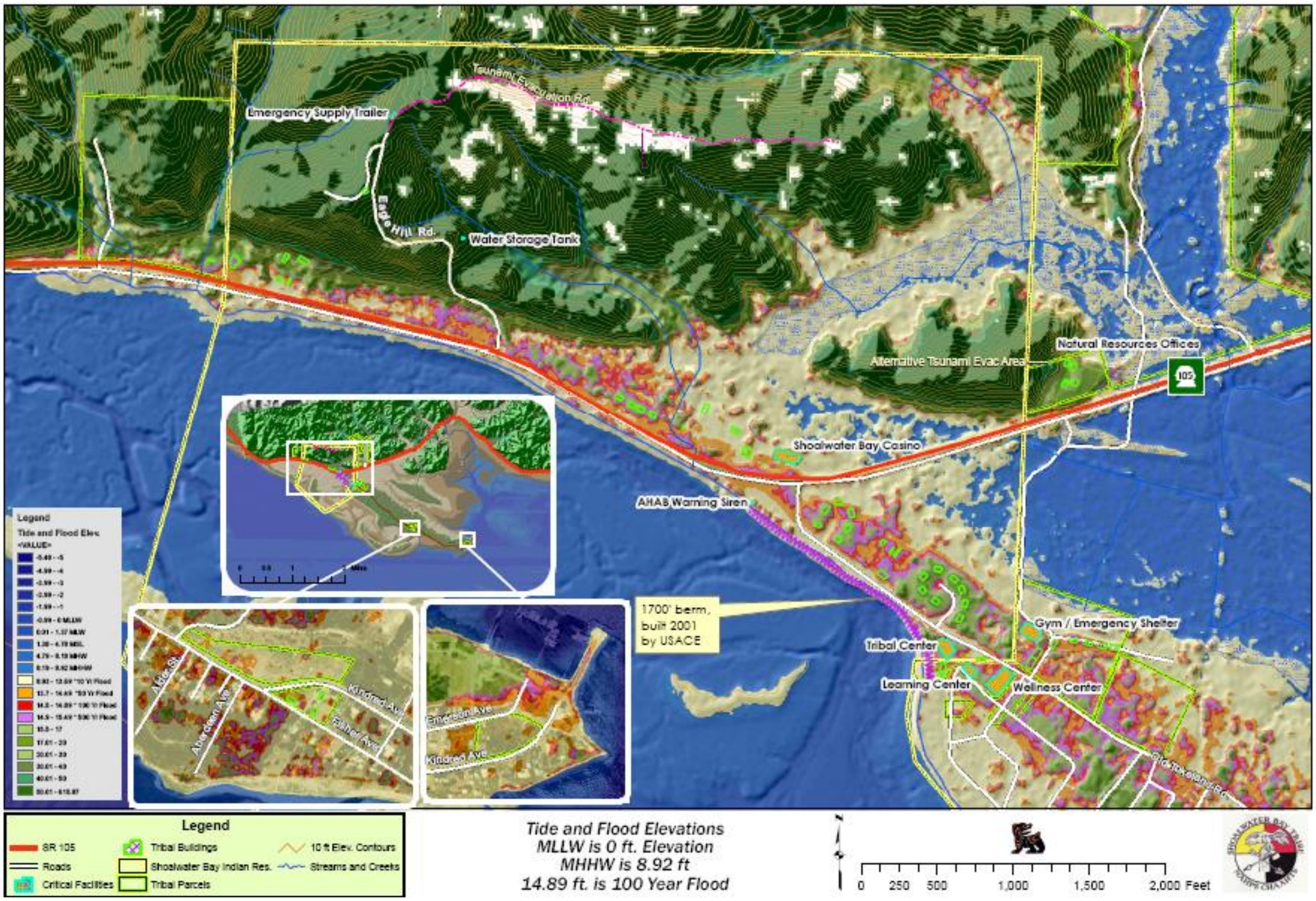


Figure 9-4. Shoalwater Reservation Mean Lower Low Water Elevation

9.2.3 Frequency

History has shown that Pacific County has experienced nine flood events since 1980. While it is unclear exactly how those events have impacted the Shoalwater Bay Tribe, damaging floods associated with riverine or surface flooding have not been a great threat to the Reservation. The Reservation is, however, impacted to some level of flooding every year from storm and tidal surge events. Washington State's Hazard Mitigation Plan (2010) identifies the frequency of occurrence of flood events statewide as identified in Figure 9-5.

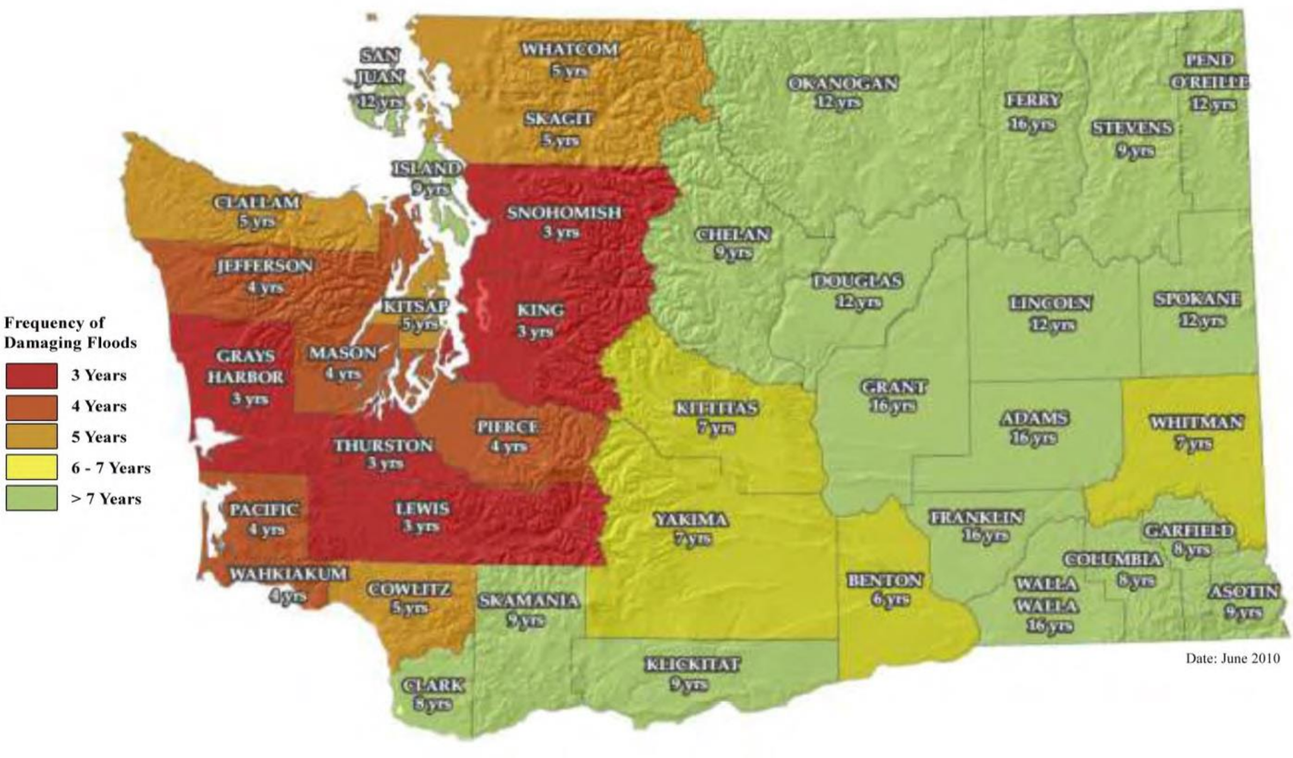


Figure 9-5. Washington State Frequency of Flooding by County

9.2.4 Severity

The principal factors affecting flood damage are flood depth and velocity. The deeper and faster water flows, the more damage they can cause. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. In the case of storm surge, this is especially true when water migrates over a broad floodplain, in some instances redirecting high velocity flows and transporting debris, sand or sediment.

9.2.5 Warning Time

Due to the sequential pattern of meteorological conditions needed to cause serious flooding on the Reservation, it is unusual for a flood to occur without warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger. Flooding is more likely to occur due to a rain storm when the soil is already wet and/or streams or culverts are already running high from recent previous rains (conditions already in place when a storm begins are called "antecedent conditions"). A storm surge caused by high winds and high tides can also be predicted through meteorological conditions which provide advanced warning. On the Shoalwater Reservation, flooding off the Reservation does have the potential to impact Tribal members whose access may be restricted due to impassable roadways or bridges that are off of the Reservation, but which support ingress or egress onto the Tribe.

Throughout Pacific County, including the Shoalwater Reservation, the flood threat recognition system consists of a network of precipitation and stream gages throughout the various watersheds. This information is fed into a USGS forecasting program, which assesses the flood threat based on the amount of flow in the stream (measured in cubic feet per second). In addition to this program, data and flood warning information is provided by the National Weather Service. All of this information is analyzed to evaluate the flood threat and possible evacuation needs.

9.3 SECONDARY HAZARDS

The most problematic secondary hazard for flooding is bank erosion and landslides, which in some cases can be more harmful than actual flooding. This is especially true in the upper courses of rivers with steep gradients, where floodwaters may pass quickly and without much damage, but scour the banks, edging properties closer to the floodplain or causing them to fall in. Flooding is also responsible for hazards such as landslides when high flows over-saturate soils on steep slopes, causing them to fail. Hazardous materials spills are also a secondary hazard of flooding if storage tanks rupture and spill into the ocean, streams, rivers or storm sewers.

9.4 CLIMATE CHANGE IMPACTS

Use of historical hydrologic data has long been the standard of practice for designing and operating water supply and flood protection projects. For example historical data are used for flood forecasting models and to forecast snowmelt runoff for water supply. This method of forecasting assumes that the climate of the future will be similar to that of the period of historical record. However, the hydrologic record cannot be used to predict changes in frequency and severity of extreme climate events such as floods, storm surge or increased tidal activities. Going forward, model calibration or statistical relation development must happen more frequently, new forecast-based tools must be developed, and a standard of practice that explicitly considers climate change must be adopted. Climate change is already impacting water resources, and resource managers have observed the following:

- Historical hydrologic patterns can no longer be solely relied upon to forecast the water future.
- Precipitation and runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management and ecosystem functions.
- Extreme climatic events will become more frequent, necessitating improvement in flood protection, drought preparedness and emergency response.

The amount of snow is critical for water supply and environmental needs, but so is the timing of snowmelt runoff into rivers and streams. Rising snowlines caused by climate change will allow more mountain area to contribute to peak storm runoff. High frequency flood event s (e.g. 10 -year floods) in particular will likely increase with a changing climate. Along with reductions in the amount of the snowpack and accelerated snowmelt, scientists project greater storm intensity, resulting in more direct runoff and flooding. Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering shoreline and channel shapes and depths, possibly increasing sedimentation and accretion, affecting aquatic and other habitat, and water quality. With potential increases in the frequency and intensity of wildfires due to climate change, there is potential for more floods following fire, which increase sediment loads and water quality impacts.

As hydrology changes, what is currently considered a 100-year flood may strike more often, leaving many communities at greater risk. Planners will need to factor a new level of safety into the design, operation, and regulation of flood protection facilities such as dams, floodways, bypass channels and levees, as well as the design of local sewers and storm drains. The planning area's location increases the amount of annual precipitation, with winter months historically damp and foggy, with limited snow but a relatively high amount of rain. Average precipitation is identified in Figure 9-6[23]. Statewide, Pacific County ranks third in the amount of rainfall annually, with Grays Harbor County and Mason County ranking first and second, respectively.

[23] http://www.usa.com/rank/washington-state--average-precipitation--county-rank.htm?hl=Pacific&hlst=WA

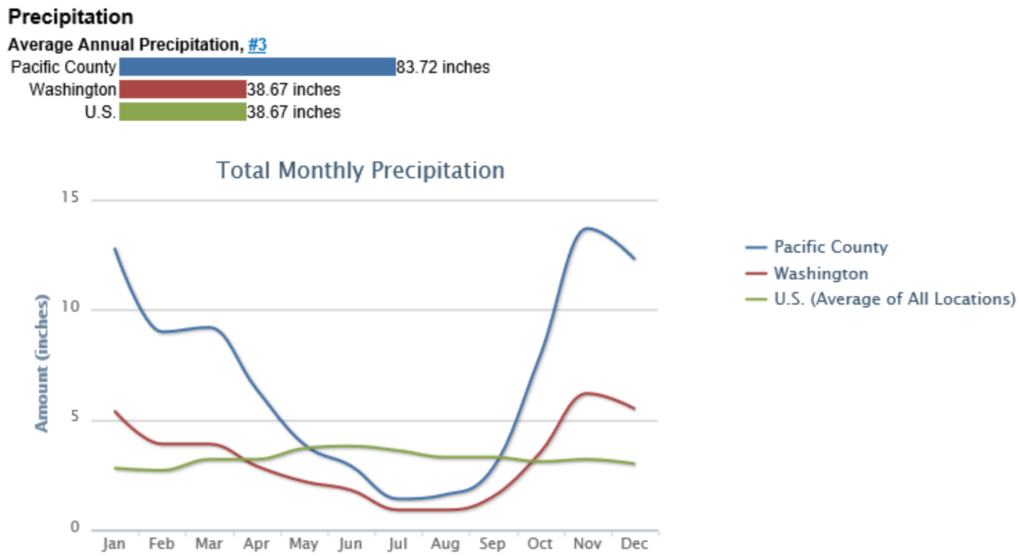


Figure 9-6. Pacific County Annual Precipitation

9.5 EXPOSURE

The Level 2 HAZUS-MH protocol was used to assess the risk and vulnerability to flooding in the planning area. A user defined building specific model was developed, incorporating a HAZUS-generated 100-year floodplain, which has a level of accuracy acceptable for planning purposes. Where possible, the HAZUS-MH default data was enhanced using local GIS data from local, state and federal sources.

9.5.1 Population

Population counts of those living in the floodplain were generated by analyzing the Reservations total population and total households that intersect the 100-year floodplain (Tribal and Non-Tribal). The methodology used to generate population estimates was determined by multiplying the average household size for the Reservation (~3 persons per household) by the number of exposed residential buildings. This number also reflects Tribal members who are within close proximity to the current Reservation Boundary, and for which the Tribe provides services. These residences are not, at present, located on what is presently recognized by the federal government as the Reservation's boundary, but do fall within the Tribe ancestral boundary.

Using this approach, it was estimated that the exposed population is 102 within the 100-year floodplain. It is important to note that this number does not reflect migrant population which may be passing through the Reservation, or those visiting the casino, hotel or RV Park.

9.5.2 Property

Structures in the Floodplain

Table 9-2 summarizes the total area and number of structures in the floodplain. The HAZUS-MH model determined that there are 55 structures within the 100-year floodplain, 62 percent are residential structures.

TABLE 9-2. AREA AND STRUCTURES IN THE FLOODPLAIN	
	100-Year Floodplain (includes all tribal lands)
Area in Floodplain (acres)	572.8
Number of Structures in Floodplain	
Commercial	8
Tribal Government	10
Tribal Industrial	1
Non-Single Family Residential	2
Single Family Residential	34
Total	**55**

Exposed Value

Table 9-3 summarizes the estimated value of exposed buildings in the planning area. This methodology estimated $16.5 million worth of building-and-contents exposure to the 100-year flood, representing 60% percent of the total assessed value of the planning area.

TABLE 9-3.
VALUE OF STRUCTURES IN THE FLOODPLAIN

	Estimated Flood Exposure			% of Total Assessed Value
	Structure	Contents	**Total**	
Commercial	$5,167,497	$2,583,748	$7,751,245	28.3%
Tribal Government	$2,449,774	$1,224,887	$3,674,660	13.4%
Tribal Industrial	$652,267	$326,133	$978,400	3.6%
Non-Single Family Res.	$384,677	$192,339	$577,016	2.1%
Single Family Residential	$2,363,160	$1,181,580	$3,544,740	12.9%
Total	**$11,017,345**	**$5,508,687**	**$16,526,061**	**60.4%**

9.5.3 Critical Facilities and Infrastructure

Tier II Facilities

Tier II facilities are those that use or store materials that can harm the environment. These facilities can be damaged by a flood, causing additional issues beyond those associated with the flood event. At present, there are no registered Tier II sites which are on the Reservation reported to Washington State Department of Ecology. The Tribe’s gas station does store a fairly large amount of fuel (gasoline and diesel). The Tokeland Marina also maintains a fairly large amount of diesel on site, although this is not on the Reservation itself. Several of the private residences also have propane tanks, which could be volatile during fires depending on the age of the tanks themselves. In addition, there are 25 actively monitored sites within a 10 mile radius of the Reservation. Tribal departments on the Reservation do maintain chemicals for various purposes, such as within Outdoor Maintenance, facilities maintenance, and the medical facility. The Tribe does allow individuals to drop off small amounts of hazardous materials to a holding facility on the Reservation, which are then transported to the larger hazardous materials disposal site in Pacific County.

Utilities and Infrastructure

In determining who may be at risk if infrastructure is damaged by flooding, it is important to remember that with the limited ingress and egress onto the Reservation, the issue need not occur on the Reservation to have a dramatic and crippling impact to the residents living in the planning area. Roads that are blocked or damaged can isolate residents and can prevent access throughout the planning area, including for emergency service providers needing to get to vulnerable populations or to make repairs. Bridges washed out or blocked by floods or debris also can cause isolation. Impact to underground utilities can also occur as a result of flooding, including any pipelines which travel to or through the Reservation. Dikes can also fail or be overtopped, inundating the land that they protect. The following sections describe specific types of critical infrastructure.

Roads

The major roads in the planning area that pass through the 100-year floodplain and are thus exposed to flooding are Highway 105, and portions of Eagle Hill Road (either due to flood waters or slides resulting from runoff). Some of these roads are built above the flood level, and others function as levees to prevent flooding. Still, in severe flood events (especially occurring during high tide or strong winds) these roads can be blocked or damaged, preventing access to some areas. Based on the MLLW, Tokeland Road is below 15’ elevation, and could be impacted by an event.

Bridges

Flooding events can significantly impact road bridges, and there is an extensive system of bridges within Pacific County that can impact access to the Reservation. Currently, Pacific County has 115 listed bridges, some built in 1916.[24] These bridges are important because often they provide the only ingress and egress to some neighborhoods, as well as providing goods and services on the Reservation. Several bridges are constructed of wood. An analysis of the planning area and immediately surrounding the planning area showed that while there are no bridges on the Reservation which would be impacted, there are at least two bridges that could be impacted by a flooding event within Pacific County that would impact the Tribe. There is also the issue of secondary events caused by flooding such as a landslide which would also impact bridge stability.

Research for the 2014 update indicates that there are currently two bridges in Pacific County, the Smith Creek and North River that are currently on the Washington State Department of Transportation’s bridge replacement program. Both of these bridges provide direct access onto the Reservation.

Water and Sewer Infrastructure

Water and sewer systems can be affected by flooding. Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing wastewater to spill into homes, neighborhoods, rivers and streams.

[24] National Bridge Inventory Database. Accessed 10/23/13. Available at: http://nationalbridges.com/

9.5.4 Environment

Flooding is a natural event, and floodplains provide many natural and beneficial functions. Nonetheless, with human development factored in, flooding can impact the environment in negative ways. Migrating fish can wash into roads or over dikes into flooded fields, with no possibility of escape. Pollution from roads, such as oil, and hazardous materials can wash into rivers and streams. During floods, these can settle onto normally dry soils, polluting them for agricultural uses. Human development such as bridge abutments and levees, and logjams from timber harvesting can increase stream bank erosion, causing rivers and streams to migrate into non-natural courses.

9.6 VULNERABILITY

The entire Shoalwater Bay Indian Reservation, as well as the Trust lands in Tokeland are exposed to Coastal flooding in addition to flooding associated with a 100- and 500-year event, although to a lesser degree based on data available as of the development of this 2014 update.

At the time of development of this plan, FEMA is developing new flood maps for the Shoalwater Reservation. As the new maps have not yet been adopted by the Tribe (anticipated adoption to be within the next six months), the Tribe elected to utilize portions of the existing analysis conducted for its 2008 plan in conjunction with this update rather than to conduct another analysis on soon-to-be outdated data in an effort to reduce redundancy. At the time the new maps are adopted, a new flood analysis will be conducted with respect to property impacted.

This section describes vulnerabilities in terms of population, property, infrastructure and environment.

9.6.1 Population

A geographic analysis of demographics using the default HAZUS-MH Census Block inventory data was not possible due to the small size of the Reservation, and the fact that the Census Block data cannot be manipulated to such a confined area of the Reservation Boundaries.

For planning purposes, the entire population of the Reservation, as well as the transient population of visitors passing through the Reservation or visiting the Casino (estimated to be approximately 500 people per day) are considered at risk as a result of potential isolation, as well as the actual flood hazard. Currently, there are 120 residents living on the Reservation.

Additional consideration should also be given with respect to economically disadvantaged populations, as they many times do not have the means with which to adequately prepare with respect to food reserves and insurance. In addition, populations over 65 or under 14 are also at greater risk and should be considered for planning purposes. Based on U.S. Census[25] data estimates (2011 data) for Pacific County, 24.2 percent of the planning area's population is 65 or older. It is also estimated that 14 percent of the population is 14 or younger. According to U.S. Census data, 9.9 percent of the over-65 population have incomes below the poverty line. Children under 18 account for 26.3 percent of individuals who are below the poverty line. Approximately 36 percent of the married couples living on the Reservation with children below the age of 5 are also within the poverty level. As the Census data cannot be allocated to only to the Shoalwater Reservation, while these numbers are undoubtedly high, consideration of these issues should be accounted for during emergency management planning.

9.6.2 Property

HAZUS-MH calculates losses to structures from flooding by looking at depth of flooding and type of structure. Using historical flood insurance claim data, HAZUS-MH estimates the percentage of damage to structures and their contents by applying established damage functions to an inventory of structures.

[25] http://factfinder2.census.gov/faces/nav/jsf/pages/community_facts.xhtml#none

For purposes of identifying property at risk, the planning team utilized the analysis conducted for the 2008 plan development identified in Table 9-4. Once the new flood hazard maps are adopted, a new analysis will be conducted and updated information utilized.

Analysis identified 41 homes and Tribal facilities as falling within the 100- or 500-year floodplains, including the Casino, Tribal Center, Wellness Center and Gymnasium. In addition, Tribal properties at the "Y" location (intersection of Fisher and Kindred Avenues), Tokeland, as well as property at Toke Point are also located within the 100 year floodplain.

TABLE 9-4.
LOSS ESTIMATES FOR FLOOD

	Estimated Loss Associated with Flood		
	Structure	Contents	**Total**
Tribal Facilities & Infrastructure	$2,680,000	$1,800,000	$4,480,000
Residential – Tribal	$730,000	$380,000	$1,110,000
Private Residential	$920,000	$690,000	$1,610,000
Total	**$4,330,000**	**2,870,000**	**$7,200,000**

a. Impacted structures are those structures with finished floor elevations below the flood event water surface elevation. These structures are the most likely to receive significant damage in a flood event.

In addition, according to existing LIDAR data using 15' above mean-low/low water (MLLW) line for storm flood height, the following are at risk:

- 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.
- In most cases, tribal structures are not elevated above the floodplain levels.
- Properties: The tribal properties at the "Y location" (intersection of Fisher and Kindred Avenues), Tokeland as well as the Property at Toke Point are located in areas lower than 15' above MLLW.

9.6.3 Critical Facilities and Infrastructure

As defined earlier in this planning document, the planning team elected to reference all facilities on the Reservation as critical facilities, due to the limited number of residential structures and the inability to re-build those structures due to both lack of funding and limited land mass. Therefore, all items previously defined in the above tables are to be considered critical facilities and infrastructure exposed to the flood risk.

9.6.4 Environment

The environment vulnerable to flood hazard is the same as the environment exposed to the hazard. Loss estimation platforms such as HAZUS-MH are not currently equipped to measure environmental impacts of flood hazards. The best gauge of vulnerability of the environment would be a review of damage from past flood events. Loss data that segregates damage to the environment was not available at the time of this plan. Capturing this data from future events could be beneficial in measuring the vulnerability of the environment for future updates.

9.7 FUTURE TRENDS

The planning area has experienced slow-to-moderate growth over the past 10 years. The Tribe is optimistic that marginal, sustained growth will return to the planning area as the state and national economies strengthen, and as the Tribe is able to gather additional land mass in the surrounding area. This increased land mass will allow for further expansion for the Tribe, to include housing and business ventures.

The Tribe is equipped to handle future growth within flood hazard areas. Its general land use plan, when completed, will addresses frequently flooded areas. The Tribe has committed to linking its land use planning efforts to this hazard mitigation plan. This will create an opportunity for wise land use decisions as future growth impacts flood hazard areas.

Currently, the Shoalwater Bay Tribe adheres to those land use development codes which are imposed by agencies that provide federal funding for construction of infrastructure and buildings on the Reservation. As part of the NFIP, the Tribe also adheres to the regulatory authority associated with maintaining good standing within the program with respect to building in hazard zone areas and to specific standards. The Tribe currently utilizes the standards established by Pacific County to meet those guidelines. The Tribe is also developing its first land use authority, which will further establish standards for construction of residential and commercial buildings through adoption of the 2009 International Building Code.

The information in this plan provides the Tribe with tools to ensure that there is no increase in exposure in areas of high seismic, tsunami or flood risk. Development in the planning area will be regulated through building standards and performance measures so that the degree of risk will be reduced.

9.8 SCENARIO

The primary water courses in the planning area have the potential to flood at irregular intervals, generally in response to a succession of intense winter rainstorms or severe storms with during high tides. Storm patterns of warm, moist air usually occur between early October and late March/April timeframe. A series of such weather events can cause flooding in the planning area. The worst-case scenario is a series of storms that flood numerous drainage basins or culverts in a short time, or high winds pushing high tides onto the Reservation. This would overwhelm the response and floodplain management capability within the planning area. Major roads could be blocked, preventing critical access for many residents and critical functions. High channel flows could cause water courses to scour, possibly washing out roads and creating more isolation problems. In such instances, the Shoalwater Bay Tribe would not be able to make repairs quickly enough to restore critical facilities and infrastructure to those areas of the Reservation which have infrastructure. Obtaining resources needed, including for emergency services to those areas experiencing isolation as a result of the flooding would be difficult.

9.9 ISSUES

The planning team has identified the following flood-related issues relevant to the planning area:

- The risk associated with the flood hazard overlaps the risk associated with other hazards such as storm surge, erosion, earthquake, landslide and fishing losses. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.
- Potential climate change could impact flood conditions in the planning area.
- More information is needed on flood risk to support the concept of risk-based analysis of capital projects.

- There needs to be a sustained effort to gather historical damage data, such as high water marks on structures and damage reports, to measure the cost-effectiveness of future mitigation projects.
- Ongoing flood hazard mitigation will require funding from multiple sources.
- There needs to be a coordinated hazard mitigation effort between the Tribe, jurisdictions and private businesses affected by flood hazards in the planning area.
- Floodplain residents need to continue to be educated about flood preparedness and the resources available during and after floods.
- The concept of residual risk should be considered in the design of future capital flood control projects and should be communicated with residents living in the floodplain.
- Existing floodplain-compatible uses such as agricultural and open space need to be maintained. There is constant pressure to convert these existing uses to more intense uses within the planning area during times of moderate to high growth. As the Tribe has very limited land mass, this is especially true as it has no other options because of the limited space available. Support by federal agencies to increase the Tribe's land mass back to its original ancestral lands is needed to allow the Tribe to continue to grow and expand in membership, reservation population and increased business opportunities.

Chapter 10.
LANDSLIDE

10.1 GENERAL BACKGROUND

A landslide is a mass of rock, earth or debris moving down a slope. Landslides may be minor or very large, and can move at slow to very high speeds. They can be initiated by storms, earthquakes, fires, volcanic eruptions or human modification of the land.

Mudslides (or mudflows or debris flows) are rivers of rock, earth, organic matter and other soil materials saturated with water. They develop in the soil overlying bedrock on sloping surfaces when water rapidly accumulates in the ground, such as during heavy rainfall or rapid snowmelt. Water pressure in the pore spaces of the material increases to the point that the internal strength of the soil is drastically weakened. The soil's reduced resistance can then easily be overcome by gravity, changing the earth into a flowing river of mud or "slurry." A debris flow or mudflow can move rapidly down slopes or through channels, and can strike with little or no warning at avalanche speeds. The slurry can travel miles from its source, growing as it descends, picking up trees, boulders, cars and anything else in its path. Although these slides behave as fluids, they pack many times the hydraulic force of water due to the mass of material included in them. Locally, they can be some of the most destructive events in nature.

DEFINITIONS

Landslide — The sliding or movement of masses of loosened rock and soil down a slope. Such failures occur when the strength of the slope soils is exceeded by the pressure, such as weight or saturation, acting upon them.

Mass Movement—A collective term for landslides, debris flows, falls and sinkholes.

Mudslide (or Mudflow or Debris Flow)—A river of rock, earth, organic matter and other materials saturated with water.

All mass movements are caused by a combination of geological and climate conditions, as well as the encroaching influence of urbanization. Vulnerable natural conditions are affected by human residential, agricultural, commercial and industrial development and the infrastructure that supports it.

10.2 HAZARD PROFILE

Landslides are caused by one or a combination of the following factors: change in slope of the terrain, increased load on the land, shocks and vibrations, change in water content, groundwater movement, and frost action, weathering of rocks, and removing or changing the type of vegetation covering slopes. In general, landslide hazard areas are where the land has characteristics that contribute to the risk of the downhill movement of material, such as the following:

- A slope greater than 15 percent
- A history of landslide activity or movement during the last 10,000 years
- Stream or wave activity, which has caused erosion, undercut a bank or cut into a bank to cause the surrounding land to be unstable
- The presence or potential for snow avalanches
- The presence of an alluvial fan, indicating vulnerability to the flow of debris or sediments
- The presence of impermeable soils, such as silt or clay, which are mixed with granular soils such as sand and gravel.

Flows and slides are commonly categorized by the form of initial ground failure. Figure 10-1 through Figure 10-4 show common types of slides. The most common is the shallow colluvial slide, occurring particularly in response to intense, short-duration storms. The largest and most destructive are deep-seated slides, although they are less common than other types.

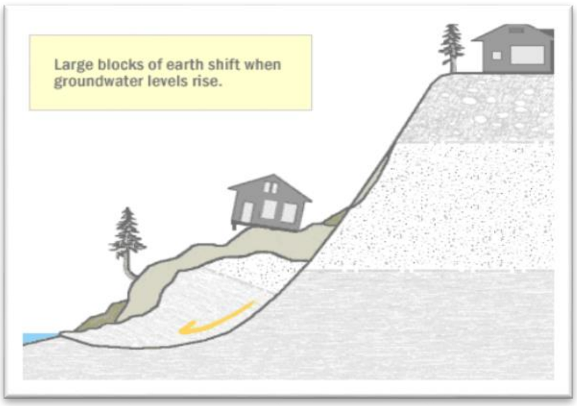


Figure 10-1. Deep Seated Slide

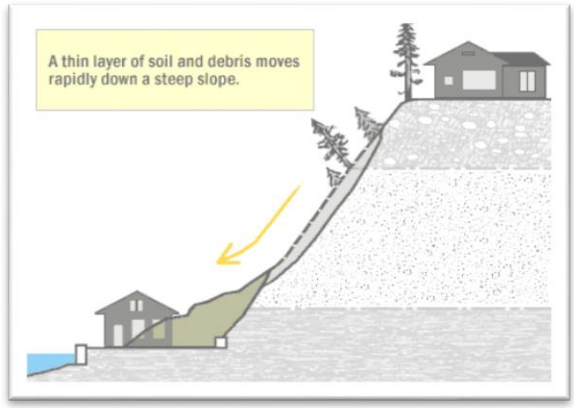


Figure 10-2. Shallow Colluvial Slide

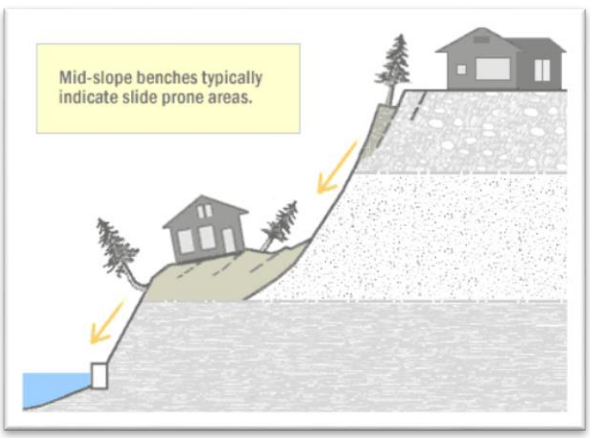


Figure 10-3. Bench Slide

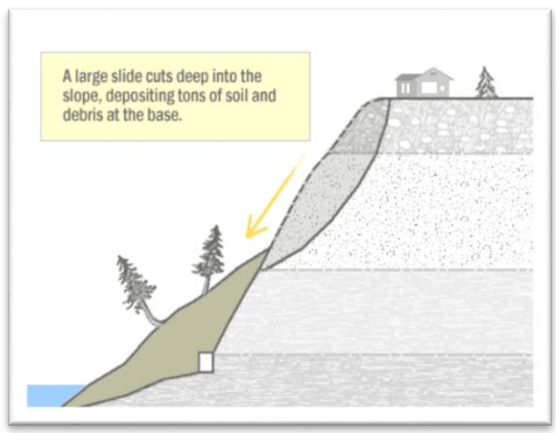


Figure 10-4. Large Slide

Slides and earth flows can pose serious hazard to property in hillside terrain. They tend to move slowly and thus rarely threaten life directly. When they move—in response to such changes as increased water content, earthquake shaking, addition of load, or removal of downslope support—they deform and tilt the ground surface. The result can be destruction of foundations, offset of roads, breaking of underground pipes, or overriding of downslope property and structures. Figure 10-5 and Figure 10-6 illustrate additional causes and types of slides which can occur.

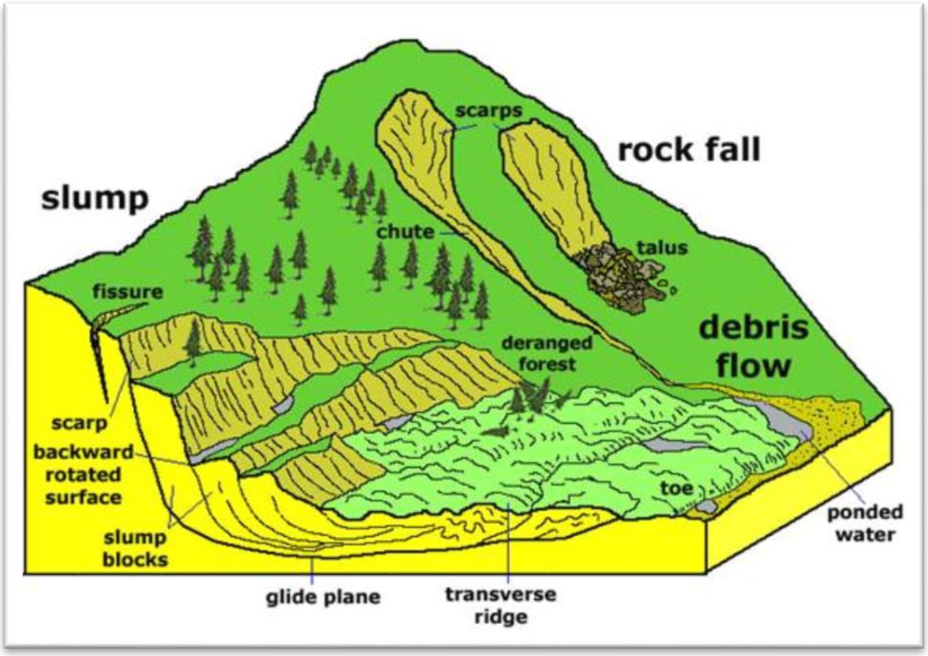


Figure 10-5. Types of Landslides

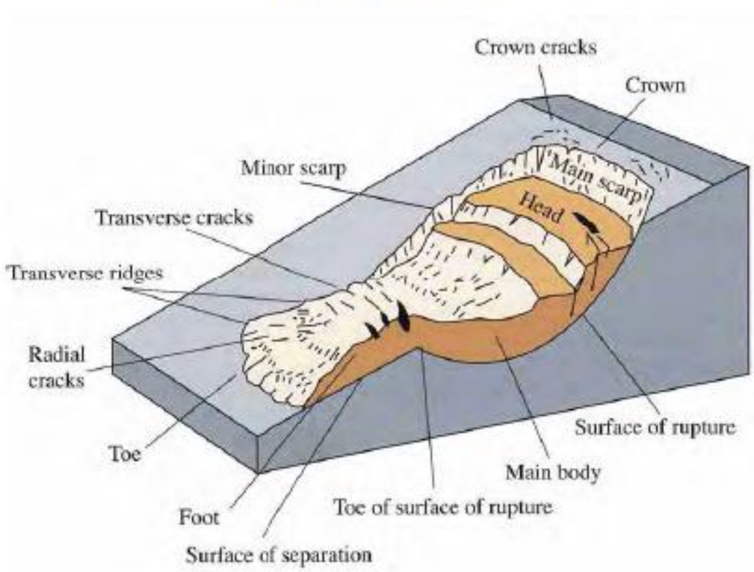


Figure 10-6. Landslide Components

10.2.1 Past Events

While slides are common in the planning area during winter weather events, little record of damage has been recorded. Review of Washington State DNR data, SHELDUS data, and FEMA disaster data provides only limited historic information for Pacific County; those which are listed are combined with other disaster-type events as identified in Table10-1. No data is listed specifically for the Shoalwater Reservation. The Washington State Hazard Mitigation Plan identifies Pacific County as one of the

Counties statewide most susceptible to landslide issues. Washington State Department of Natural Resources also identifies areas at risk for potential shallow landslides as identified in Figure 10-7[26].

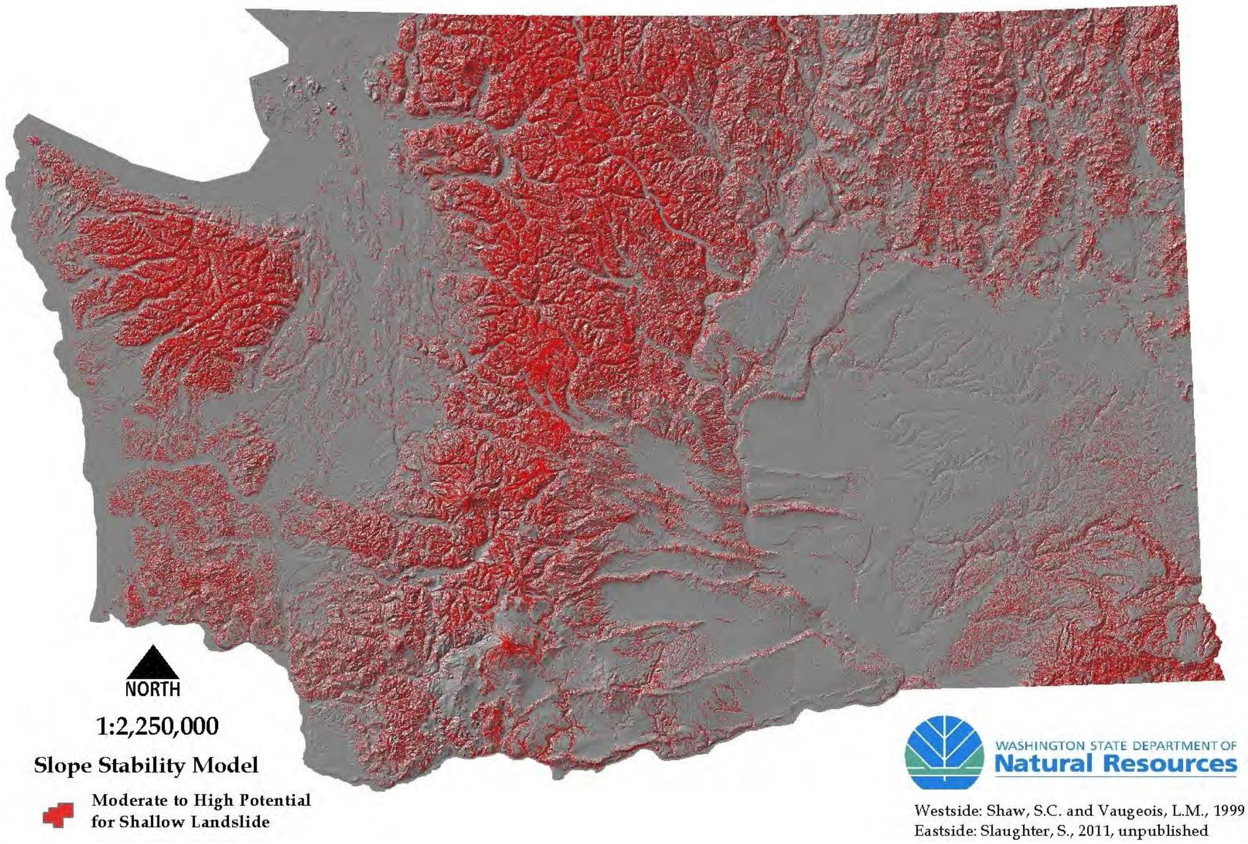


Figure 10-7. Washington DNR Unpublished Slope Stability Map

History has demonstrated that slides and mudflows develop when water rapidly accumulates in the ground, such as during heavy rainfall (or rapid snowmelt), changing the earth into a flowing river of mud. More than 30 percent of the Reservation or the area leading into or off of the Reservation is over 15% slope as identified in Table 10-2**.**

[26] Washington Department of Natural Resources (2011), unpublished map: Slope Stability Model for Shallow Landslide Potential, West and East Side.

TABLE 10-1.
LANDSLIDE AREAS OF IMPACT PACIFIC COUNTY 1956-2013

Begin Date	Hazard Type/ Disaster Number	County	Injuries	Fatalities	Property Damage	Crop Damage
1/26/1965	Flooding - Landslide - Winter Weather	Pacific	0	0	12820.51	0
2/27/1972	Flooding - Landslide - Severe Storm/Thunder Storm - Wind	Pacific	0.25	0	41666.7	4166.67
12/18/1972	Coastal - Flooding - Landslide	Pacific	0	0	18518.52	0
3/5/1972	Flooding - Landslide - Wind	Pacific	0	0	2777.78	2777.78
12/10/1977	Severe Storms, Mudslides, & Flooding	Pacific	Unknown	Unknown	Unknown	Unknown
1/17/1997	Severe Winter Storms, Land & Muds Slides, Flooding	Pacific	Unknown	Unknown	Unknown	Unknown
4/2/1997	Heavy Rains, Snow Melt, Flooding, Land & Mud Slides	Pacific	Unknown	Unknown	Unknown	Unknown
5/17/2006	Severe Storms, Flooding, Tidal Surge, Landslides, And Mudslides	Pacific	Unknown	Unknown	Unknown	Unknown
12/12/2006	Severe Storms, Flooding, Landslides, And Mudslides	Pacific	Unknown	Unknown	Unknown	Unknown
2/14/2007	Severe Winter Storm, Landslides, And Mudslides	Pacific	Unknown	Unknown	Unknown	Unknown
12/8/2007	Severe Storms, Flooding, Landslides, And Mudslides	Pacific	Unknown	Unknown	Unknown	Unknown
1/30/2009	Severe Winter Storm, Landslides, Mudslides, And Flooding	Pacific	Unknown	Unknown	Unknown	Unknown

Source: FEMA and SHELDUS

TABLE 10-2.
PERCENT SLOPE

Slope (degrees˚)	Area (Acres)	Area (Sq. Mi.)	Percent of Total
0˚- 8.5˚	503.58	0.7868	61.75%
8.51˚- 15˚	57.31	0.0895	7.03%
15.01˚- 25.6˚	48.22	0.0753	5.91%
25.61˚- 34.2˚	24.67	0.0385	3.03%
34.21˚- 42.7˚	24.36	0.0381	2.99%
42.7˚- 51.3˚	30.17	0.0471	3.70%
51.31˚- 59.8˚	34.54	0.0539	4.24%
59.81˚- 68.4˚	43.04	0.0673	5.28%
68.41˚ - 76.9˚	37.47	0.0585	4.59%
76.91˚ - 85.5˚	12.15	0.0189	1.49%
Total	815.51	1.2739	100.00%

10.2.2 Location

Within the planning area, landslides and soil slips are common due to the combination of sheared rocks, shallow soil profile development, steep slopes, and heavy seasonal precipitation. The best available predictor of where movement of slides and earth flows might occur is the location of past movements. Past landslides can be recognized by their distinctive topographic shapes, which can remain in place for thousands of years. Most landslides recognizable in this fashion range from a few acres to several square miles. A small proportion of them may become active in any given year, with movements concentrated within all or part of the landslide masses or around their edges.

The recognition of ancient dormant mass movement sites is important in the identification of areas susceptible to flows and slides because they can be reactivated by earthquakes or by exceptionally wet weather. Also, because they consist of broken materials and frequently involve disruption of groundwater flow, these dormant sites are vulnerable to construction-triggered sliding. Within the Shoalwater Bay Reservation, 350 feet of the hillside north of Eagle Hill Road (overlying the Shoalwater Tribe's water main) is subject to frequent landslides from unstable slopes (Chadwick, 2011). This area is of significant concern because of the fact that Eagle Hill Road is the Tribe's evacuation route and evacuation site for the entire Reservation for all hazards of concern.

The Shoalwater Bay Tribal lands are located in one of the six landslide provinces of Washington State – the Southwest Washington province. 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 10-8 demonstrates the slope stability on the Reservation. Figure 10-9 demonstrates the slope stability in the area of the structures which are off the current Reservation boundary.

In addition, the Washington State Department of Transportation has identified in Figure 10-10[27] several areas of concern within Pacific County due to unstable slopes, which would impact ingress and egress onto the Reservation.

[27] http://www.wsdot.wa.gov/NR/rdonlyres/6E3AABB2-65B4-4CAF-90B1-149CFAC1C4E8/0/Section3_ProblemHwyCorUnstableSlopes.pdf

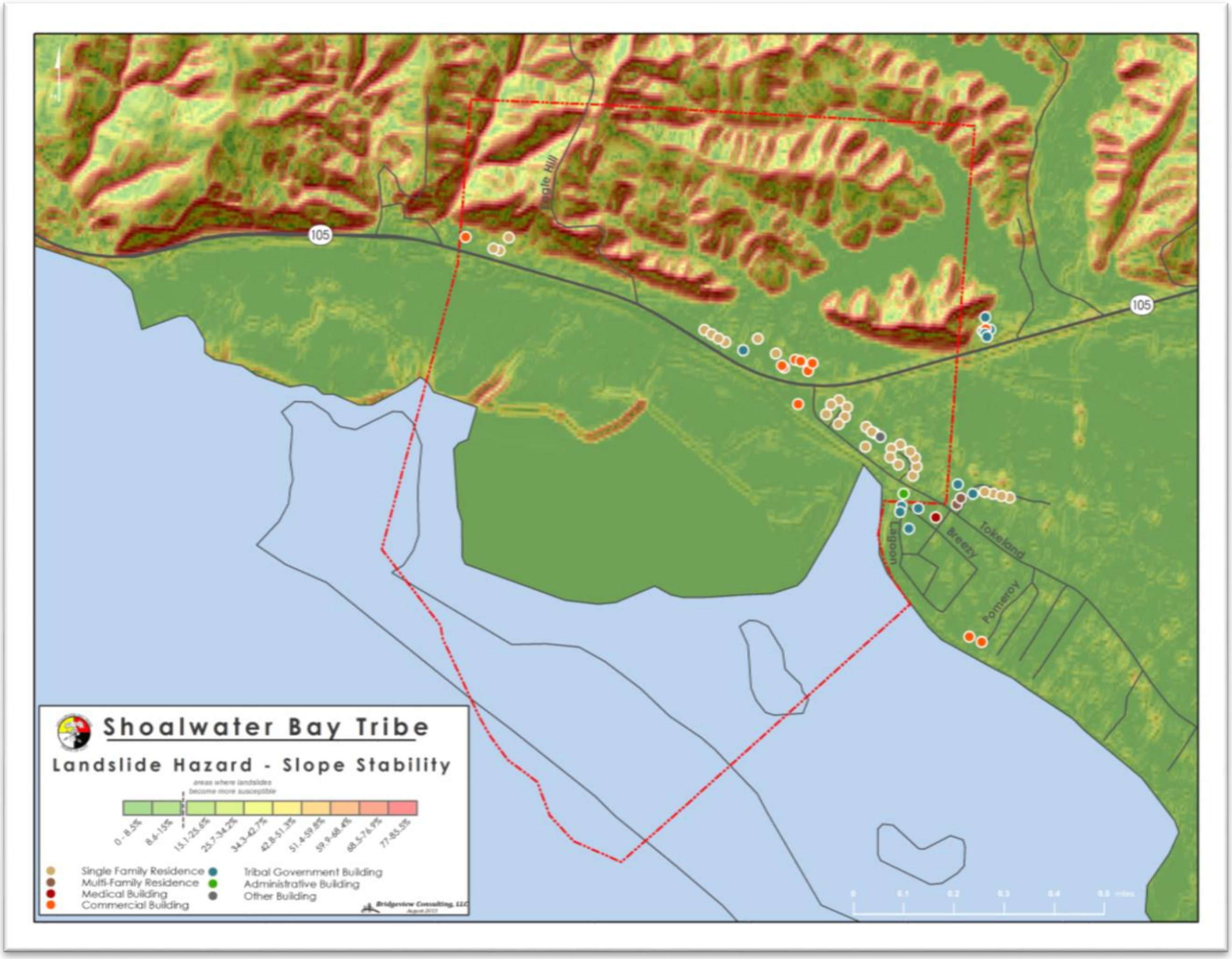


Figure 10-8. Slope Stability and Structures on Shoalwater Reservation

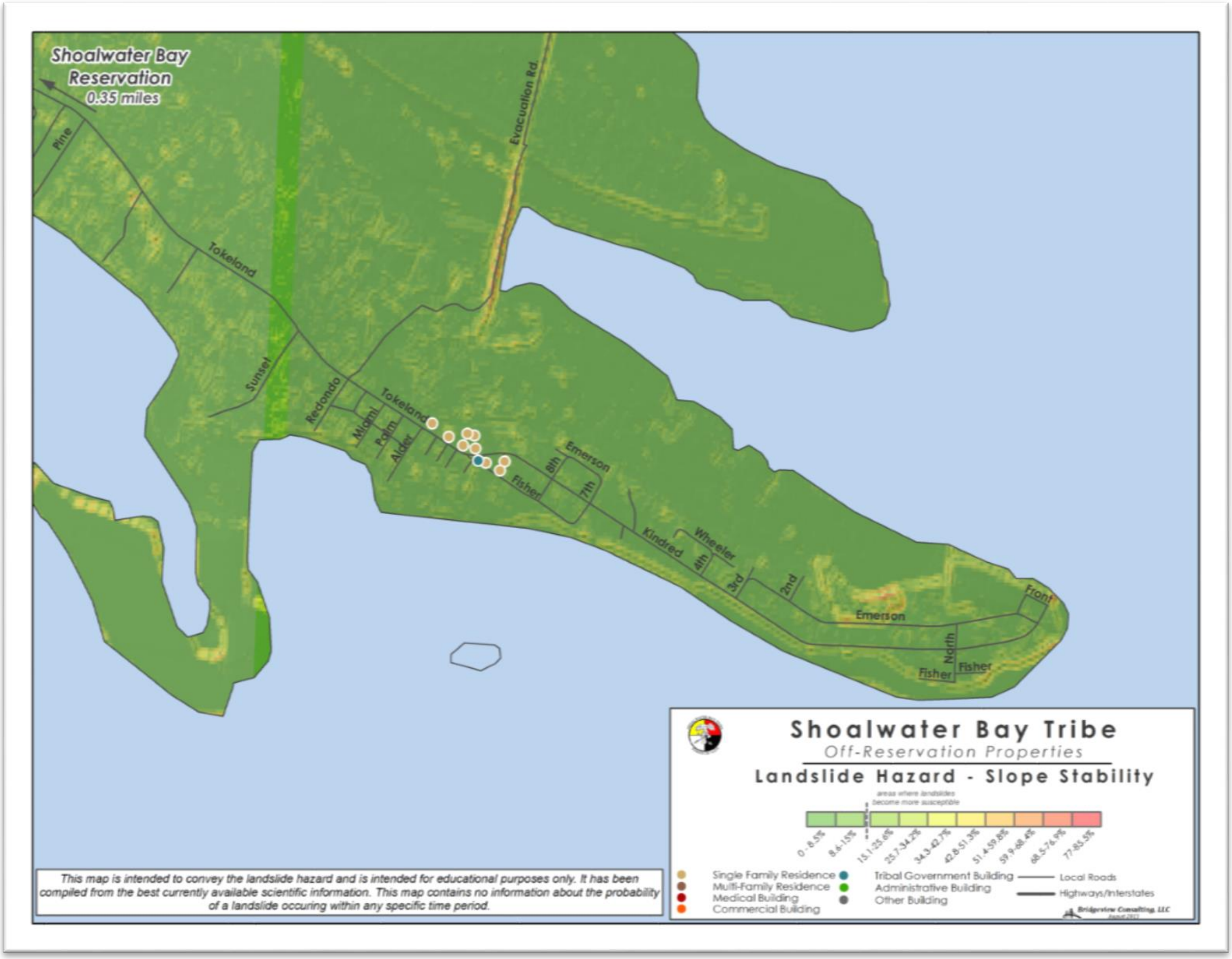


Figure 10-9. Slope Stability and Shoalwater Bay Tribal-Owned Structures off Reservation

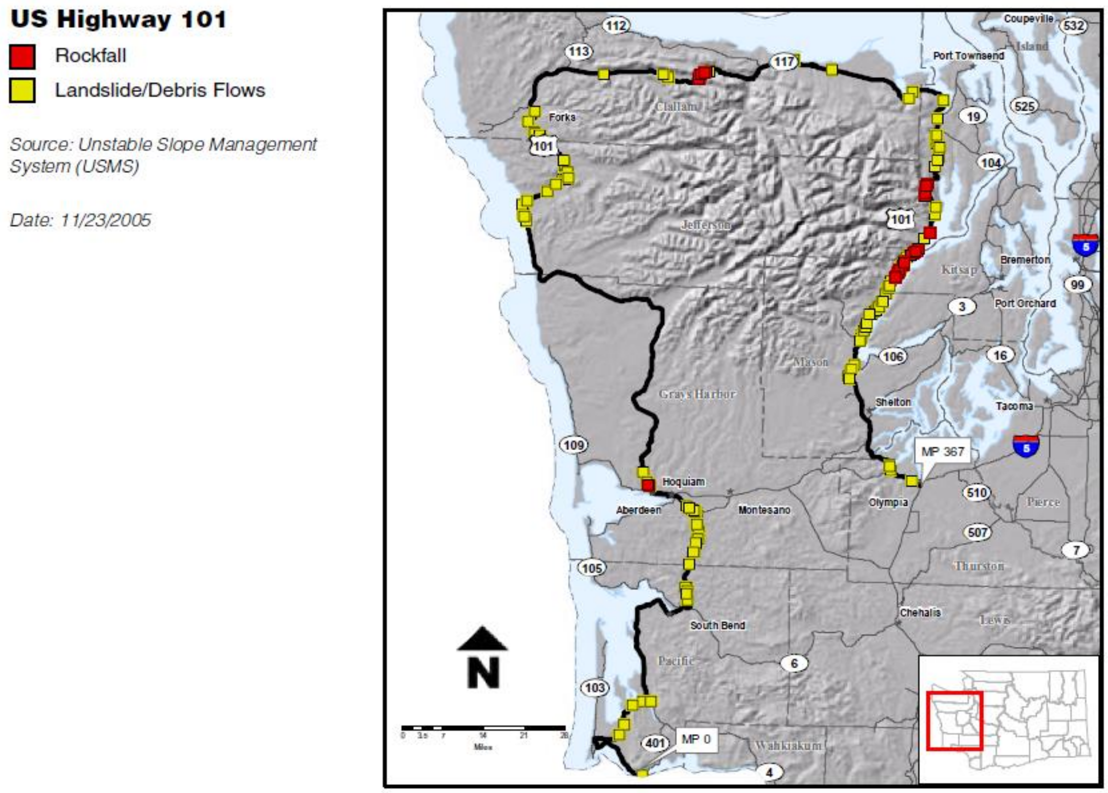


Figure 10-10. WA DOT Unstable Slopes US Highway 101

10.2.3 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 these triggering events. In Pacific County, as with all coastal bluffs, U.S. 101, 103, 105 and 109 Highway corridors, landslides have been active in the recent past. Although landslides typically occur during and after major storms, they also occur naturally in average rainfall years in remote and non-human impacted areas as is the case in the planning region. Dormant to relict deep-seated landslides in the Willapa Hills of Southwest Washington are a concern because of their potentially large size and the impact on commerce and utility corridors for the rural coastal communities. Deep seated landslides typically occur along the deeply weathered soil interface with the bedroom. Reactivation of such slides, while generally occurring slowly, can consist of a few feet of movement in a particular episode, usually in the late-winter or early spring, after an unusually wet winter, or during intense precipitation events. Even a small amount of movement can cause severe damage to structures and utilities. It is also likely that a number of the larger, dormant to relict landslides in the Willapa Hills have historically failed during strong ground shaking in this area, and are susceptible to do so again.

According to the Washington State Hazard Mitigation Plan, Pacific County is among those counties identified by the Washington State Department of Natural Resources and the U.S. Geologic Survey as having the greatest vulnerability to landslides.

10.2.4 Severity

Landslides destroy property, infrastructure and transportation systems, and can take the lives of people in the path of the slide. The March 22, 2014 landslide in Snohomish County took the lives of 41 people, destroyed millions of dollars of property, and caused the closure of a major arterial through the county, causing millions of dollars in economic losses. Nationally, prior to this incident, the United States had averaged 25 lives lost annually, with economic losses of approximately $1.5 billion.

The Tribe has experienced slides on various parts of the Reservation. Eagle Hill Road has previously experienced numerous slides, which is of significant concern because this is an evacuation route for the Reservation, as well as the area which maintains a significant amount of the Tribe's storage of emergency supplies. In addition, there are residential structures on top of the hill. Should the hillside slump or give way, the impact could have significant impacts on the Reservation and its population.

10.2.5 Warning Time

Mass movements can occur suddenly or slowly. The velocity of movement may range from a slow creep of inches per year to many feet per second, depending on slope angle, material and water content. Some methods used to monitor mass movements can provide an idea of the type of movement and the 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 an area can help in these predictions. However, there is no practical warning system for individual landslides. The current standard operating procedure is to monitor situations on a case-by-case basis, and respond after the event has occurred.

Generally accepted warning signs for landslide activity include:

- Springs, seeps, or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavements or sidewalks
- Soil moving away from foundations
- Ancillary structures such as decks and patios tilting and/or moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities
- Leaning telephone poles, trees, retaining walls or fences
- Offset fence lines
- Sunken or down-dropped road beds
- Rapid increase in creek water levels, possibly accompanied by increased turbidity (soil content)
- Sudden decrease in creek water levels though rain is still falling or just recently stopped
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb
- A faint rumbling sound that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together.

10.3 SECONDARY HAZARDS

Landslides can cause several types of secondary effects, such as blocking access to roads, which can isolate residents and businesses and delay 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 or poles on slopes can be knocked over, resulting in possible losses to power and communication lines. Landslides also have the potential of destabilizing the foundation of structures, which may result in monetary loss for residents. They also can damage rivers or streams, potentially harming water quality, fisheries and spawning habitat. In the case of the Shoalwater Tribe, a landslide on Eagle Hill Road could also block and hinder the Tribe's ability to evacuate.

10.4 CLIMATE CHANGE IMPACTS

Climate change may impact storm patterns, increasing the probability of more frequent, intense storms with varying duration. Increase in global temperature could affect the snowpack and its ability to hold and store water. Warming temperatures also could increase the occurrence and duration of droughts, which would increase the probability of wildfire, reducing the vegetation that helps to support steep slopes. All of these factors would increase the probability for landslide occurrences.

10.5 EXPOSURE

10.5.1 Population

Population could not be examined by landslide hazard area in the customary manner of using census block information because accurate census block information does not exist for the Reservation. The most significant factor for the reservation population is the potential landslide area cutting off ingress and egress, which has the potential to impact a large percentage of tribal members, as well as any outsiders who may be trapped on the reservation should a landslide occur. The evacuation of the Reservation could also be impacted due to a slide on Eagle Hill Road.

10.5.2 Property

Currently, one residential structure on the Reservation is in a landslide prone area, valued at ~$130,000. However, over 30% of the total acreage of the Reservation's land mass is included within the elevated landslide susceptibility area. There are a number of cultural resources that also could be impacted by landslides, depending on their size. Those resources have been discussed during steering/planning team meetings, and strategies to address them will be developed separately from this document due to the sensitive nature of the cultural resources. The predominant land use on the reservation is single-family residences, which many times support multiple families. Table 10-3 shows the number and assessed value of structures exposed to the landslide risk.

10.5.3 Critical Facilities and Infrastructure

Table 10-4 summarizes the critical facilities exposed to the landslide hazard. As previously indicated, all structures on the Reservation were considered as being critical by the planning team due to the limited resources available to the Tribe. No loss estimation of these facilities was performed due to the lack of established damage functions for the landslide hazard.

TABLE 10-3.
EXPOSURE AND VALUE OF STRUCTURES IN LANDSLIDE RISK AREAS

Number of Buildings Exposed	1
Value Exposed	
Structure	$130,000
Contents	$ 65,000
Total	**$195,000**
Exposed Value as % of Total Assessed Value	<1%

TABLE 10-4.
STRUCTURES EXPOSED TO LANDSLIDE RISK AREAS

	Number of Exposed Structures in Risk Area
Government Non-Tribal	1
Non Residential	1
Single Family Residential	19
Total	**21**

A significant amount of infrastructure can be exposed to mass movements which has the potential to impact the Tribe. This includes infrastructure both on and off the Reservation:

- **Roads**—Access to major roads is crucial to life-safety after a disaster event and to response and recovery operations. Landslides can block egress and ingress on roads, causing isolation for neighborhoods, traffic problems and delays for public and private transportation. This can result in economic losses for businesses.
- **Bridges**—Landslides can significantly impact road bridges. Mass movements can knock out bridge abutments or significantly weaken the soil supporting them, making them hazardous for use. While the Reservation itself has no bridges on the Reservation, there are several bridges within Pacific County which provided ingress and egress to the Reservation which could be impacted by landslides.
- **Power Lines—**Power lines are generally elevated above steep slopes; but the towers supporting them can be subject to landslides. A landslide could trigger failure of the soil underneath a tower, causing it to collapse and ripping down the lines. Power and communication failures due to landslides can create problems for vulnerable populations and businesses.
- **Water Systems—**Surface Water systems, intake systems, and above ground water lines and tanks are also at risk from landslides. Given the Tribe’s limited infrastructure in place, coupled with the economic impact repair to damages sustained as a result of a landslide event would create, a significant issue would exist for the entire population living and doing business on the Reservation. The Tribe’s Potable Water System is in the northern part of the Reservation, which is made up of steep hills subject to increased landslide susceptibility.

10.5.4 Environment

Environmental problems as a result of mass movements can be numerous. Landslides that fall into streams may significantly impact fish and wildlife habitat, as well as affecting water quality. Hillsides that provide wildlife habitat can be lost for prolonged periods of time due to landslides.

10.6 VULNERABILITY

10.6.1 Population

Due to the nature of census block group data, it is difficult to determine demographics of populations vulnerable to mass movements. In general, all of the estimated residential buildings exposed to landslide hazard areas are considered to be vulnerable. Increasing population and the fact that many homes are built on view property atop or below bluffs and on steep slopes subject to mass movement, increases the number of lives endangered by this hazard.

10.6.2 Property

Although complete historical documentation of the landslide threat in the planning area is limited, landslides occurring in 2010, 2011 and 2012 suggest a significant vulnerability to such hazards. The dollars in damage attributable to mass movement during those storms affected private property, public infrastructure and facilities, including the Tribe's primary evacuation route. The Tribe has been attempting to shore-up the area and repair slide damage since 2010.

Loss estimations for the landslide hazard are not based on modeling utilizing damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing 10 percent, 30 percent and 50 percent of the assessed value of exposed structures. This allows emergency managers to select a range of economic impact based on an estimate of the percent of damage to the general building stock. Damage in excess of 50 percent is considered to be substantial by most building codes and typically requires total reconstruction of the structure. Table 10-5 identifies the general building stock loss estimates in landslide risk areas.

Table 10-5.
Loss Estimates for Landslide

Total Exposed Value	$27,400,000
Estimated Loss Potential from Landslide	
10% Damage	$2,740,000
30% Damage	$8,220,000
50% Damage	$13,700,000

10.6.3 Critical Facilities and Infrastructure

Current landslide data available does not allow for the identification of any facilities exposed to the landslide hazard, in part, due to the lack of available data which addresses this hazard. The Tribe has previously experienced impact from landslides, such as to Eagle Hill Road, which has been impacted by slide events a minimum of two times in recent history (2011 and 2012). While limited data has been retained, retention and capturing of such data has been included within the mitigation plan as a strategy to allow for more specific information in future updates. At present, a more in-depth analysis for mitigation measures to be taken by potentially impacted facilities and structures to prevent damage from mass movements should be done to determine if they could withstand impacts of a mass movement. This will mean engineered studies to determine structural code capacity, as well as continued collaboration with those state agencies currently responsible for capturing landslide data and analysis.

Several types of infrastructure are exposed to mass movements, including transportation, water and sewer and power infrastructure. Highly susceptible areas of the planning area include mountain and coastal roads and transportation infrastructure. At this time, all infrastructure and transportation corridors identified as exposed to the landslide hazard are considered vulnerable until more information becomes available.

Roads critical to the Reservation which provide escape routes during hazard incidents include: US Highways 101, 103, 105 and 109 (running the entire coastal area of the Reservation, including roadways of ingress and egress through Pacific and Grays Harbor Counties), and Eagle Hill Road, among others. As indicated, the transportation system on the Reservation is very limited, with most of these roadways susceptible to landslide hazards.

10.6.4 Environment

The environment vulnerable to landslide hazard is the same as the environment exposed to the hazard.

10.7 FUTURE TRENDS IN DEVELOPMENT

While experiencing low-to-minimal growth over the past 10 years, it is hoped that with new programs and the expansion and development of new business opportunities being created with the acquisition and growth of the Tribe's Casino, hotel and new restaurant, that the population will again begin to climb more steadily. The Tribe is optimistic that marginal, sustained growth will return to the planning area as the state and national economies strengthen, and as the tribe is able to re-acquire additional land mass, allowing for the expansion of the Tribe.

The Shoalwater Bay Tribe is equipped to handle future growth within landslide hazard areas once its land use authority has been completed and adopted by the Tribe. Its land use guidelines, which are currently under development, will address landslide risk areas. The Tribe has committed to linking its land use plans to this hazard mitigation plan. This will create an opportunity for wise land use decisions as future growth impacts landslide hazard areas. Additionally, the State of Washington has adopted the International Building Code (IBC) by reference in its Building Standards Code. The IBC includes provisions for geotechnical analyses in steep slope areas that have soil types considered susceptible to landslide hazards. These provisions assure that new construction is built to standards that reduce the vulnerability to landslide risk. While the Tribe is not bound to adhere to State Building Codes, the Tribe does build to IBC standards and codes on construction projects occurring on the Reservation in an effort to maintain the safety of all Tribal members and visitors to the Reservation.

10.8 SCENARIO

Major landslides in the planning area occur as a result of soil conditions that have been affected by severe storms, groundwater or human development. The worst-case scenario for landslide hazards in the planning area would generally correspond to a severe storm that had heavy rain and caused flooding. Landslides are most likely during late winter when the water table is high. After heavy rains from October to April, soils become saturated with water. As water seeps downward through upper soils that may consist of permeable sands and gravels and accumulates on impermeable silt, it will cause weakness and destabilization in the slope. A short intense storm could cause saturated soil to move, resulting in landslides. As rains continue, the groundwater table rises, adding to the weakening of the slope. Gravity, poor drainage, a rising groundwater table and poor soil exacerbate hazardous conditions.

Mass movements are becoming more of a concern as development moves outside of urban centers and into areas less developed in terms of infrastructure. As is the case on the Reservation, while most mass movements would be isolated events affecting specific areas, the impact of those mass movements have the potential to restrict ingress and egress to entire areas within the planning area. It is probable that private and public property, including infrastructure, will be affected. Road obstructions caused by mass movements would create isolation problems for residents and businesses in sparsely developed areas. Property owners exposed to steep slopes may suffer damage to property or structures. Landslides carrying vegetation such as shrubs and trees may cause a break in utility lines, cutting off power and communication access to residents. As utility lines, power and communication systems are very limited, this would be a devastating incident, and make impact not only the Tribe's ability to grow in the future, but also impact their ability to return to the levels before such an incident occurred.

Continued heavy rains and flooding will complicate the problem further. As emergency response resources are applied to problems with flooding, it is possible they will be unavailable to assist with landslides occurring all over the planning area.

10.9 ISSUES

Important issues associated with landslides in the planning area include the following:

- There are existing homes in landslide risk areas throughout the planning area. The degree of vulnerability of these structures depends on the codes and standards the structures were constructed to. Information to this level of detail is not currently available for all structures.
- Future development could lead to more homes in landslide risk areas.
- Mapping and assessment of landslide hazards are constantly evolving. As new data and science become available, assessments of landslide risk should be reevaluated.
- The impact of climate change on landslides is uncertain. If climate change impacts atmospheric conditions, then exposure to landslide risks is likely to increase.
- Landslides may cause negative environmental consequences, including water quality degradation, impact fish spawning, and destroy culturally sensitive areas.
- The risk associated with the landslide hazard overlaps the risk associated with other hazards such as earthquake, flood and wildfire. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.

Chapter 11.
SEVERE WEATHER

11.1 HAZARD PROFILE

Severe weather refers to any dangerous meteorological phenomena with the potential to cause damage, serious social disruption, or loss of human life. It includes thunderstorms, downbursts, tornadoes, waterspouts, snowstorms, ice storms, and dust storms.

Severe weather can be categorized into two groups: those that form over wide geographic areas are classified as general severe weather; those with a more limited geographic area are classified as localized severe weather. Severe weather, technically, is not the same as extreme weather, which refers to unusual weather events are at the extremes of the historical distribution for a given area.

Severe weather events that most typically impact the planning area are: fog, storm surge, damaging winds and thunderstorms.

<u>**DEFINITIONS**</u>

Freezing Rain—The result of rain occurring when the temperature is below the freezing point. The rain freezes on impact, resulting in a layer of glaze ice up to an inch thick. In a severe ice storm, an evergreen tree 60 feet high and 30 feet wide can be burdened with up to six tons of ice, creating a threat to power and telephone lines and transportation routes.

Severe Local Storm—"Microscale" atmospheric systems, including tornadoes, thunderstorms, windstorms, ice storms and snowstorms. These storms may cause a great deal of destruction and even death, but their impact is generally confined to a small area. Typical impacts are on transportation infrastructure and utilities.

Thunderstorm—A storm featuring heavy rains, strong winds, thunder and lightning, typically about 15 miles in diameter and lasting about 30 minutes. Hail and tornadoes are dangers associated with thunderstorms. Lightning is a threat to human life. Heavy rains over a small area in a short time can lead to flash flooding.

Tornado—Funnel clouds that generate winds up to 500 miles per hour. They can affect an area up to three-quarters of a mile wide, with a path of varying length. Tornadoes can come from lines of cumulonimbus clouds or from a single storm cloud. They are measured using the Fujita Scale, ranging from F0 to F5.

Windstorm—A storm featuring violent winds. Southwesterly winds are associated with strong storms moving onto the coast from the Pacific Ocean. Southern winds parallel to the coastal mountains are the strongest and most destructive winds. Windstorms tend to damage ridgelines that face into the winds.

Winter Storm—A storm with significant snowfall, ice, or freezing rain; the quantity of precipitation varies by elevation.

11.2 GENERAL BACKGROUND

Factors that affect the climate include:

- **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 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 area. 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 planning area. Condensation occurs as the air moves inland and rises along the windward mountain slopes. This results in a wet season beginning in late October or November, reaching a peak in winter, and decreasing by late spring.

Temperature (Excessive Heat or Cold)

Temperatures along the coastal ranges of the Reservation are relatively mild as defined in Table 11-1 and Figure 11-1. The Shoalwater Bay Reservation experiences a predominantly marine climate associated with a coastal presence. The coastal water temperature adjacent to Willapa Bay ranges from 48-58 degrees year round. Cooling breezes off the Pacific Ocean regulate the moderate temperatures along the coast, with average temperature ranging from 34.9 degrees to 72.4 degrees. Summers are cool and relatively dry; winters are mild, wet and cloudy. Peak summertime heat occurs during August to September, with temperatures rarely exceeding 80 degrees; however, contrary to the average temperatures, the Tribe has experienced a few days where temperatures have reached 100 degrees. Wintertime cold temperatures seldom drop to 30 degrees, with only a few occasions of snow occurring within the planning area. It is anticipated that with climate change, temperatures will increase, which will, ultimately also increase water temperatures.

The average warmest months are August and September. On average, the coolest month is December. Snow on the Reservation is not common, but a small amount does fall most winters. Roadways off the reservation which serve as the main thoroughfares are often difficult to travel during winter snowstorms, as they customarily are not cleared. This makes it more difficult for residents to obtain vital goods and services as shipments are delayed. The Tribe has not been impacted by excessive heat or cold issues, although they do have plans in place should such an event occur for cooling and warming stations within their shelter facility.

TABLE 11-1.
MONTHLY TEMPERATURES*

Month	Average Maximum	Average Minimum
January	47.2	38
February	49.7	37.7
March	52.4	39.6
April	55.5	41.9
May	59.7	46.3
June	63.2	50.5
July	66.6	53.2
August	67.6	53.6
September	66.6	50.8
October	59.1	45.4
November	51.1	40.4
December	46.2	36.9

*These numbers are approximate as no recorded weather station exist on Reservation

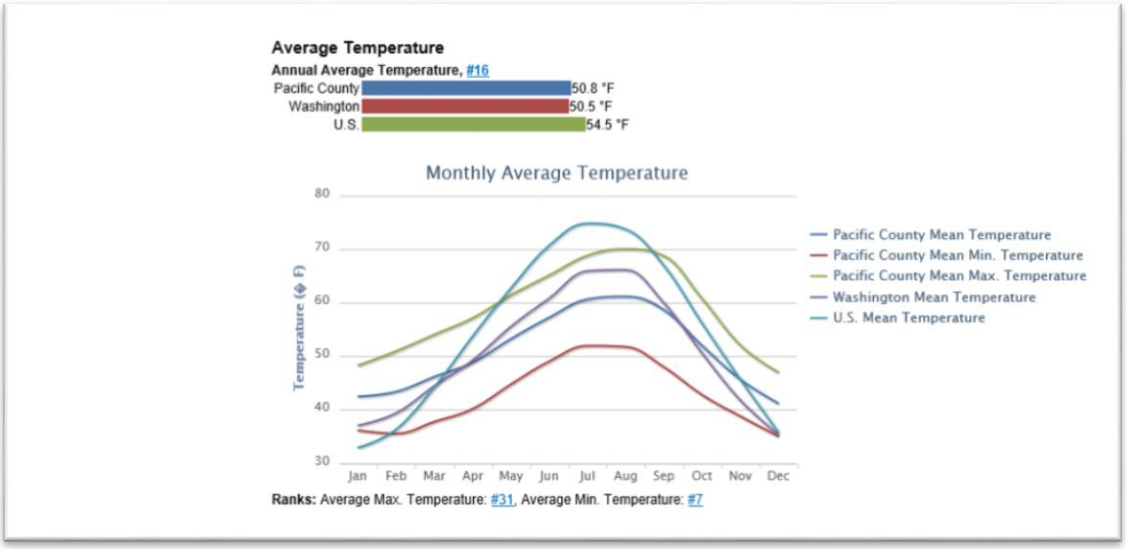


Figure 11-1. Average Monthly Temperatures

Precipitation

Limited recorded data is available specific to the area of the Shoalwater Bay Reservation. As such, much of the weather data captures information from surrounding sites as recorded by NOAA, SHELDUS, etc.

Measurable precipitation occurs approximately 190 days each year along the coast. Damaging hailstorms rarely occur. During July, August, and September, the driest months, two to four weeks can pass with only a few showers; however, in December and January, the wettest months, precipitation is frequently recorded on 20 to 25 days or more each month. Snowfall is light in the lower elevations along the coastline. During the wet season, rainfall is usually of light to moderate intensity and continuous over a long period rather than occurring in heavy downpours for brief periods; heavier intensities occur along the windward slopes of the mountains. Average rainfall annually on the Reservation is approximately 87 inches[28] (Figure 11-2)

[28] http://www.usa.com/pacific-county-wa-weather

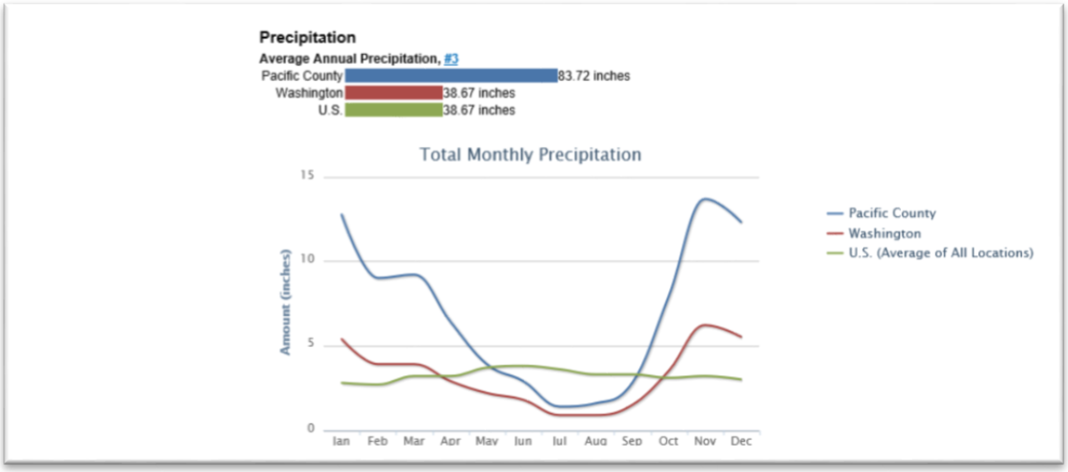


Figure 11-2. Average Monthly Precipitation

Thunderstorm

A thunderstorm is a rain event that includes thunder and lightning. A thunderstorm is classified as "severe" when it contains one or more of the following: hail with a diameter of three-quarter inch or greater, winds gusting in excess of 50 knots (57.5 mph), or tornado. While somewhat rare, thunderstorms can occur up to 10 days each year over the lower elevations of the Reservation.

Three factors cause thunderstorms to form: moisture, rising unstable air (air that keeps rising when disturbed), and a lifting mechanism to provide the disturbance. The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise (hills or mountains can cause rising motion, as can the interaction of warm air and cold air or wet air and dry air) it will continue to rise as long as it weighs less and stays warmer than the air around it. As the air rises, it transfers heat from the surface of the earth to the upper levels of the atmosphere (the process of convection). The water vapor it contains begins to cool and it condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice and some of it turns into water droplets. Both have electrical charges. Ice particles usually have positive charges, and rain droplets usually have negative charges. When the charges build up enough, they are discharged in a bolt of lightning, which causes the sound waves we hear as thunder. Thunderstorms have three stages (see Figure 11-3):

- The ***developing stage*** of a thunderstorm is marked by a cumulus cloud that is being pushed upward by a rising column of air (updraft). The cumulus cloud soon looks like a tower (called towering cumulus) as the updraft continues to develop. There is little to no rain during this stage but occasional lightning. The developing stage lasts about 10 minutes.
- The thunderstorm enters the ***mature stage*** when the updraft continues to feed the storm, but precipitation begins to fall out of the storm, and a downdraft begins (a column of air pushing downward). When the downdraft and rain-cooled air spread out along the ground, they form a gust front, or a line of gusty winds. The mature stage is the most likely time for hail, heavy rain, frequent lightning, strong winds, and tornadoes. The storm occasionally has a black or dark green appearance.
- Eventually, a large amount of precipitation is produced and the updraft is overcome by the downdraft beginning the ***dissipating stage***. At the ground, the gust front moves out a long distance from the storm and cuts off the warm moist air that was feeding the thunderstorm. Rainfall decreases in intensity, but lightning remains a danger.

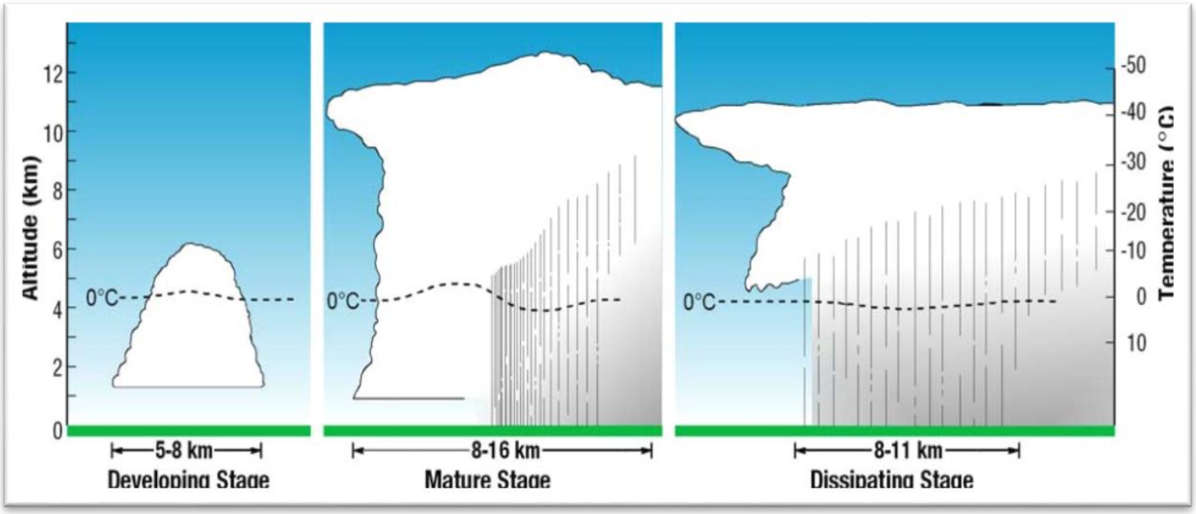


Figure 11-3. The Thunderstorm Life Cycle

There are four types of thunderstorms:

- **Single-Cell Thunderstorms—**Single-cell thunderstorms usually last 20 to 30 minutes. A true single-cell storm is rare, because the gust front of one cell often triggers the growth of another. Most single-cell storms are not usually severe, but a single-cell storm can produce a brief severe weather event. When this happens, it is called a pulse severe storm.
- **Multi-Cell Cluster Storm—**A multi-cell cluster is the most common type of thunderstorm. The multi-cell cluster consists of a group of cells, moving as one unit, with each cell in a different phase of the thunderstorm life cycle. Mature cells are usually found at the center of the cluster and dissipating cells at the downwind edge. Multi-cell cluster storms can produce moderate-size hail, flash floods and weak tornadoes. Each cell in a multi-cell cluster lasts only about 20 minutes; the multi-cell cluster itself may persist for several hours. This type of storm is usually more intense than a single cell storm.
- **Multi-Cell Squall Line—**A multi-cell line storm, or squall line, consists of a long line of storms with a continuous well-developed gust front at the leading edge. The line of storms can be solid, or there can be gaps and breaks in the line. Squall lines can produce hail up to golf-ball size, heavy rainfall, and weak tornadoes, but they are best known as the producers of strong downdrafts. Occasionally, a strong downburst will accelerate a portion of the squall line ahead of the rest of the line. This produces what is called a bow echo. Bow echoes can develop with isolated cells as well as squall lines. Bow echoes are easily detected on radar but are difficult to observe visually.
- **Super-Cell Storm—**A super-cell is a highly organized thunderstorm that poses a high threat to life and property. It is similar to a single-cell storm in that it has one main updraft, but the updraft is extremely strong, reaching speeds of 150 to 175 miles per hour. Super-cells are rare. The main characteristic that sets them apart from other thunderstorms is the presence of rotation. The rotating updraft of a super-cell (called a mesocyclone when visible on radar) helps the super-cell to produce extreme weather events, such as giant hail (more than 2 inches in diameter), strong downbursts of 80 miles an hour or more, and strong to violent tornadoes.

Wind

Damaging winds are classified as those exceeding 60 mph, although winds at 55 mph can topple chimneys. Damage from such winds accounts for half of all severe weather reports in the lower 48 states and is more common than damage from tornadoes. Wind speeds can reach up to 100 mph and can produce a damage path extending for hundreds of miles. There are seven types of damaging winds:

- **Straight-line winds—**Any thunderstorm wind that is not associated with rotation; this term is used mainly to differentiate from tornado winds. Most thunderstorms produce some straight-line winds as a result of outflow generated by the thunderstorm downdraft.
- **Downdrafts—**A small-scale column of air that rapidly sinks toward the ground.
- **Downbursts—**A strong downdraft with horizontal dimensions larger than 2.5 miles resulting in an outward burst or damaging winds on or near the ground. Downburst winds may begin as a microburst and spread out over a wider area, sometimes producing damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.
- **Microbursts—**A small concentrated downburst that produces an outward burst of damaging winds at the surface. Microbursts are generally less than 2.5 miles across and short-lived, lasting only 5 to 10 minutes, with maximum wind speeds up to 168 mph. There are two kinds of microbursts: wet and dry. A wet microburst is accompanied by heavy precipitation at the surface. Dry microbursts, common in places like the high plains and the intermountain west, occur with little or no precipitation reaching the ground.
- **Gust front—**A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud.
- **Derecho—**A derecho is a widespread thunderstorm wind caused when new thunderstorms form along the leading edge of an outflow boundary (the boundary formed by horizontal spreading of thunderstorm-cooled air). The word “derecho” is of Spanish origin and means “straight ahead.” Thunderstorms feed on the boundary and continue to reproduce. Derechos typically occur in summer when complexes of thunderstorms form over plains, producing heavy rain and severe wind. The damaging winds can last a long time and cover a large area.
- **Bow Echo—**A bow echo is a linear wind front bent outward in a bow shape. Damaging straight-line winds often occur near the center of a bow echo. Bow echoes can be 200 miles long, last for several hours, and produce extensive wind damage at the ground.

The coastal range of the Reservation is subject to high winds that form off the Pacific Ocean. Winds can, and have, reached 80 miles per hour, knocking out power and falling trees. The frequency of northeasterly winds is greatest in the fall and winter, with springtime winds peaking during the April-May timeframe. Wind velocities ranging from five to 10 knots can be expected 60 to 80 percent of the time; 10 to 15 knots, 30 to 45 percent of the time; and 20 knots or higher, two to 15 percent of the time (Figure 11-4). The wind speed when considered a potential power resource would provide the Reservation with a fairly good capacity for some form of wind generation illustrated in Figure 11-5. The highest wind velocities are from the southwest or west and are frequently associated with rapidly moving weather systems. Extreme wind velocities on the coast 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). 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.[29]

[29] http://www.usa.com/pacific-county-wa-weather.htm#HistoricalPrecipitation

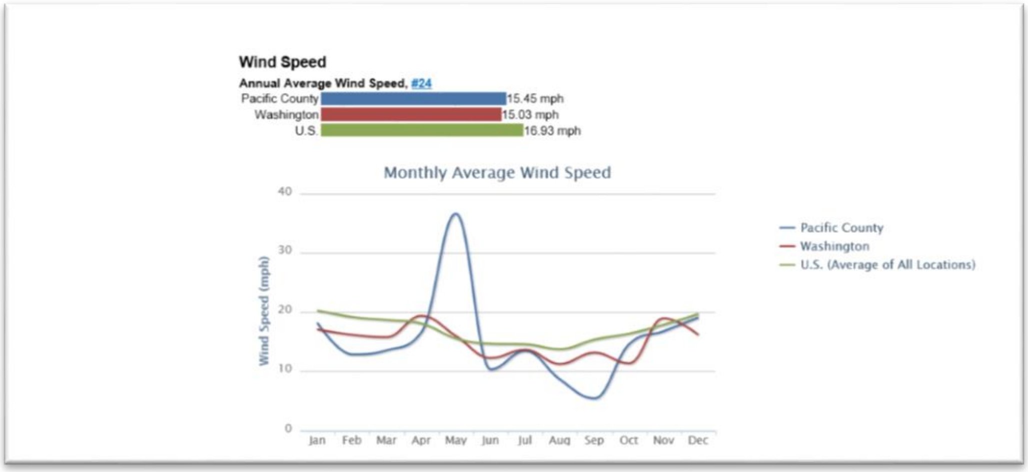


Figure 11-4. Average Wind Speed in Pacific County

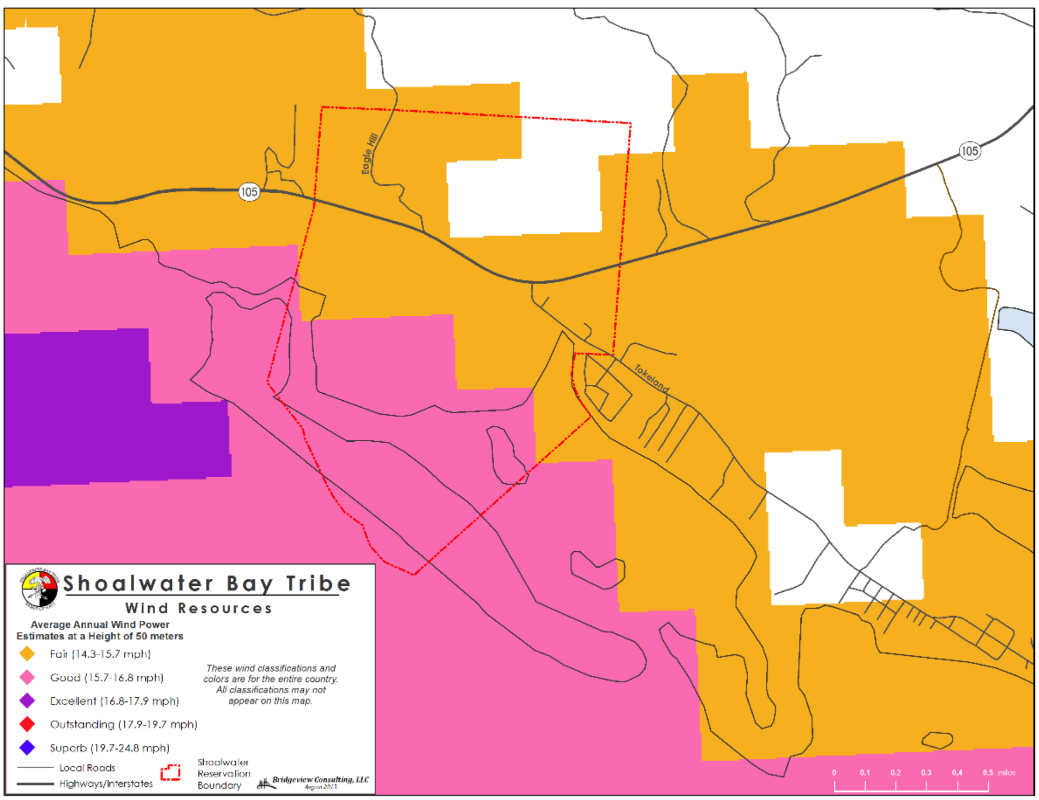


Figure 11-5. Average Annual Wind Power Estimations

Tornadoes[30]

According to SHELDUS and NOAA's Project Tornado, there have been two reported tornadoes in Pacific County; however, neither impacted the Shoalwater Bay Tribe. The first, an F0, occurred on

[30] http://www.tornadohistoryproject.com

December 1, 1990 in Raymond. The second, also an F0, occurred in June 12, 1991 at 2:00 p.m. at Fort Columbia State Park. Damage was limited in nature, and there were no reported injuries or fatalities associated with the event. In general, the magnitude of tornadoes in Washington as a whole have been between a Gale Tornadoes (F0) and a Moderate Tornadoes (F1). A Gale Tornadoes, with winds of 40-72 mph, causes light damage with possible damage to chimneys; breaks twigs and branches off tress; pushes over shallow-rooted trees; damages signboards; some windows broken; and hurricane winds. Moderate tornadoes have hurricane wind speeds of 73-112 mph and can peel surfaces off roofs; push mobile homes off their foundations, overturn and demolish outbuildings, push autos off the roads; and snap off trees and branches.

11.2.1 Past Severe Weather Events

Table 11-2 summarizes severe weather events in the planning area since 1960, as recorded by the National Oceanic and Atmospheric Administration (NOAA), SHELDUS and the State's HMP. Some extreme events are described in the sections below. It should be noted that the disasters listed may be included in other hazard profiles, as the incident may involve multiple hazards, e.g., a severe storm may have resulted in flooding or landslides, so the disaster will be noted in each table of historic occurrence.

TABLE 11-2.
SEVERE WEATHER EVENTS IMPACTING PLANNING AREA 1960 - 2013

Date	Type	Deaths or Injuries	Property Damage
October 1962 (Disaster 137)	Wind storm (Columbus Day Wind Storm)	7 in Washington; 46—combined all state's impacted	$235 million in property damage; 15 billion board feet of timber valued at $750 million
Description: *Most powerful non-tropical storm to impact lower 48 states. Impact felt in Washington, Oregon and California. Damaged over 50,000 buildings throughout regions impacted. Power in some areas out for 3+ weeks. Wind speeds ranged from 88 mph in Tacoma to 160 mph in Naselle, WA.*			
December 1964 (Disaster 185)	Severe winter storm event	Unknown	$128,205 (SHELDUS figures)
Description: *Cold wave, heavy snowfall and heavy rain.*			
February 1972 (Disaster 322)	Severe winter storm with heavy rains	Unknown	Unknown
Description: *Strong winds and heavy rains*			
December 1986 (Disaster 784)	Severe storm, heavy rain, wind and flooding	None	Unknown
Description: *Strong winds, rain and flooding impacted County*			
January 1993 (Disaster 981*)	Severe winter storm, flood, snow and high winds (Inauguration Day Wind Storm)	Unknown	
Description: *A powerful low-pressure system swept through central Western Washington, causing great destruction, numerous injuries and the loss of five lives. Winds averaging 50 miles per hour with gusts to over 100 miles per hour caused trees to fall and knocked out power to 965,000 customers.* Neither Pacific or Grays Harbor Counties were not included in Presidential Declaration—Public Assistance was only provided for jurisdictions reaching threshold, with no Individual Assistance provided. The Shoalwater Reservation did sustain limited damage as a result of this event.*			
January 1996 (Disaster 1079)	Severe Storm, High Winds, Flooding	Unknown	Unknown

**TABLE 11-2.
SEVERE WEATHER EVENTS IMPACTING PLANNING AREA 1960 - 2013**

Date	Type	Deaths or Injuries	Property Damage
Description: Incident period was November 7 to December 18, 1995. Topping the list was $20.7 million in damages to public facilities. There was more than $14.6 million in damages to private dwellings, including 82 homes that were totally destroyed, 350 that suffered major damage, and 450 with minor damage. Farms and the agricultural industry incurred more than $7.4 million in damages. Businesses incurred more than $2.3 million in damage. Seven counties were included in the governor's proclamation of emergency exclusively because of damages to state roads (Benton, Ferry, Island, Kitsap, Klickitat, Pacific and Spokane).			
Dec. 1996—Jan. 1997 (Disaster 1159)	Severe winter storm, snow, freezing rain; high winds; landslides. (Holiday Blast Storm)	24 deaths statewide	Stafford Act assistance $83 million; SBA $31.7 million; total losses $140 million statewide
Description: *Saturated ground combined with snow, freezing rain, rain, rapid warming and high winds within a five-day period produced flooding and landslides. 37 counties were impacted*			
January 2006 (Disaster 1641)	Severe winter storm, flood, landslide, mudslide, tidal surge	Unknown	Unknown
Description: *Heavy rains, strong winds and high tides caused significant damage, including coastal flooding related to the tidal surge.*			
November 2006 (Disaster 1671)	Severe storm, flooding, landslide and mudslides	15 deaths statewide	Unknown
Description*: Severe storm event caused flooding, landslides and mudslides throughout area.*			
December 2006 (Disaster 1682)	Windstorm (Chanukah Even Storm)	15 deaths statewide	+$50 million statewide; both Pacific and Grays Harbor Counties were included in the disaster declaration.
Description: *The most powerful windstorm since the Inauguration Day Storm of 1993 slammed into Washington State with 90 MPH winds on the Coast, gusts up to 70 MPH in the Puget Sound basin, and peak winds well over 100 MPH along the Cascade Crest. Up to 1.5 million residents were without power for up to 11 days.*			
December 2007 (Disaster 1734)	Severe winter storm, snow, heavy rains, landslides, winds, tidal surge	Unknown	Pacific and Grays Harbor Counties were included in the disaster declaration.
Description: *Severe winter storm, including snow fall and heavy rains; reported winds gusts as high as 146 mph. Winds lasted 36 hours in some areas. Increased wave heights in some areas 44 to 48 feet offshore. After snowfall, near record temperatures and moist tropical air led to record rainfall, with reports indicating 100-year flood event. The Shoalwater Bay Tribe's electricity and water supply (which runs off of electricity) was shut off for days, as were communications. Access to the area was significantly limited.*			
January 2009 (Disaster #1817)	Severe Winter Storm, Landslides, Mudslides and Flooding	Unknown	$10 million statewide in Individual Assistance; Pacific and Grays Harbor Counties were included in the disaster declaration.
Description: *Strong warm and very wet Pacific weather system brought high amounts of rainfall to Washington during 6-8 January, 2009. Snow levels rose from low levels to between 6,000 and 8,000 feet, with strong westerly winds enhancing precipitation amounts in the mountains. Conditions from a mid-December through early January region-wide cold snap and associated heavy snow helped set the stage for flooding. This event produced avalanches in the mountains, caused more than 1,500 slides across the state, and resulted in structural damage to buildings from added snow load. All counties of Western Washington lowlands received 3-8 inches of rain. The National Weather Service issued flood warnings for 49 points across the state. Quillayute saw 2.88 inches on January 7, breaking the 2.39-inch record for the date set in 1983.*			

TABLE 11-2.
SEVERE WEATHER EVENTS IMPACTING PLANNING AREA 1960 - 2013

Date	Type	Deaths or Injuries	Property Damage
January 2009 (Disaster 1825)	Severe winter storm, record and near record snow, heavy rains, landslides, winds, tidal surge	Unknown	Public Assistance was provided to 22 counties, including Pacific and Grays Harbor Counties. IA provided to 15 counties. Appx. $10 million was paid to WA residents with over 3,400 individuals applying for assistance
Description: *Severe winter storm, including record and near record snow fall and heavy rains and winds. All counties of Western Washington lowlands received 3-8 inches of rain, while east of the Cascades, amounts ranged from 2 to 7.5 inches. The National Weather Service issued flood warnings for 49 flood warning points across the state*			

In addition to the disaster declarations, there have also been events which have occurred which do not elevate to the level of a disaster statewide or even reach the threshold within the County, but nonetheless impact the Tribe. For example, the March 3, 1999 La Nina Winter Windstorm created storm surges of 4.6 feet, accompanied by ~50 mph winds, causing widespread issues along the coastline. Wave heights in areas exceeded 29.5 feet for over 5 hours, peaking at 34.8 feet. At Ocean Shores in Grays Harbor, WA, several houses were damaged. In addition, the November 11-12, 2007 windstorm left numerous trees down around the Reservation and the Tokeland Peninsula. Power was disrupted to the Tribe for days[31].

11.2.2 Location

Severe weather events have the potential to happen anywhere in the planning area. Communities in low-lying areas next to coast lines, streams or lakes are more susceptible to flooding. Wind events are most damaging to areas that are heavily wooded.

Areas most vulnerable to winter storms are those affected by convergence of dry, cold air from the interior, and moist air off the Pacific Ocean. Typically, significant winter storms occur during the transition between cold and warm periods. The Washington State Hazard Mitigation Plan (2010), illustrates the counties most vulnerable to winter storms. It identifies those areas which are most affected by the conditions that lead to the development of such storms previously discussed, and those areas with a recurrence rate of 50 percent, meaning that the area experiences at least one damaging winter storm event every two years. The Shoalwater Reservation (Pacific County) is not identified within the analysis as being exceptionally high to vulnerability to winter storms based on the established recurrence interval of >50%, with at least one occurrence every two years. However, the area is identified as one being highly vulnerable to high winds, with a recurrence rate >100%, with at least one occurrence per year.

11.2.3 Frequency

The planning area can expect to experience exposure to some type of severe weather event at least annually, although the events typically do not rise to the level of a declared disaster. Pacific County is identified in the (2010) Washington State Hazard Mitigation Plan (most current edition available as of this writing) as one being highly vulnerable to high winds, with a recurrence rate >100%, with at least one occurrence per year. The recurrence interval for a winter storm (snow or ice event) has a less than 50% of occurring at least one time every two years.

[31] Photos by Todd Ellingburg

11.2.4 Severity

The most common problems associated with severe storms are immobility and loss of utilities. Fatalities are uncommon, but can occur. Roads may become impassable due to flooding, downed trees, ice or snow, or a landslide. Power lines may be downed due to high winds or ice accumulation, and services such as water or phone may not be able to operate without power. Lightning can cause severe damage and injury.

Windstorms can be a frequent problem in the planning area and have been known to cause damage to utilities, such as those demonstrated in the photographs contained in Figure 11-6 and Figure 11-7 of the November 11, 2007 wind event.[32] The predicted wind speed given in wind warnings issued by the National Weather Service is for a one-minute average; gusts may actually be 25 to 30 percent higher.

Figure 11-6. Downed Tree - November 11, 2007 Windstorm

[32] Photos by Todd Ellingburg

Figure 11-7. Downed Trees at Tribal Center from November 11, 2007 Windstorm

Tornadoes are potentially the most dangerous of local storms, but they are not common in the planning area. If a major tornado were to strike within the populated areas of the planning area, damage would be widespread, especially given the age of much of the building stock and the density of the forest area. Businesses could be forced to close for an extended period or permanently, fatalities could be high, many people could be homeless for an extended period, and routine services such as telephone or power could be disrupted. Buildings may be damaged or destroyed. Washington historically ranks 43rd nationwide among states for frequency of tornadoes, 29th for injuries, and 46th for cost of damage.[33]

Extreme heat kills by pushing the human body beyond its limits. In extreme heat and high humidity, evaporation is slowed and the body must work extra hard to maintain a normal temperature. Older adults, young children, and those who are sick or overweight are more likely to succumb to extreme heat. Periods of extreme heat can also be lethal to salmonids and other aquatic life. Temperatures capable of killing salmonids could easily be reached during an extreme heat episode. Periods of extreme heat also foster disease and parasites among salmonids (especially as they crowd together in cold water refugia) and promote the development of toxic algae and other offensive species within water system.

11.2.5 Warning Time

Meteorologists can often predict the likelihood of a severe storm, wind event and extreme temperatures. This can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of the storm. Some storms may come on more quickly and have only a few hours or minutes of warning time, such as a tornado.

[33] http://www.spc.noaa.gov/archive/tornadoes/st-trank.html

11.3 SECONDARY HAZARDS

The most significant secondary hazards associated with severe local storms are floods, falling and downed trees, landslides and downed power lines. Rapidly melting snow combined with heavy rain can overwhelm both natural and man-made drainage systems, causing overflow and property destruction. Landslides occur when the soil on slopes becomes oversaturated and fails.

11.4 CLIMATE CHANGE IMPACTS

Climate change presents a significant challenge for risk management associated with severe weather. The frequency of severe weather events has increased steadily over the last century. The number of weather-related disasters during the 1990s was four times that of the 1950s, and cost 14 times as much in economic losses. Historical data shows that the probability for severe weather events increases in a warmer climate (see Figure 11-8). The changing hydrograph caused by climate change could have a significant impact on the intensity, duration and frequency of storm events. All of these impacts could have significant economic consequences.

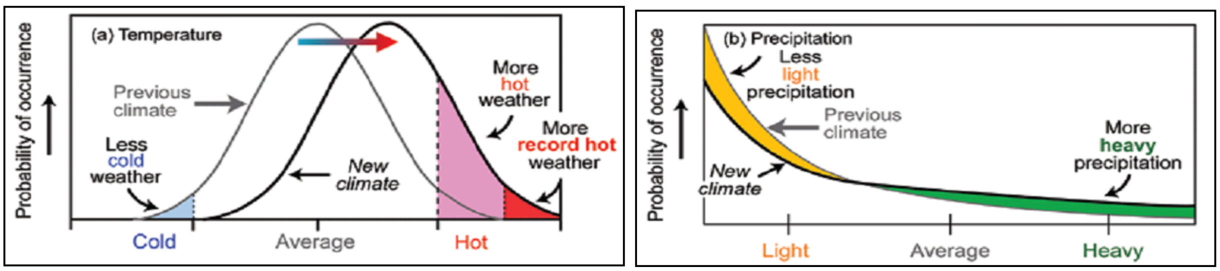


Figure 11-8. Severe Weather Probabilities in Warmer Climates

Most recent climate change data released by the National Snow and Ice Data Center (2014)[34] indicates that rising ambient temperature has increased the rate of melt of the polar ice caps as illustrated in Figure 11-9. “Arctic sea ice extent for April 2014 averaged 14.14 million square kilometers (5.46 million square miles). This is 610,000 square kilometers (236,000 square miles) below the 1981 to 2010 average extent, and 270,000 square kilometers (104,000 square miles) above the record April monthly low, which occurred in 2007” (2014).[35] Air temperatures were from 1 to 3 degrees Celsius (2 to 5 degrees Fahrenheit) above the 1981 to 2010 average over most of the Arctic Ocean. With the increased rate of melt, sea level rise will also increase, further increasing the extent and severity of coastal flooding and storm surge. The increased temperature will also further increase the frequency and severity of storm events in general.

[34] http://nsidc.org/arcticseaicenews/
[35] ibid

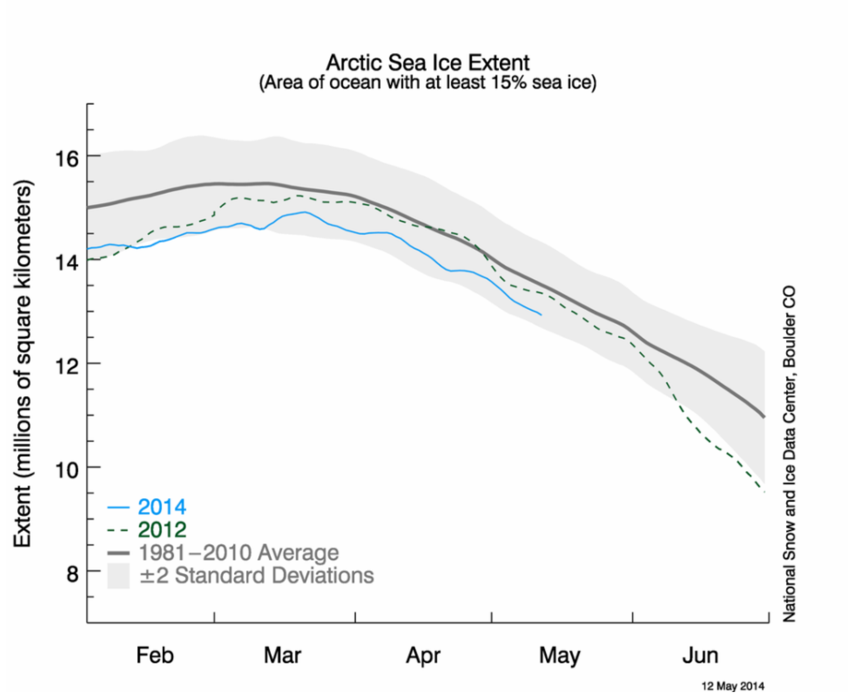


Figure 11-9. Artic Sea Ice Extent Variation 2012-2014

11.5 EXPOSURE

11.5.1 Population

The entire planning area is exposed to some extent to severe weather events. Certain areas are more exposed due to geographic location and local weather patterns. Populations living at higher elevations with large stands of trees or power lines may be more susceptible to wind damage and black out, while populations in low-lying areas are at risk for possible flooding, storm surge and erosion.

11.5.2 Property

Currently there are approximately 75 governmental, commercial and residential structures within the planning area. The majority of these structures are residential in nature; all are exposed to the severe weather hazard. The frequency and degree of damage is dependent on specific location and specific event scenario. As the Tribe is fairly remote, any assistance such as fire response, if needed, would take time beyond what has been established as national standards. Therefore, exposure is assessed against all structures on the Reservation, whether residences or commercial.

11.5.3 Critical Facilities and Infrastructure

All critical facilities exposed to flooding would also likely be exposed to severe weather from a precipitation event. Additional facilities on higher ground may also be exposed to wind damage or damage from falling trees. The most common problems associated with severe weather are loss of utilities. Downed power lines can cause blackouts, leaving large areas isolated and without heat sources. Phone, water and sewer systems (including septic systems) may not function. Roads may become impassable due to ice or snow or from secondary hazards such as landslides.

11.5.4 Environment

The environment is highly exposed to severe weather events. Natural habitats such as streams and trees are exposed to the elements during a severe storm and risk major damage and destruction. Prolonged rains can saturate soils and lead to slope failure. Flooding events caused by severe weather or snowmelt can produce (river) channel migration or damage riparian habitat. Storm surges can erode beachfront and redistribute sediment loads.

11.6 VULNERABILITY

11.6.1 Population

Vulnerable populations are the elderly, low income or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life threatening to those dependent on electricity for life support, such as breathing machines; for heat during periods of low temperatures; or for cooling during periods of high temperatures. Isolation of the populations is a significant concern, as is the potential exposure to the elements during severe weather events.

11.6.2 Property

All property is vulnerable during severe weather events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. It is estimated that the majority of residential structures were built without the influence (or limited influence) of a structured building code with provisions for wind loads. Those in higher elevations or on ridges may be more prone to wind damage. Those that are located under or near overhead lines or near large trees may be vulnerable to falling ice or may be damaged in the event of a collapse.

Loss estimations for the severe weather hazard are not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing 10 percent, 30 percent and 50 percent of the total assessed value and content loss of exposed structures. This allows emergency managers to select a range of potential economic impact based on an estimate of the percent of damage to the general building stock. Damage in excess of 50 percent is considered to be substantial by most building codes and typically requires total reconstruction of the structure. Table 11-3 lists the loss estimates.

TABLE 11-3.
LOSS ESTIMATES FOR SEVERE WEATHER

Exposed Value	$27.4 million
Estimated Loss Potential from Severe Weather	
10% Damage	$2,740,000
30% Damage	$8,220,000
50% Damage	$13,700,000

11.6.3 Critical Facilities and Infrastructure

Incapacity and loss of roads are the primary transportation failures resulting from severe weather, mostly associated with secondary hazards. Landslides caused by heavy prolonged rains large snow pack can block roads. High winds can cause significant damage to trees and power lines, blocking roads with debris, incapacitating transportation, isolating population, and disrupting ingress and egress. Snowstorms in higher elevations can significantly impact the transportation system and the availability of public safety services. Of particular concern are roads providing access to isolated areas and to the elderly.

Prolonged obstruction of major routes due to landslides, snow, debris or floodwaters can disrupt the shipment of goods and other commerce. Large, prolonged storms can have negative economic impacts for an entire region.

Severe windstorms, downed trees, and ice can create serious impacts on power and above-ground communication lines. Freezing of power and communication lines can cause them to break or be damaged, disrupting electricity and communication. Loss of electricity and phone connection would leave certain populations isolated because residents would be unable to call for assistance.

11.6.4 Environment

The vulnerability of the environment to severe weather is the same as the exposure.

11.7 FUTURE TRENDS IN DEVELOPMENT

All future development will be affected by severe storms. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. The Shoalwater Bay Tribe has adopted the International Building Code in response to federal mandates for funding purposes in an effort to keep its citizens as safe as possible from the impacts of severe weather. This code is equipped to deal with the impacts of severe weather events. The Tribe is currently in the process of developing its own land use policies, and once completed, those plans will also address many of the secondary impacts (flood and landslide) of the severe weather hazard. With these tools, the Tribe will be well equipped to deal with future growth and the associated impacts of severe weather.

11.8 SCENARIO

Although severe local storms are infrequent, impacts can be significant, particularly when secondary hazards of storm surge, flood or landslide occur. A worst-case event would involve prolonged high winds during a winter storm accompanied by thunderstorms. Such an event would have both short-term and longer-term effects. Initially, schools and roads would be closed due to power outages caused by high winds and downed tree obstructions. In more rural areas, some areas could experience limited ingress and egress. Prolonged rain could produce flooding, overtopped culverts with ponded water on roads, and landslides on steep slopes, especially in the Eagle Hills Road area. Flooding and landslides could further obstruct roads, further isolating residents, and also reducing the ability to evacuate the Reservation if significant enough along evacuation routes.

11.9 ISSUES

Important issues associated with a severe weather in the planning area include the following:

- Older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to severe weather events such as windstorms.
- Redundancy of power supply must be evaluated.
- The capacity for backup power generation is somewhat limited, and current available only for some of the public facilities.
- Isolated population centers.

Chapter 12.
TSUNAMI

12.1 GENERAL BACKGROUND

> **DEFINITIONS**
>
> **Tsunami—**A series of traveling ocean waves of extremely long wavelength usually caused by displacement of the ocean floor and typically generated by seismic or volcanic activity or by underwater landslides.

From southern British Columbia down to California, people and property are at risk both from distantly and locally generated tsunamis. Earthquakes may produce displacements of the sea floor that can set the overlying column of water in motion, initiating a tsunami.

Tsunamis are typically classified as local or distant. Locally generated tsunamis have minimal warning times, leaving few options except to run to high ground. They may be accompanied by damage resulting from the triggering earthquake due to ground shaking, surface faulting, liquefaction or landslides. Distant tsunamis may travel for hours before striking a coastline, giving a community a chance to implement evacuation plans.

12.1.1 Tsunami Wave Formation

A tsunami consists of a series of high-energy waves that radiate outward like pond ripples from an area where a generating event occurs. The waves arrive at shorelines over an extended period. The most common cause of a tsunami is an underwater earthquake, as shown in Figure 12-1

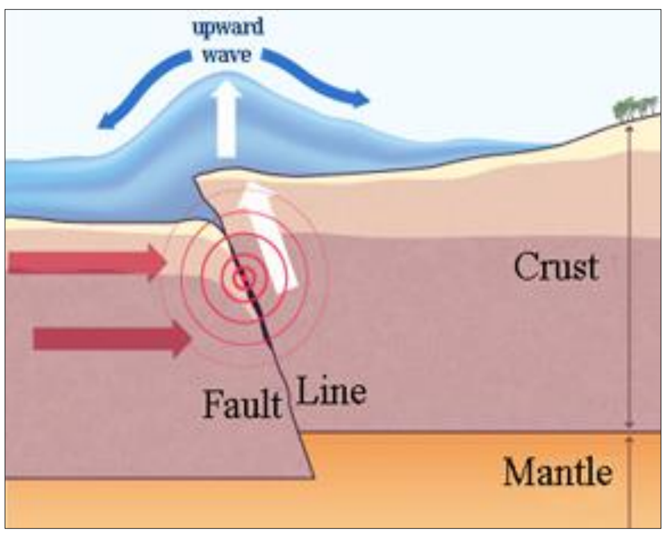


Figure 12-1. Tsunami Wave Formation

12.1.2 Physical Characteristics of Tsunami

All types of waves, including tsunami, have a wavelength, a wave height, an amplitude, a frequency or period, and a velocity, as shown on Figure 12-2 and described below:

- ***Wavelength*** is defined as the distance between two identical points on a wave (i.e. between wave crests or wave troughs). Normal ocean waves have wavelengths of about 100 meters. Tsunami have much longer wavelengths, usually measured in kilometers (up to 500 kilometers).

- ***Wave height*** refers to the distance between the trough of the wave and the crest or peak of the wave.
- ***Wave amplitude*** refers to the height of the wave above the still water line, usually this is equal to 1/2 the wave height. Tsunami can have variable wave height and amplitude that depends on water depth.

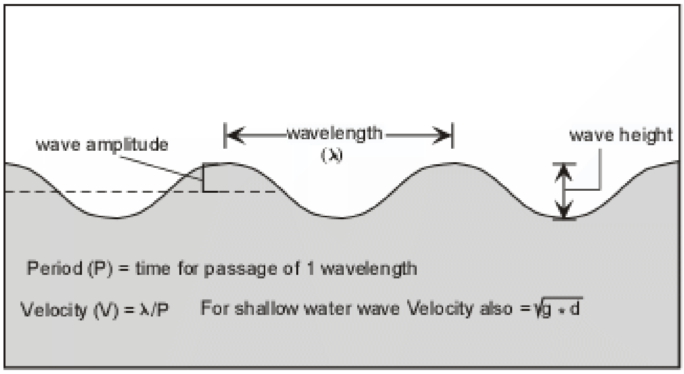


Figure 12-2. Physical Characteristics of Tsunamis

- ***Wave frequency or period*** is the amount of time it takes for one full wavelength to pass a stationary point.
- ***Wave velocity*** is the speed of the wave. Velocities of normal ocean waves are about 90 km/hr while tsunami have velocities up to 950 km/hr (about as fast as jet airplanes), and thus move much more rapidly across ocean basins. The velocity of any wave is equal to the wavelength divided by the wave period.

Tsunami are characterized as shallow-water waves. These are different from the waves most of us have observed on a beach, which are caused by the wind blowing across the ocean's surface (see Figure 12-3 and Figure 12-4).[36] Wind-generated waves usually have periods (time between two successive waves) of five to twenty seconds and a wavelength of 100 to 200 meters. A tsunami can have a period in the range of ten minutes to two hours and wavelengths greater than 500 km. A wave is characterized as a shallow-water wave when the ratio of the water depth and wavelength is very small.

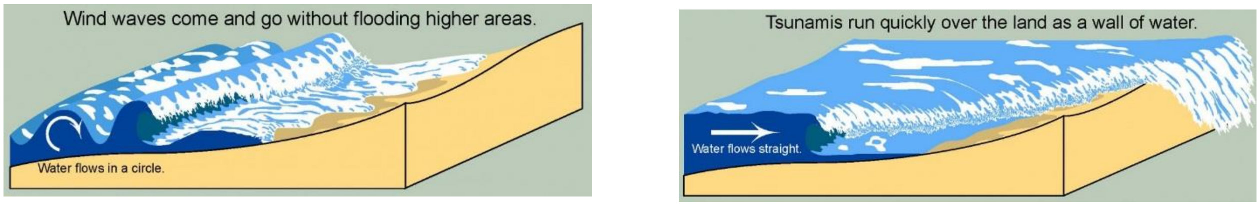
The rate at which a wave loses its energy is inversely related to its wavelength. Since a tsunami has a very large wavelength, it will lose little energy as it propagates. Thus, in very deep water, a tsunami will travel at high speeds with little loss of energy. For example, when the ocean is 6100 m deep, a tsunami will travel about 890 km/hr, and thus can travel across the Pacific Ocean in less than one day.

As a tsunami leaves the deep water of the open sea and arrives at the shallow waters near the coast, it undergoes a transformation. Since the velocity of the tsunami is also related to the water depth, as the depth of the water decreases, the velocity of the tsunami decreases. The change of total energy of the tsunami, however, remains constant.

Furthermore, the period of the wave remains the same, and thus more water is forced between the wave crests causing the height of the wave to increase. Because of this "shoaling" effect, a tsunami that was imperceptible in deep water may grow to have wave heights of several meters or more.

[36] Earth Science: http://earthsci.org/education/teacher/basicgeol/tsunami/tsunami.html

Figure 12-3. Comparison of Normal and Tsunami Waves



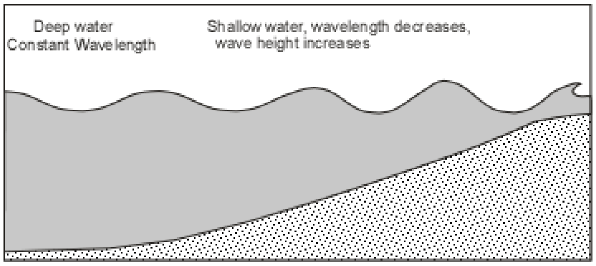


Figure 12-4. Effect of Water Depth on Wave

In the open ocean, a tsunami may be only a few inches or feet high, but it can travel with speeds approaching 600 miles per hour. As a tsunami enters the shoaling waters near a coastline, its speed diminishes, its wavelength decreases, and its height increases greatly. The first wave usually is not the largest. Several larger and more destructive waves often follow the first one. As tsunamis reach the shoreline, they may take the form of a fast-rising tide, a cresting wave, or a bore (a large, turbulent wall-like wave). The bore phenomenon resembles a step-like change in the water level that advances rapidly (from 10 to 60 miles per hour).

The configuration of the coastline, the shape of the ocean floor, and the characteristics of advancing waves play important roles in the destructiveness of the waves. Offshore canyons can focus tsunami wave energy and islands can filter the energy. The orientation of the coastline determines whether the waves strike head-on or are refracted from other parts of the coastline. A wave may be small at one point on a coast and much larger at other points. Bays, sounds, inlets, rivers, streams, offshore canyons, islands, and flood control channels may cause various effects that alter the level of damage. It has been estimated, for example, that a tsunami wave entering a flood control channel could reach a mile or more inland, especially if it enters at high tide.

The first part of a tsunami to reach land is a trough – called a drawdown- rather than a wave crest, the water along the shoreline recedes dramatically, exposing normally submerged areas. Drawdown is followed immediately by the crest of the wave which can catch people observing the drawdown off guard. When the crest of the wave hits, sea level rises (called run-up).

Run-up is usually expressed in meters above normal high tide. Run-ups from the same tsunami can be variable because of the influence of the shapes of coastlines. One coastal area may see no damaging wave activity while in another area destructive waves can be large and violent. The flooding of an area can extend inland by 300 meters or more, covering large areas of land with water and debris. Flooding tsunami waves tend to carry loose objects and people out to sea when they retreat. Tsunami may reach a maximum vertical height onshore above sea level, called a run-up height, of 30 meters. A notable exception is the landslide generated tsunami in Lituya Bay, Alaska in 1958 which produced a 60 meter high wave.

Because the wavelengths and velocities of tsunami are so large, the period of such waves is also large, and larger than normal ocean waves. Thus, it may take several hours for successive crests to reach the shore. (For a tsunami with a wavelength of 200 km traveling at 750 km/hr, the wave period is about 16 minutes). Thus people are not safe after the passage of the first large wave, but must wait several hours for all waves to pass. The first wave may not be the largest in the series of waves. For example, in several different recent tsunami the first, third, and fifth waves were the largest.

Rapid drawdown can create strong currents in harbor inlets and channels that can severely damage coastal structures due to erosive scour around piers and pilings. As the water's surface drops, piers can be damaged by boats or ships straining at or breaking their mooring lines. The vessels can overturn or sink due to strong currents, collisions with other objects, or impact with the harbor bottom.

Conversely, the first indication of a tsunami may be a rise in water level. The advancing tsunami may initially resemble a strong surge increasing the sea level like the rising tide, but the tsunami surge rises faster and does not stop at the shoreline. Even if the wave height appears to be small, 3 to 6 feet for example, the strength of the accompanying surge can be deadly. Waist-high surges can cause strong currents that float cars, small structures, and other debris. Boats and debris are often carried inland by the surge and left stranded when the water recedes.

At some locations, the advancing turbulent wave front will be the most destructive part of the wave. In other situations, the greatest damage will be caused by the outflow of water back to the sea between crests, sweeping all before it and undermining roads, buildings, bulkheads, and other structures. This outflow action can carry enormous amounts of highly damaging debris with it, resulting in further destruction. Ships and boats, unless moved away from shore, may be dashed against breakwaters, wharves, and other craft, or be washed ashore and left grounded after the withdrawal of the seawater.

12.2 HAZARD PROFILE

The Cascadia Subduction Zone off the coast of Washington is capable of causing an extreme earthquake that could produce a tsunami along the north coast of California, Oregon and Washington like that experienced during the 2005 Indonesian Tsunami, and also experienced as a result of the March 2011 earthquake and resulting Tsunami occurring in Japan. While the March 2011 tsunami did not cause any significant damage within the planning area, there was slight increased waive activity as a result of the earthquake, as well as debris found along the beaches of Pacific County several months later, the most recent of which was found in May 2014, during development of this update.

12.2.1 Past Events

Washington is at risk from both local and distant tsunamis, and has experienced several over the course of time.

- Current geological evidence concludes that a tsunami struck the north coast in 1700. The tsunami also struck the coast of Japan. Tribal history speaks of the event.
- The 1960 Chilean earthquake produced a great tsunami that impacted the entire Pacific basin with recorded wave height as illustrated in Table 12-1.

TABLE 12-1.
RECORDED HEIGHT OF TSUNAMI WAVES FROM 1960 CHILEAN EARTHQUAKE

Location	Wave Height
Grays Harbor	Small waves
Tokeland	2 feet
Ilwaco	2 feet
Neah Bay	1.2 feet
Friday Harbor	0.3 feet

- On March 28, 1964 Magnitude-9.2 earthquake in Prince William Sound, Alaska - the largest recorded earthquake ever to hit the United States struck Anchorage, Alaska. The earthquake caused tsunami waves along the entire Washington, Oregon and California coastlines, killing 128 people, mostly in Alaska. There were no reported deaths in Washington, but there were reports of damaged boats and houses along the coastline. 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. Resulting wave heights along the Washington coastline are illustrated in Table 12-2. A 2000 research paper titled *Tsunami Hazard Map of the Southern Washington Coast: Modeled Tsunami Inundation from a Cascadia Subduction Zone Earthquake*[37] provides the following excerpt as it relates to this event and its impact to the planning area:

> In Willapa Bay, the greatest damage occurred in the northern part of the bay. Strong currents scoured into oyster beds, in some cases transporting oysters more than a half mile (0.8 km), and in others, burying oyster beds with sand transported from the spits at the entrance to the bay (*Raymond Herald*, April 2, 1964). Highway 101 was damaged when the Moore Cannery building was lifted from its foundation and washed against the south approach of the bridge over the Bone River. One piling and all its supports were washed away, causing the bridge to be restricted to one lane until repairs could be made (*Raymond Herald*, April 2, 1964). John Shulene, a retired science teacher and volunteer with the U.S. Geological Survey (USGS), interviewed residents in the Willapa Bay area, who provided additional information on the behavior of this tsunami within Willapa Bay. The most destructive part of the 1964 Alaska tsunami, near Raymond and South Bend, hit about 12 hours after the first waves reached Washington (p. 11).

TABLE 12-2.
RECORDED HEIGHT OF TSUNAMI WAVES FROM 1964 ALASKA EARTHQUAKE

Location	Wave Height
Mouth of the Hoh River	1.5 feet
LaPush	5 feet
Ocean Shores	10 feet
Tahola	23 feet
Moclips	11 feet
Neah Bay	2 feet

- November 2006 - 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. Wave heights for the general planning area are illustrated in Table 12-3.

[37] Tsunami Hazard Map of the Southern Washington Coast (2000). Accessed 4 Nov 2013 at: http://www.dnr.wa.gov/ResearchScience/Topics/GeologyPublicationsLibrary/Pages/tsuevac.aspx

TABLE 12-3. 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
Source: http://www.ngdc.noaa.gov/nndc/struts/results?EQ_0=3016&t=101650&s=9&d=92,183&nd=display	

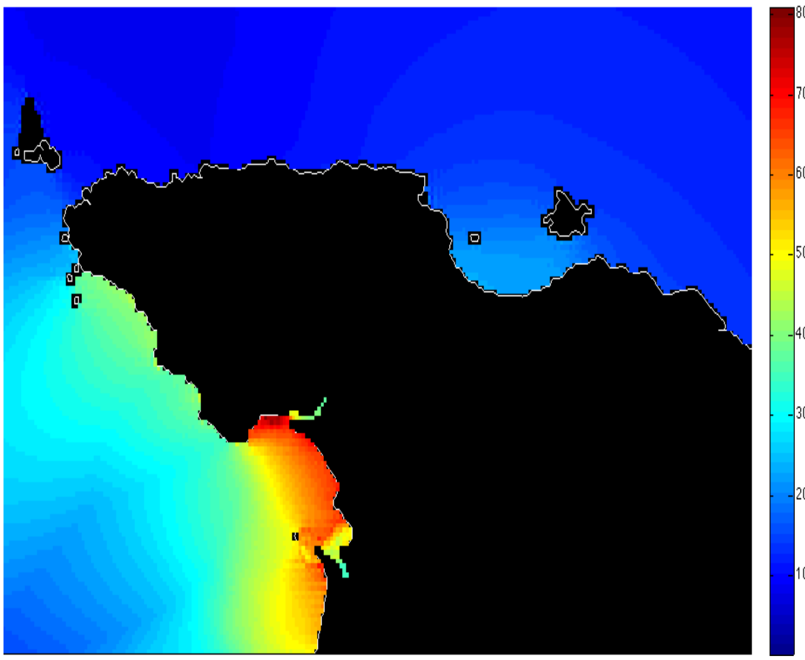
- The March 11, 2011 magnitude 9.0 Honshu, Japan earthquake (38.297 N, 142.373 E, depth 29 km) generated a tsunami observed over the Pacific region and caused tremendous local devastation as the impacts were experienced over a large area as demonstrated in Figure 12-5.
- 

Figure 12-5. Computer Generated Tsunami Wave Resulting from 2011 Japan Earthquake

This is the fourth largest earthquake in the world and the largest in Japan since instrumental recordings began in 1900. This is the deadliest tsunami since the 2004 magnitude 9.1 Sumatra earthquake and tsunami caused nearly 230,000 deaths and $10 billion in damage. This is also the most devastating earthquake to occur in Japan since the 1995 Kobe earthquake, which caused over 5,500 deaths and the deadliest tsunami since the 1993 Hokkaido earthquake generated a tsunami which was responsible for over 200 deaths. While no significant damage was reported as a result of the increased wave height as illustrated in Table 12-4, and Figure 12-6 and Figure 12-7[38], according to NOAA (2011), this incident had the potential to be much worse. The Tribe worked closely with the Pacific Marine Environmental Laboratory (PMEL), the West Coast and Alaska Tsunami Warning Center, who provided wave predictions for coastal areas, Washington State EMD and Pacific County Emergency Management to ensure that the most accurate and current data was used for decision making purposes. The Tribe sustained no damages as a result of this Tsunami, but it served as an excellent example of the

[38] http://wcatwc.arh.noaa.gov/previous.events/?p=03-11-11_Honshu

unpredictable nature of tsunami waves, and provided the Tribe with pertinent information with respect to its response which further enhances response techniques.).

TABLE 12-4.
RECORDED HEIGHT OF TSUNAMI WAVES FROM 2011 JAPAN EARTHQUAKE

Location	Wave Height
La Push	28 inches
Neah Bay	17 inches
Port Angeles	23 inches
Port Townsend	6 inches
Westport	18 inches
Toke Point	13 inches

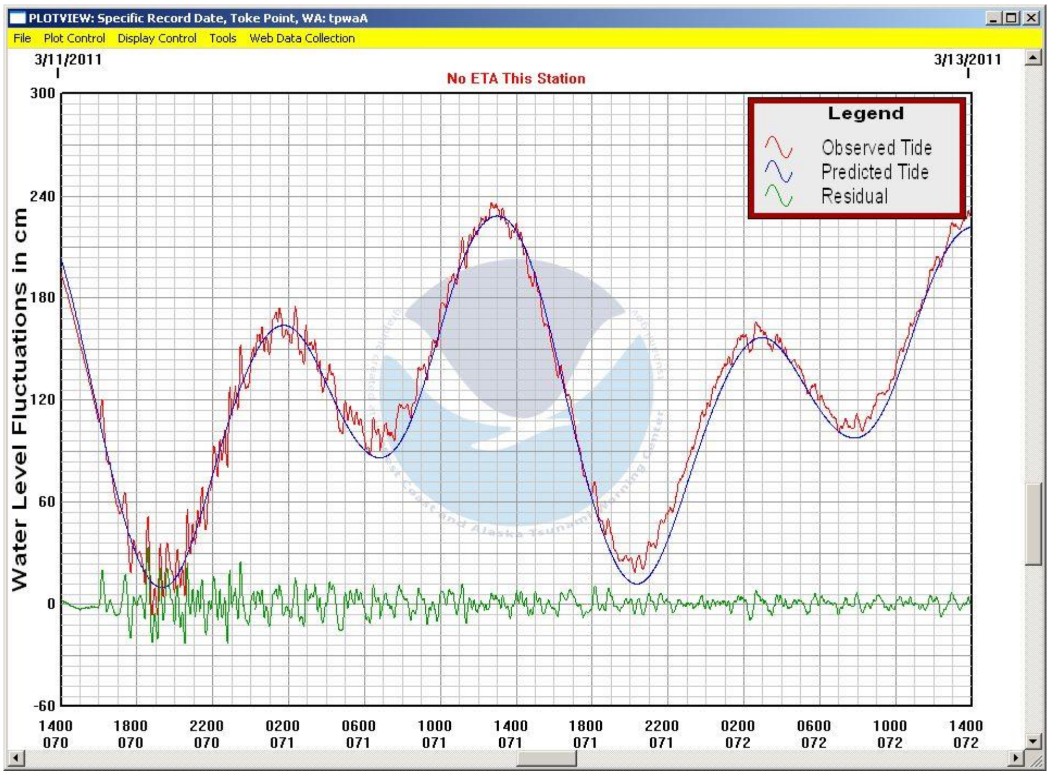


Figure 12-6. Water Level Fluctuations March 2011 Tsunami at Toke Point, WA

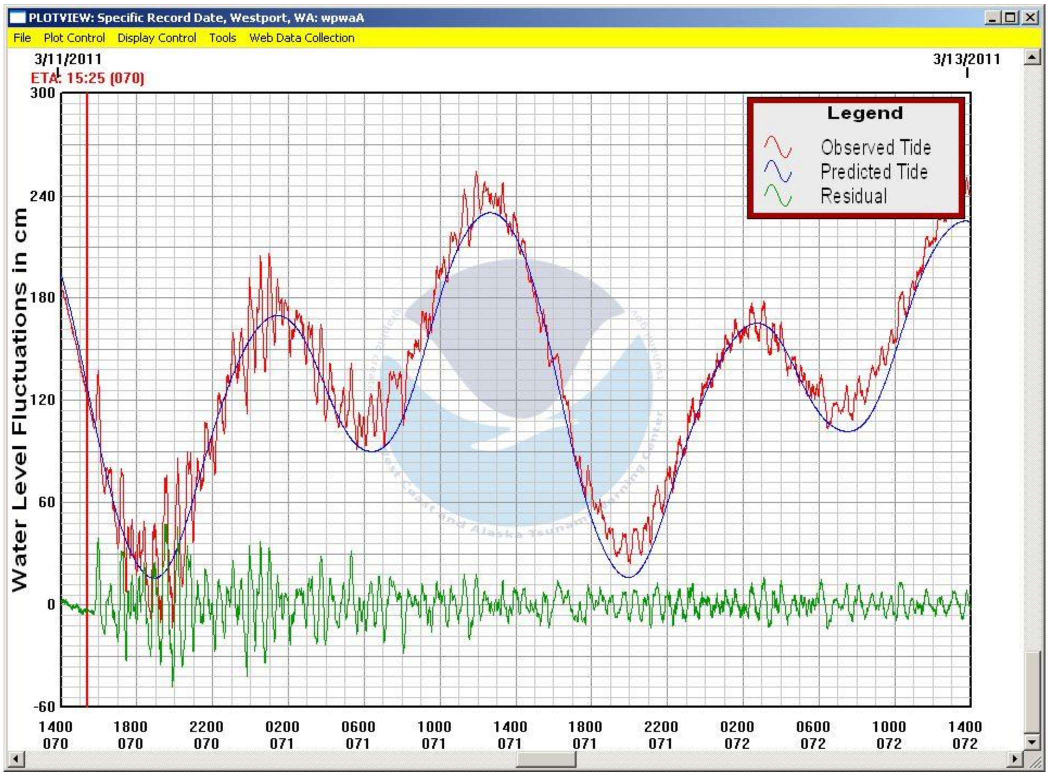


Figure 12-7. Water Level Fluctuations March 2011 Tsunami at Westport, WA

- October 28, 2012. A 7.7 magnitude earthquake off the west coast of Canada near Queen Charlotte Island produced tsunami warnings along the entire western coast; however, no significant wave increase was reported within the planning area.

12.2.2 Location

Washington's outer coast faces a dual threat: tsunamis generated by both distant sources (such as earthquakes in Japan, Chile, or Alaska) and tsunamis generated directly offshore during earthquakes on the Cascadia Subduction Zone. According to a 2012/2013 study conducted, in part, by Washington State Department of Natural Resources, "Tsunamis from distant earthquakes on the Pacific rim, such as the 2011 magnitude 9.0 earthquake near Japan. This type is the most common. Because the waves arrive hours after the quake, they are less likely to cause loss of life, but may inflict damage" (WA-DNR, 2012/2013).

Approximately 80 percent of tsunamis originate in the Pacific Ocean and can strike distant coastal areas in a matter of hours. Most recorded tsunamis affecting the Pacific Northwest originated in the Gulf of Alaska. There is also geological evidence of significant impacts from tsunamis originating along the Cascadia subduction zone, which extends from Cape Mendocino, California to the Queen Charlotte Islands in British Columbia.

Tsunamis affecting Washington may be induced by geologic events of local origin, or earthquakes at a considerable distance, such as in Alaska or South America. The earth's crustal plates may pull apart from, slide past, override, or under-ride ("subduct") one another. Plate boundaries coincide with faults that produce earthquakes as the plates move against one another. These earthquakes may produce displacements of the sea floor that can set the overlying column of water in motion, initiating a tsunami, depending on the magnitude of the earthquake and the type of faulting.

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 Washington Department of Natural Resources has mapped the tsunami risk zones and evacuation zones in the vicinity of the Shoalwater Bay Reservation as shown in Figure 12-8[39]. Figure 12-9 is an aerial view of the Shoalwater Indian Reservation between Cape Shoalwater and Toke Point on the southwest coast of Washington. The tsunami hazard zone is shaded in yellow. Highway 105 is marked by a solid red line. Figure 12-10, and Figure 12-11 further illustrate the area at risk from tsunami inundation for the Shoalwater Reservation.

[39] http://www.dnr.wa.gov/Publications/ger_tsunami_inundation_maps.pdf

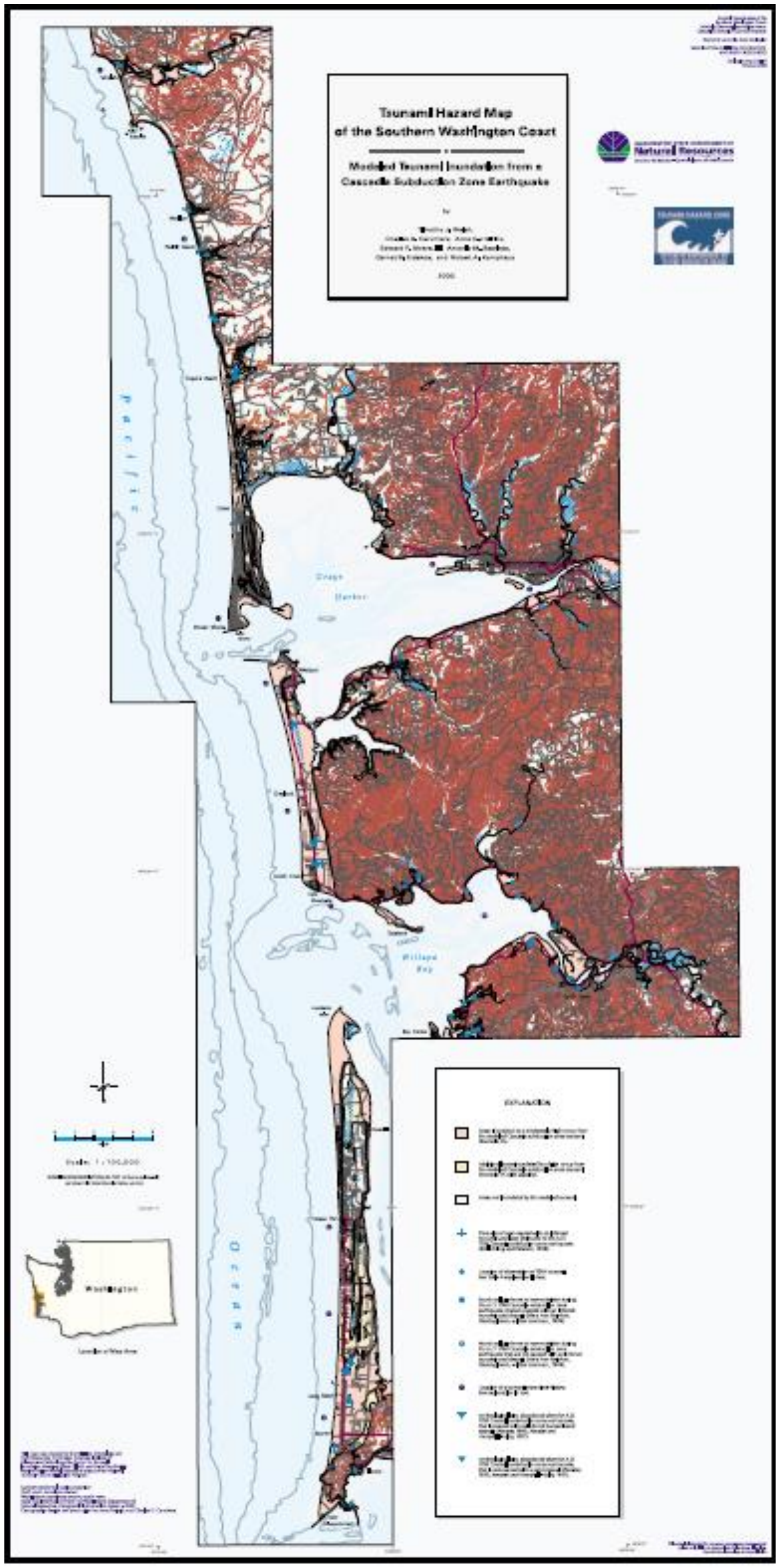


Figure 12-8. Tsunami Hazard Map of Southern Washington Coast

Figure 12-9. Aerial view of the Shoalwater Reservation between Cape Shoalwater and Toke Point

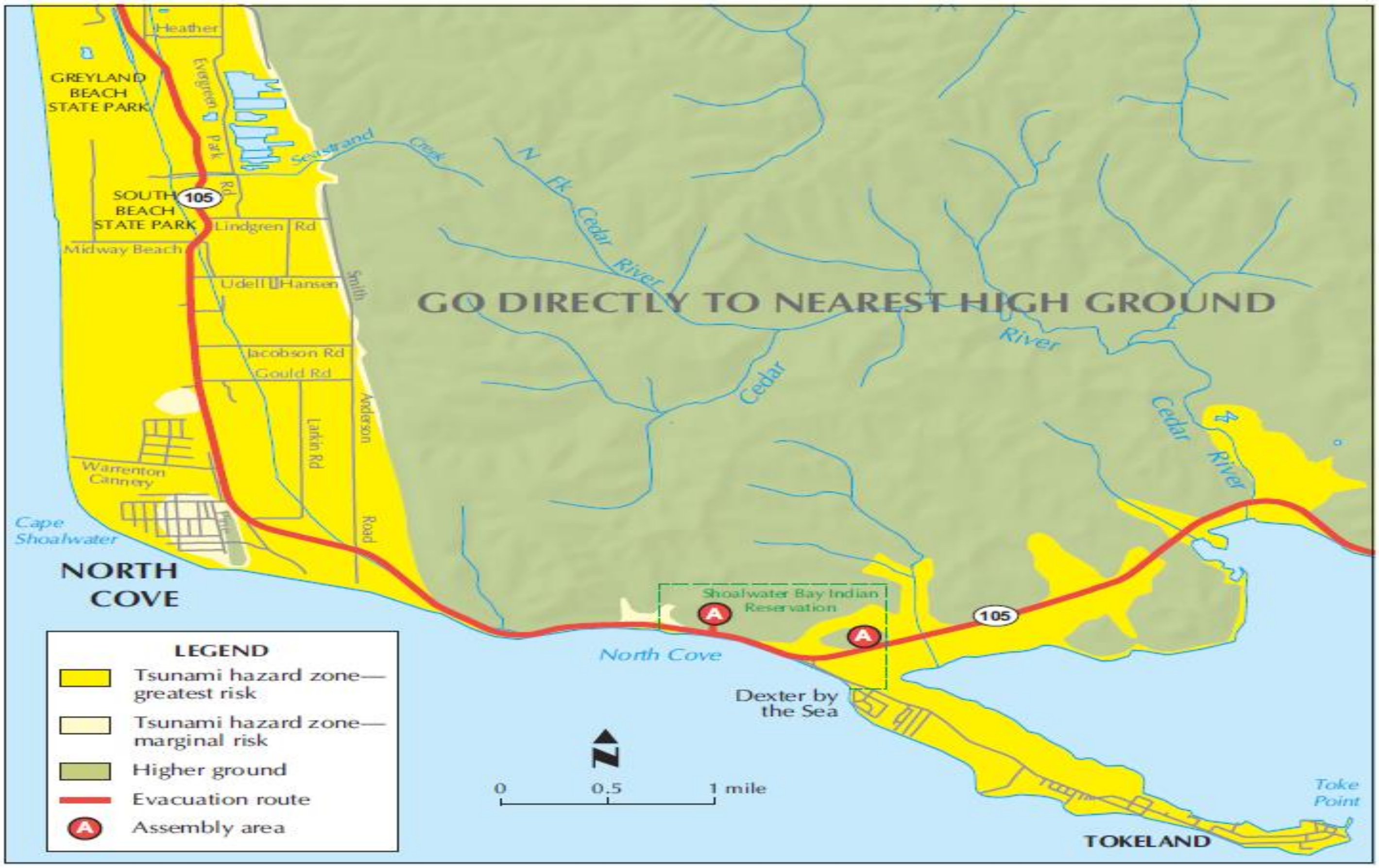


Figure 12-10. Washington State Department of Natural Resources Tsunami Evacuation Map

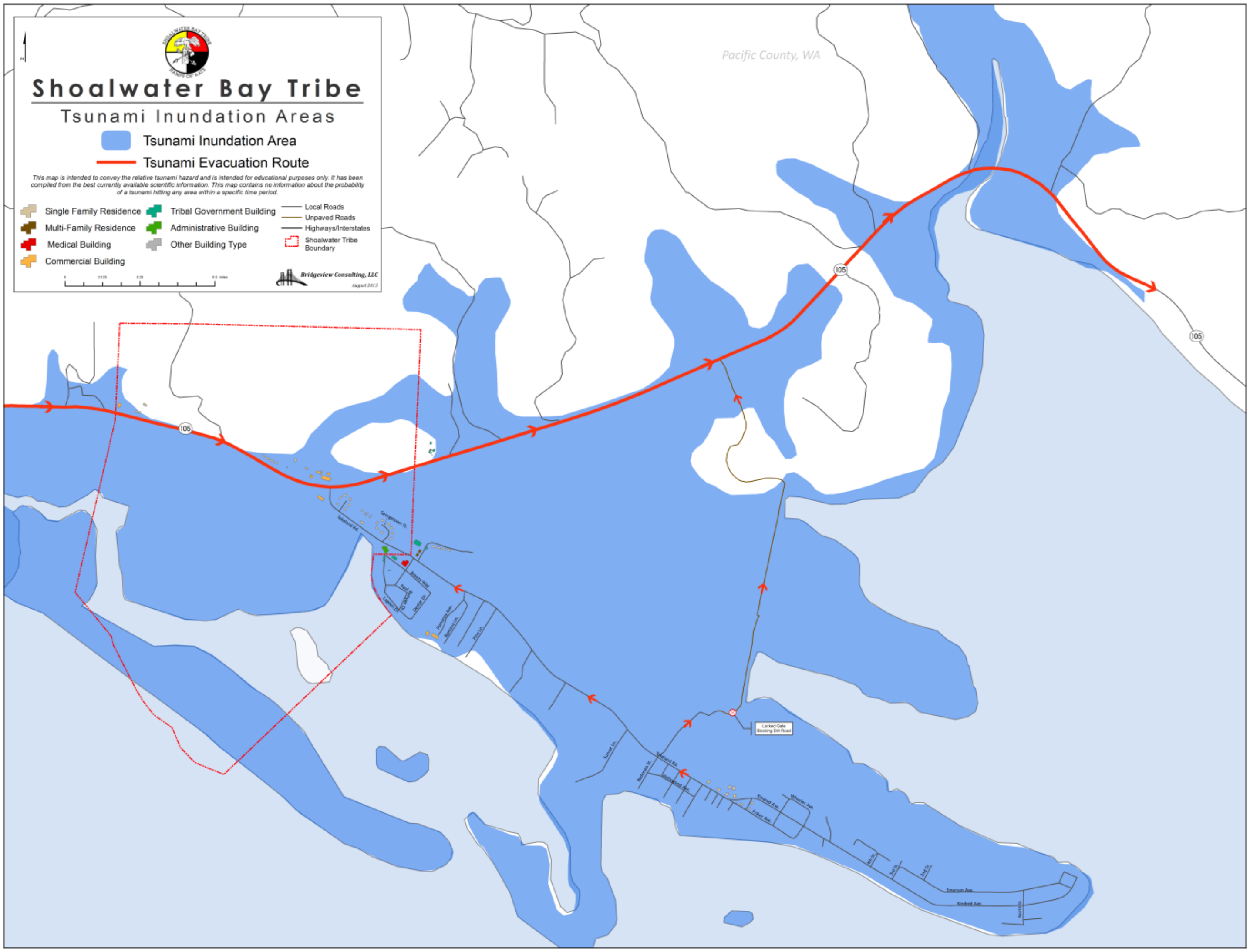


Figure 12-11. Shoalwater Bay Reservation Maximum Tsunami Inundation Zone

12.2.3 Frequency

The frequency of tsunamis is related to the frequency of the events that cause them, so it is similar to the frequency of seismic or volcanic activities or landslides. Generally four or five tsunamis occur every year in the Pacific Basin, and those that are most damaging are generated in the Pacific waters off South America rather than in the northern Pacific. Pacific-wide tsunamis are rare, occurring every 10 to 12 years on average. Most of these tsunamis are generated by earthquakes that cause displacement of the seafloor, but a tsunami can also be generated by volcanic eruptions, landslides, underwater explosions, and meteorite impacts (Nelson, undated). 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.

According to the Pacific Tsunami Warning Center (2011), major tsunamis occur about once per decade. There is an average of two destructive tsunamis per year in the Pacific basin. Based on historical data, about 59% of the world's tsunamis have occurred in the Pacific Ocean, 25% in the Mediterranean Sea, 12% in the Atlantic Ocean, and 4% in the Indian Ocean. Most of these tsunamis (81% as of 2009 according to NOAA/NCDC) are generated by earthquakes that cause displacement of the seafloor.

12.2.4 Severity

Tsunamis have been reported since ancient times. They have been documented extensively, especially in Japan and the Mediterranean areas. The first recorded tsunami occurred off the coast of Syria in 2000 B.C. Since 1900 (the beginning of instrumentally located earthquakes), most tsunamis have been generated in Japan, Peru, Chile, New Guinea and the Solomon Islands. However, the only regions that have generated remote-source tsunamis affecting the entire Pacific Basin are the Kamchatka Peninsula, the Aleutian Islands, the Gulf of Alaska, and the coast of South America. Hawaii, because of its location in the center of the Pacific Basin, has experienced tsunamis generated in all parts of the Pacific.

From 1950 to 2013, well over 625 tsunamis were recorded globally (NOAA/NGDC). Over half of these events caused fatalities. The overwhelming majority of these events occurred in the Pacific basin. Recent tsunamis have struck Nicaragua, Indonesia, and Japan, killing several hundred thousand people. The 2004 Indian Ocean Tsunami killed ~230,000 people alone. Property damage due to these waves exceeds $300 billion. 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.

Closer to the Northwest, the tsunami that hit the Washington coast after the great 1964 Alaska earthquake; caused wave heights in areas which reached 15 feet. No deaths were reported in Washington; however, the tsunami caused $115,000 in damage (1964 value). 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[40].

The Cascadia subduction zone will produce the planning area's largest tsunami. The Cascadia subduction zone is similar to the Alaska-Aleutian Trench that generated the 1964 Alaska earthquake and the Sunda Trench in Indonesia that produced the December 2004 Sumatra earthquake. Comparison of the Sunda Trench to the Cascadia Subduction Zone within Figure 12-12, compiled by Humboldt State University in Arcata, California, demonstrates the similarities in the rupture zones[41].

[40] Washington State Department of Natural Resources
[41] Humboldt State University, Arcata, CA

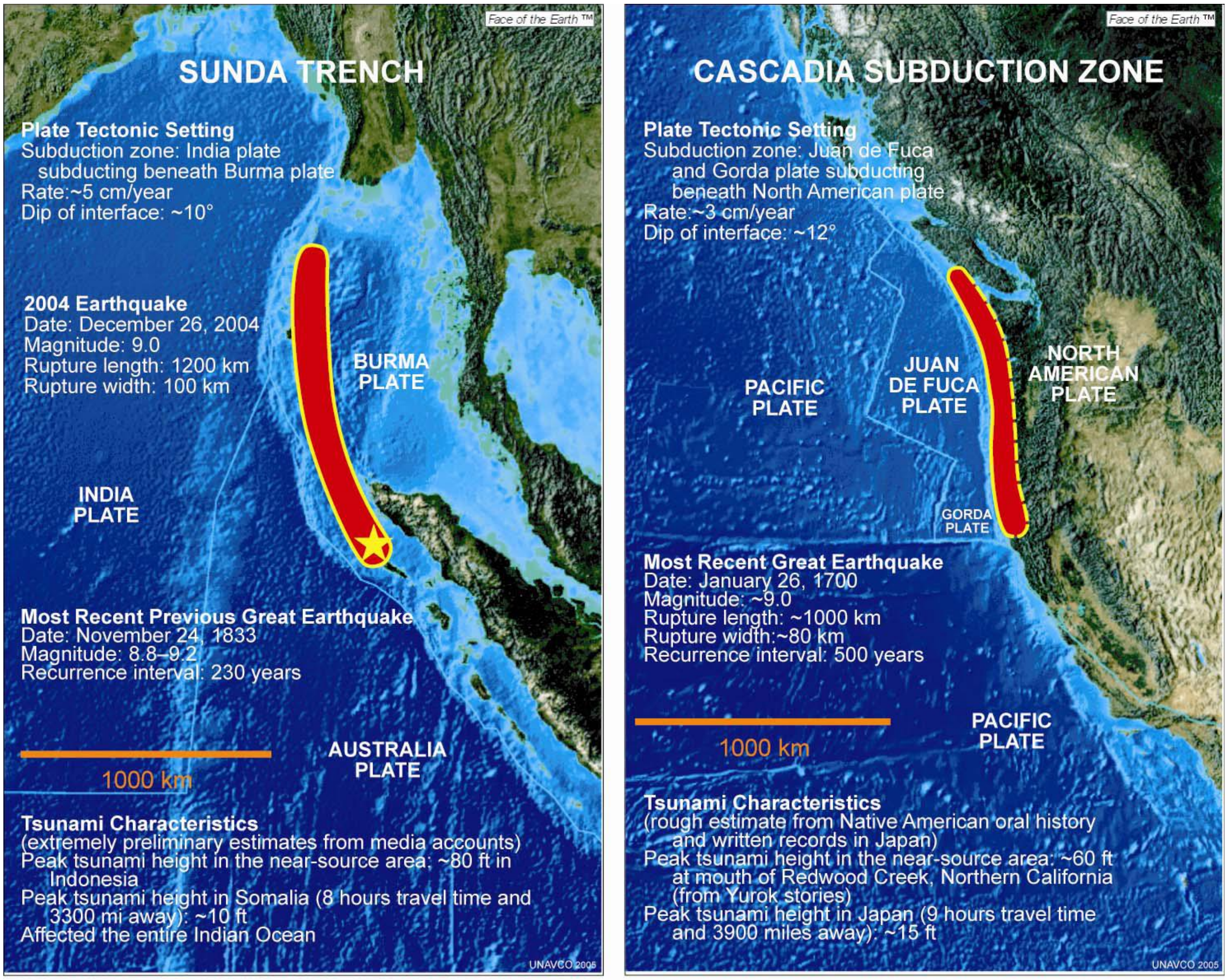


Figure 12-12. Sunda Trench Comparison to Cascadia Subduction Zone

Native American accounts of past Cascadia earthquakes suggest tsunami wave heights on the order of 60 feet, comparable to water levels in Aceh Province Indonesia during the December 2004 tsunami there. Water heights in Japan produced by the 1700 Cascadia earthquake were over 15 feet, comparable to tsunami heights observed on the African coast after the Sumatra earthquake. The Cascadia subduction zone last ruptured in 1700, creating a tsunami that left markers in the geologic record from California to Vancouver Island in Canada and is noted in written records in Japan. At least seven ruptures of the Cascadia subduction zone have been observed in the geologic record.

12.2.5 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 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 less than 3 feet high. The tsunami's size and speed, as well as the coastal area's form and depth, affect the impact of a tsunami; wave heights of 50 feet are not uncommon. In general, scientists believe it requires an earthquake of at least a magnitude 7 to produce a tsunami.

Most tsunamis originate in the Pacific Ocean, where tsunami waves triggered by seismic activity can travel at up to 500 miles per hour, striking distant coastal areas in a matter of hours. Figure 12-13 shows tsunami travel times measured for the 1960 Chilean earthquake event and the 1964 Alaskan earthquake event.

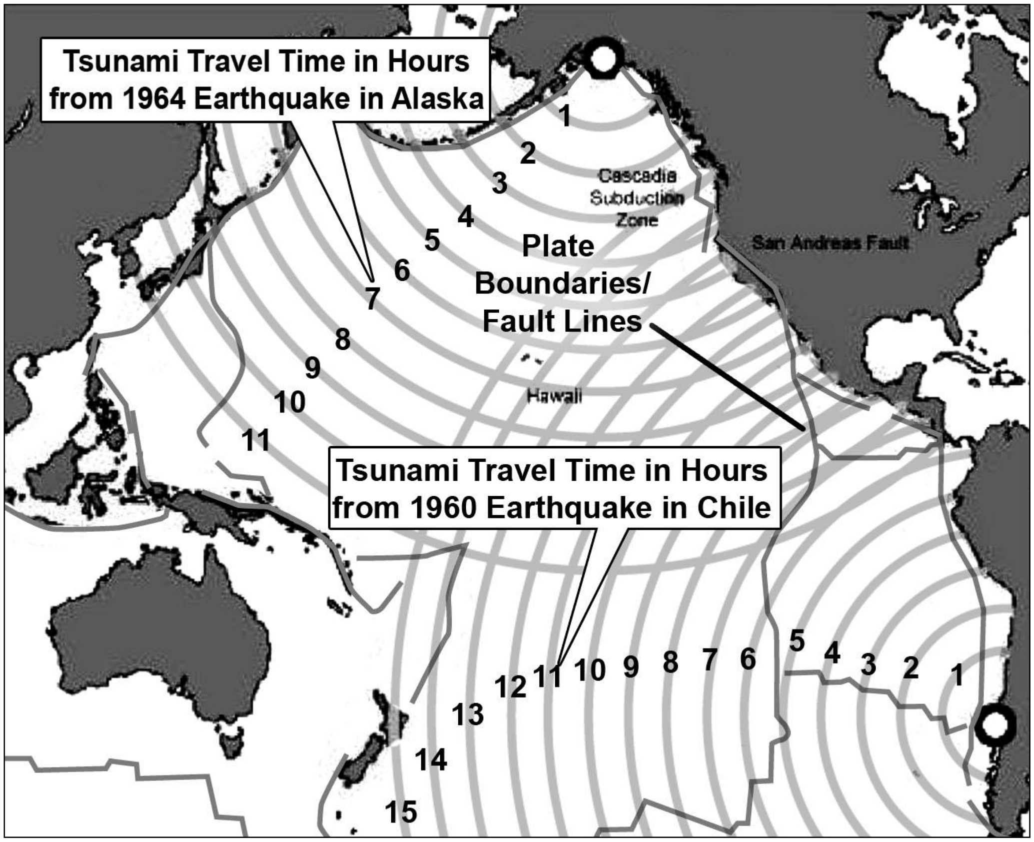


Figure 12-13. Potential Tsunami Travel Times in the Pacific Ocean

The Pacific Tsunami Warning System evolved from a program initiated in 1946. It is a cooperative effort involving 26 countries along with numerous seismic stations, water level stations and information distribution centers. The National Weather Service operates two regional information distribution centers. One is located in Ewa Beach, Hawaii, and the other is in Palmer, Alaska. The Ewa Beach center also serves as an administrative hub for the Pacific warning system.

The warning system only begins to function when a Pacific basin earthquake of magnitude 6.5 or greater triggers an earthquake alarm. When this occurs, the following sequence of actions occurs:

- Data is interpolated to determine epicenter and magnitude of the event.
- If the event is magnitude 7.5 or greater and located at sea, a Tsunami Watch is issued.
- Participating tide stations in the earthquake area are requested to monitor their gages. If unusual tide levels are noted, the tsunami watch is upgraded to a Tsunami Warning.
- Tsunami travel times are calculated, and the warning is transmitted to the disseminating agencies and thus relayed to the public.
- The Ewa Beach center will cancel the watch or warning if reports from the stations indicate that no tsunami was generated or that the tsunami was inconsequential.

NOAA utilizes a Deep-ocean Assessment and Reporting of Tsunamis (DART) system to collect data, which is then relayed to the Pacific Tsunami Warning Center in Honolulu, Hawaii (Figure 12-14)[42]. These units generate computer models which predict tsunami arrival, usually within minutes of the arrival time. This information is relayed in real time.

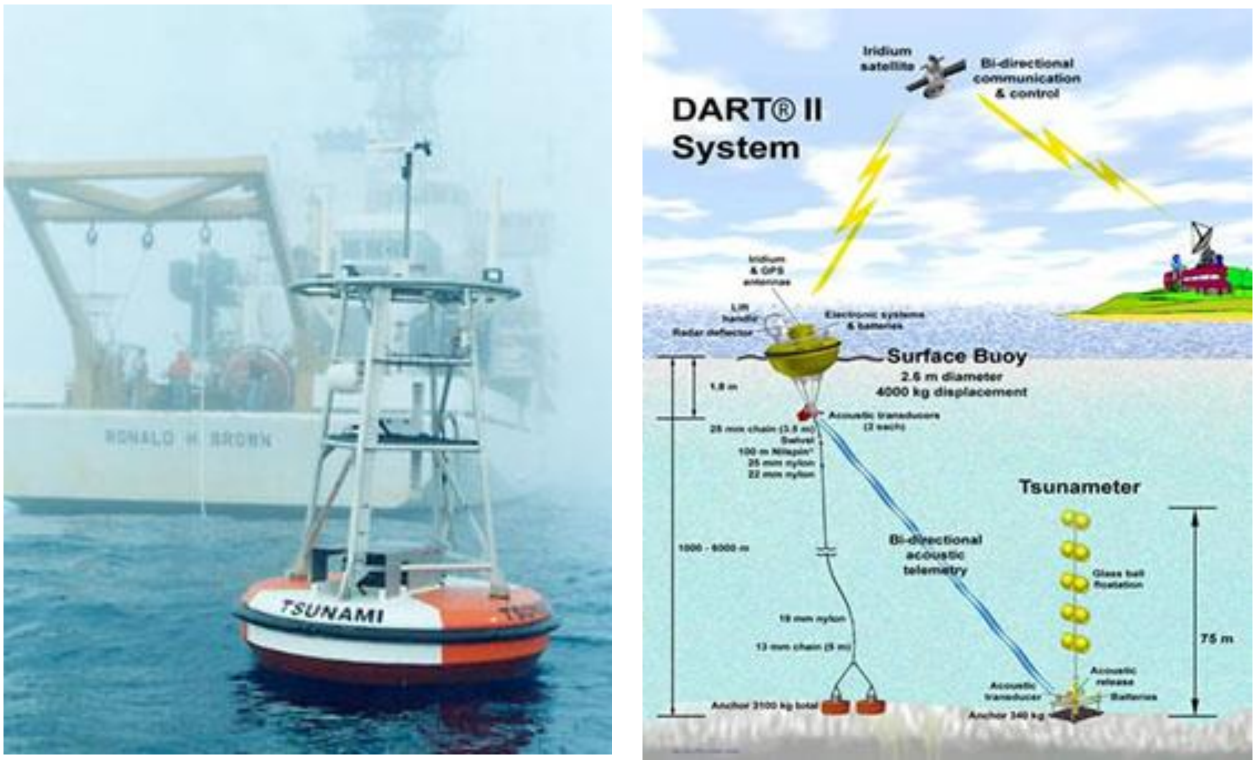


Figure 12-14. Deep-Ocean Assessment and Reporting of Tsunamis (DART) System

However, this system is not considered to be as effective for communities close to the tsunami because the first wave would arrive before the data were processed and analyzed. In the case of the Shoalwater Bay Tribe, strong ground shaking would provide the first warning of a potential tsunami. In response to the Tribe's vulnerability to this hazard, they have taken several proactive measures to help ensure the safety of its members and citizens living within the Reservation boundaries.

TsunamiReady

Washington State's entire coastline made up of various communities are all TsunamiReady Communities. Proudly, the Shoalwater Tribe is also recognized as TsunamiReady by the National Weather Service. In order to become Tsunami Ready the Tribe installed warning sirens and educated residents about the impacts of a tsunamis and how to prepare for such a disaster. The Shoalwater Tribe annually conducts tsunami evacuation drill in conjunction with its health walk, and continues to build upon these past accomplishments by enhancing its efforts throughout the Reservation through working collaboratively with NOAA, State DNR, State EMD, Pacific County Emergency Management, and other agencies.

[42] NOAA

All-Hazard Alert Broadcast (AHAB) Sirens

The Tribe's warning sirens are installed at locations shown in Figure 12-15 The Tribe also created evacuation routes, some of which are trails up into wooded hillsides. The Tribe worked closely with the National Weather Service, National Oceanic and Atmospheric Administration, Washington State Emergency management, and Pacific County Emergency Services to develop this comprehensive plan. As a member of the National Tsunami Hazard Mitigation Program (NTHMP), Washington State and the Shoalwater Bay Tribe work to ensure tsunami warning information is as accurate as possible using real-time data through deep ocean tsunami detection devices. Real-time data in transmitted as illustrated in Figure 12-15, and provides the West Coast/Alaska Warning Center with quick and reliable information to determine whether an earthquake has generated a tsunami.

If the event is tsunami, the tsunami detectors send data via satellite to the Tsunami Warning Centers. In turn, a message is generated via the NOAA Weather Wire Service to the National Weather Service offices and State Emergency Operations Center. A message is then sent by Emergency Alert System to NOAA Weather Radios that are located in businesses, homes, TV, and Radios. The message is also sent via satellite to the AHAB sirens on beach heads or high traffic areas to warn of a pending tsunami. Through this cycle, dissemination of a warning can be obtained rapidly and effectively.

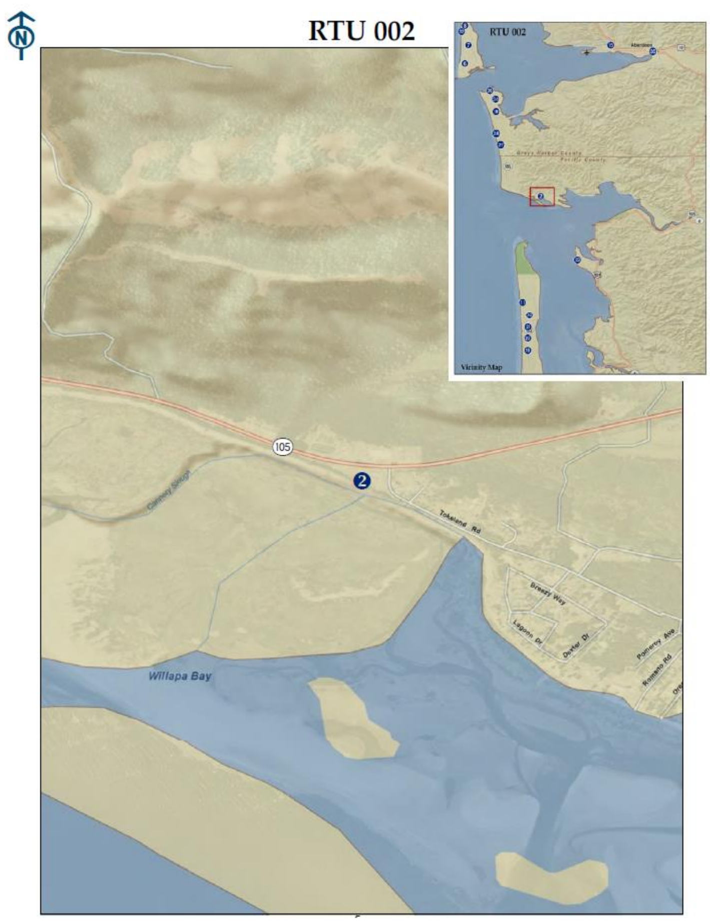


Figure 12-15. AHAB Siren Locations

12.3 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. 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 often the backbone of the economy of the affected areas, and these are the resources that generally receive the most severe damage. Until debris can be cleared, wharves and piers rebuilt, utilities restored, and 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.

As a result of the March 2011 Japan Earthquake and ensuing Tsunami, NOAA has conducted significant studies related to the debris which will wash ashore along the western coastline of the United States. Several planning concepts are underway. Figure 12-16 depicts NOAA's methodology for projecting onshore flow of the debris generated by the event.

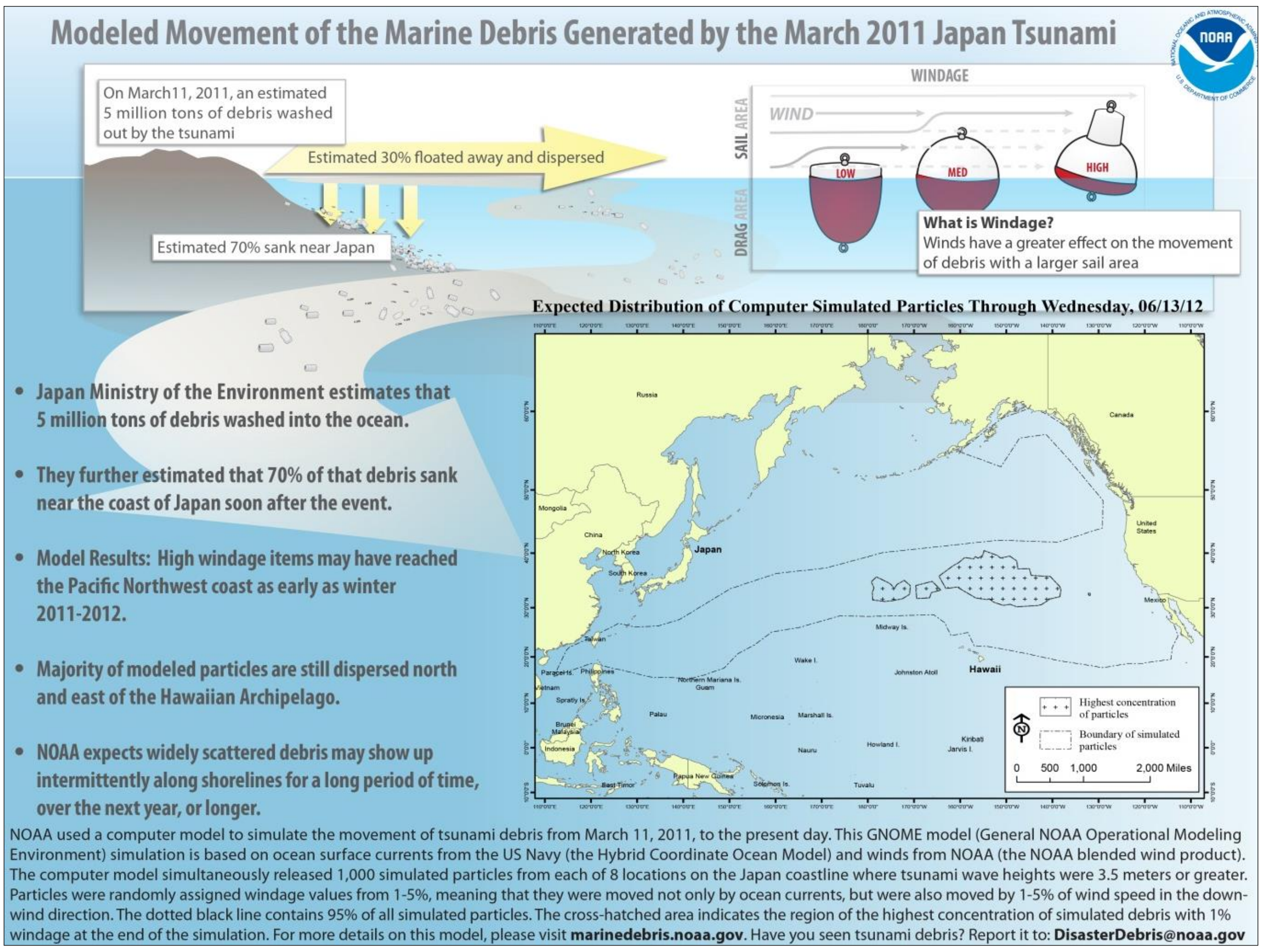


Figure 12-16. NOAA Model Used to Determine Movement of Marine Debris from March 2011 Japan Tsunami

Figure 12-17. Debris Generated during March 2011 Japan Tsunami

Figure 12-17 demonstrates the debris accumulated after the Tsunami (Photo courtesy of the US Navy). The Japanese government estimates that approximately 5 million tons of debris washed out to sea. Of that mass, it is estimated that approximately 1.5 million tons floated away, and could potentially be transported to beaches fringing the northeast Pacific Ocean, including the coast of Washington state.[43].While studies suggest that 'at least 75 percent of the floating debris will not make landfall and will end up in the Pacific-Sub-Tropical Convergence Zone," there is speculation that the remaining debris may make landfall. Within the shorelines of Washington, analysis suggests that most of the debris will do so within 3-4 years of the event. Evidence of this has already occurred on various parts of our coastline, including within the Shoalwater Reservation. Analysis estimates a baseline of approximately 0.5-6.7 tons/mile of debris may be distributed to the outer coastal shores.[44]

12.4 CLIMATE CHANGE IMPACTS

The impacts of climate change on the frequency and severity of tsunami events could be significant in regions with vulnerable coast line. Global sea-level rise will affect all coastal societies, especially small island states and densely populated low-lying coastal areas. *The Scientific Basis* estimates a sea level rise of 0.3 to 2.9 feet from 1990 to 2100. Currently sea level is rising at a rate of about 0.1 inches per year. This rise has two effects on low-lying coastal regions: any structures located below the new level of the sea will be flooded; and the rise in sea level may lead to coastal erosion that can further threaten coastal structures. As a rule-of-thumb, a sandy shoreline retreats about 100 feet for every 1-foot rise in sea level.

[43] http://wsg.washington.edu/communication/online/TsunamiDebris.pdf
[44] Ibid

12.5 EXPOSURE

All structures along beaches, low-lying coastal areas, tidal flats and river deltas would be vulnerable to a tsunami, especially in an event with little or no warning time. The impact of the waves and the scouring associated with debris that may be carried in the water could be damaging to structures in the tsunami's path. Those that would be most vulnerable are those located in the front line of tsunami impact and those that are structurally unsound. Based on Hazus analysis conducted by Washington State Department of Natural Resources, USGS and others, the entire Shoalwater Reservation is deemed to be at risk and exposed to Tsunami events.

12.5.1 Population

The population living in tsunami hazard zones was generated by analyzing the Tribe's total population and total households that intersect the inundation zone. Based on exposure analysis, the entire populations of the Tribe, including visitors, tourists and transient populations, are exposed to tsunami coastal areas, tidal flats and river deltas that empty into ocean-going waters.

12.5.2 Property

All structures on the Reservation are at risk to the Tsunami hazard.

12.5.3 Critical Facilities and Infrastructure

Roads that are blocked or damaged can prevent access throughout the planning area and can isolate residents and emergency service providers needing to get to vulnerable populations or to make repairs. Bridges washed out or blocked by tsunami inundation or debris from flood flows also can cause isolation, this includes on the limited roadways leading onto the Reservation. Water and sewer systems can be flooded or backed up, causing further health problems. Underground utilities can also be damaged during flood events. Table 12-5 provides an estimate of the number and types of critical facilities directly exposed to the tsunami hazard.

TABLE 12-5.
STRUCTURES EXPOSED TO TSUNAMI INUNDATION ZONE

	Assessed Value			
	Structure	Contents	Total	% of AV
Commercial Facilities	$7,501,582	$3,750,791	$11,252,373	49.6%
Government Facilities	$3,744,983	$1,872,491	$5,617,474	24.8%
Industrial Facilities	$652,267	$326,133	$978,400	4.3%
Residential	$3,219,566	$1,609,783	$4,829,349	21.3%
Total	**$15,118,398**	**$7,559,198**	**$22,677,596**	**100%**

Roads

Roads are an important component in the management of tsunami-related emergencies in that they act is the primary resource for evacuation to higher ground before and during the course of a tsunami event. Roads often act as flood control facilities in low depth, low velocity flood events by acting as levees or berms and diverting or containing flood flows. All roadways on and off the vicinity of the Reservation will be impacted by tsunami events.

Bridges

Bridges exposed to tsunami events can be extremely vulnerable due to forces transmitted by the wave run-up and by the impact of debris carried by the wave action. While there are no bridge on the Reservation, there are several bridges along the main arterials leading into and off of the Reservation which are of primary concern, both within both Grays Harbor and Pacific County.

Water/Sewer/Utilities

Water and sewer systems can be affected by the flooding associated with tsunami events. Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing wastes to spill into homes, neighborhoods, rivers and streams. The forces of tsunami waves can impact above-ground utilities by knocking down power lines and radio/cellular communication towers. Power generation facilities can be severely impacted by both the impact of the wave action and the inundation of floodwaters.

12.5.4 Environment

All waterways would be exposed to the effects of a tsunami; inundation of water and introduction of foreign debris could be hazardous to the environment. All wildlife inhabiting the area also is exposed.

12.6 VULNERABILITY

12.6.1 Population

The populations most vulnerable to the tsunami hazard are the elderly, disabled and very young who reside near beaches, low-lying coastal areas, tidal flats and river deltas that empty into ocean-going waters. In the event of a local tsunami generated in or near the planning area, there would be little warning time, so more of the population would be vulnerable. The degree of vulnerability of the population exposed to the tsunami hazard event is based on a number of factors:

- Is there a warning system?
- What is the lead time of the warning?
- What is the method of warning dissemination?
- Will the people evacuate when warned?

For this assessment, the population vulnerable to possible tsunami inundation is considered to be the same as the exposed population.

12.6.2 Property

All structures along beaches, low-lying coastal areas, tidal flats and river deltas would be vulnerable to a tsunami, especially in an event with little or no warning time. The impact of the waves and the scouring associated with debris that may be carried in the water could be damaging to structures in the tsunami's path. Those that would be most vulnerable are those located in the front line of tsunami impact and those that are structurally unsound. The value of vulnerable property is the same as the exposed loss estimates, $27.4 million dollars including both structural and content loss.

12.6.3 Environment

The vulnerability of aquatic habit and associated ecosystems would be highest in low-lying areas close to the coastline. Areas near gas stations, industrial areas and Tier II facilities would be vulnerable due to potential contamination from hazardous materials. While there are limited Tier II facilities on the

Reservation, there is a gas station on the Reservation, as well as numerous propane tanks used by Tribal residents. All of these would have the potential to impact the environment of the Reservation.

Tsunami waves can carry destructive debris and pollutants that can have devastating impacts on all facets of the environment. Millions of dollars spent on habitat restoration and conservation in the planning area could be wiped out by one significant tsunami. There are currently no tools available to measure these impacts. However, it is conceivable that the potential financial impact of a tsunami event on the environment could equal or exceed the impact on property. Community planners and emergency managers should take this into account when preparing for the tsunami hazard.

12.7 FUTURE TRENDS IN DEVELOPMENT

The information in this plan provides the Tribe a tool to ensure that there is no increase in exposure within the tsunami hazard zones of the planning area with respect to future development in high-hazard areas. Given the limited land mass which makes up the Shoalwater Reservation, areas for development are currently very limited by various factors, including lack of infrastructure, especially power. Therefore, additional mitigation-type efforts will be needed to protect tribal members. Given the potential tsunami wave heights for some portions of the planning area, standard floodplain development regulation may not provide adequate risk protection for new development, unless the development is restricted to the upper area of the Reservation in the Eagle Hill Road vicinity, and then only a small percentage of the land is available. Acquiring additional land mass and moving the Reservation is the only way certain to ensure safety of the tribal members, as presently, all residences and structures fall within the tsunami zone.

12.8 SCENARIO

The worst-case scenario for the planning area is a local tsunami event triggered by a seismic event along the Cascadia subduction zone. Historical records suggest that tsunami wave heights on the order of 15 to 60 feet could be generated by a Cascadia subduction event. A major tsunami event in the region would have devastating impacts on the people, property and economy of the Shoalwater Tribe.

12.9 ISSUES

The planning team has identified the following issues related to the tsunami hazard for the planning area:

- Hazard Identification: To truly measure and evaluate the probable impacts of tsunamis on planning, new hazard mapping based on probabilistic scenarios likely to occur needs to be created. The science and technology in this field are emerging. For tsunami hazard mitigation programs to be effective, probabilistic tsunami mapping will need to be a key component.
- Present building codes and guidelines do not adequately address the impacts of tsunamis on structures, and current tsunami hazard mapping is not appropriate for code enforcement.
- As tsunami warning technologies evolve, the tsunami warning capability within the planning area will need to be enhanced to provide the highest degree of warning.
- With the possibility of climate change, the issue of sea level rise will become an important consideration as probable tsunami inundation areas are identified through future studies.
- Special attention will need to be focused on the vulnerable communities in the tsunami zone and on hazard mitigation through public education and outreach.

Chapter 13.
WILDFIRE

13.1 GENERAL BACKGROUND

A wildfire is any uncontrolled fire on undeveloped land that requires fire suppression. Wildfires can be ignited by lightning or by human activity such as smoking, campfires, equipment use or arson. Typically, the wildfire season in Washington usually begins in early July, and ends with precipitation in late September; however, wildfires have occurred in every month of the year. Drought, snow pack and local weather conditions can expand the length of wildfire season.

Wildfire danger on the Shoalwater Reservation is enhanced significantly during the 4th of July timeframe as a result of fireworks. The sale of fireworks is an important seasonal industry for many Tribal members. The Tribe also sponsors an annual fireworks show each 4th of July, which draws several thousand people to the Reservation. As a result, the increased ignition source from the fireworks, as well as the use of fireworks on the Reservation by non-tribal members, significantly increases the fire danger throughout the planning area.

DEFINITIONS

Conflagration—A fire that 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—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 into one. The involved area becomes so hot that all combustible materials ignite, even if they are not exposed to direct flame. Temperatures may exceed 1000°C. Superheated air and hot gases of combustion rise over the fire zone, drawing surface winds in from all sides, often at velocities approaching 50 miles per hour. Firestorms seldom spread because of the inward direction of the winds, but there is no known way of stopping them. Within the area of the fire, lethal concentrations of carbon monoxide are present; posing a serious life threat to fire forces. In very large events, the rising heated air and combustion gases carry 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 wildfires and where wildland vegetation and urban or suburban development occur together. An example would be smaller urban areas and dispersed rural housing in forested areas.

Wildfire—Fires that result in uncontrolled destruction of forests, brush, field crops, grasslands, and real and personal property in non-urban areas. Because of their distance from firefighting resources, they can be difficult to contain and can cause a great deal of destruction.

13.1.1 Wildland Urban Intermix Planning Area

The potential for significant damage to life and property is also increased in areas designated as "wildland urban interface (WUI) areas," where development is adjacent to densely vegetated wildland areas. The wildland-urban intermix exists wherever residential and supporting commercial land uses intermingle with forest and range commercial uses and wildlands. Typically in these situations, homes and other structures are built into the wildlands so that there is little separation between the flammable native vegetation and structures. In some places, the landscapes around homes have been largely modified from the native vegetation, but homes lie close to the wildlands and are not constructed to resist ignition in a wildfire.

Population de-concentration in Washington has resulted in rapid development in the outlying fringe of metropolitan areas and in rural areas with attractive recreational and aesthetic amenities, especially forests. This demographic change is increasing the size of the wildland-urban interface (WUI), defined as *the area where structures and other human development meet or intermingle with undeveloped wildland.* The WUI is where wildfire poses the biggest risk to human lives and structures. The expansion of the WUI in recent decades has significant implications for wildfire management and impact. The WUI creates an environment in which fire can move readily between structures and vegetation fuels. Its expansion has increased the likelihood that wildfires will threaten structures and people.

WUI is composed of both *interface and intermix* communities. In both interface and intermix communities, housing must meet or exceed a minimum density of one structure per 40 acres. *Intermix* communities are places where housing and vegetation intermingle. In *intermix,* wildland vegetation is continuous, more than 50 percent vegetation, in areas with more than 1 house per 40 acres. *Interface* communities are areas with housing *in the vicinity* of contiguous vegetation. Interface areas have more than 1 house per 40 acres, have less than 50 percent vegetation, and are within 1.5 miles of an area that is more than 75 percent vegetated. An interface can also be defined as a zone where human-made infrastructure is located in, or adjacent to, wildfire prone areas. At a community-level perspective, the interface can be defined as the conditions that contribute to a neighborhood or community's vulnerability to a wildland fire. Based on these factors, the Shoalwater Reservation constitutes an *interface* community, as housing and wildland vegetation are intermingled, with continuous vegetation surrounding structures.

During the pre-settlement period (before 1875) the Native American people commonly used fires for many reasons, including food harvesting and for cultural and traditional practices. It also helped drive out rodents and insects, and kept the forest understory open, which made for easier travel and hunting. Additionally, it enhanced the forbs and grasses used in basket weaving, something which was, and continues to be, a common practice for many of the Shoalwater people.

The practiced use of fire maintained the natural balance on the lands, and provided the resources necessary to maintain and support the lifestyle of the Tribal Nations. Over time, the ability to continue the use of controlled fires has been restricted to a great extent. These restrictions have not only impinged upon the Native People's way of life, but have also impacted nature's way of sustaining and maintaining itself. While suppression activities are intended to protect us, these activities, ultimately, have also significantly increased fire danger to some degree.

Much of the native wildland of North America adapted to frequent wildfire over the thousands of years since climate warming at the end of the last ice age. Individual species adapted to fire. Over time, the species in the fire-adapted wildlands adjusted to each other until many ecosystems not only tolerate fire, but also often depend on fire to sustain the relationships that keep the system healthy. One of the important roles of frequent fire has been to keep fuel from accumulating. In the last century, land managers became more and more successful in excluding fire. As they did so, vegetation accumulated and the species composition and structure of forests changed. As a result, few present-day landscapes still resemble the native landscapes. In many of the forest types preferred for wildland-urban intermix development, vegetation is much denser, there is more dead woody material within the stands, and thickets of suppressed reproduction beneath the canopy easily carry fire from the surface into the tree crowns.

13.1.2 Wildfire Impact

Beyond the threat to humans, wildfire presents a risk to vegetation and wildlife habitats. Short-term loss caused by a wildfire can include the destruction of timber, wildlife habitat, scenic vistas, and watersheds. Long-term effects include smaller timber harvests, reduced access to affected recreational areas, and destruction of cultural and economic resources and community infrastructure. Vulnerability to flooding increases due to the destruction of watersheds. The potential for significant damage to life and property exists in WUI areas, where development is adjacent to densely vegetated areas. At present time, the area surrounding the Reservation is not densely populated, but is heavily wooded.

13.1.3 Communities at Risk

At the request of Congress, states submitted lists of all communities within their borders where there was a high level of wildfire risk from adjacent federal lands. The preliminary criteria and methodology for evaluating wildfire risk to communities is published in the *Federal Register,* January 4, 2001. Based on that criteria, a national list of "Communities at Risk" was published in the Federal Register in 2001.

In coordination with the federal effort, Washington State Department of Natural Resources generated a statewide list establishing the communities at risk. Three main factors used to determine the wildfire threat in the wildland-urban interface areas of Washington were: fuel hazards, probability of fire, and areas of suitable housing density that could create wildland urban interface fire protection strategy situations. Washington's analysis (DNR, 2011) included the entire extent of the state's wildland urban interface (not just those adjacent to federal lands). Communities at Risk are defined as all areas within "the vicinity" of 1.5 miles of wildland vegetation, roughly the distance that firebrands can be carried from a wildland fire to the roof of a house. It captures the idea that even those homes not sited within the forest are at risk of being burned in wildland fire. With the use of the above definition as a foundation, the communities in and around these WUI areas become "Communities at Risk".

Review of the DNR analysis concerning risk areas in demonstrates a low hazard risk for the Shoalwater Bay Reservation as seen in Figure 13-1. Based on planning team input and historical occurrences, the planning team agreed with this assessment. However, as climate change continues to impact the area, the planning team also felt that the likelihood of future occurrences and fire severity on and around the Reservation would increase.

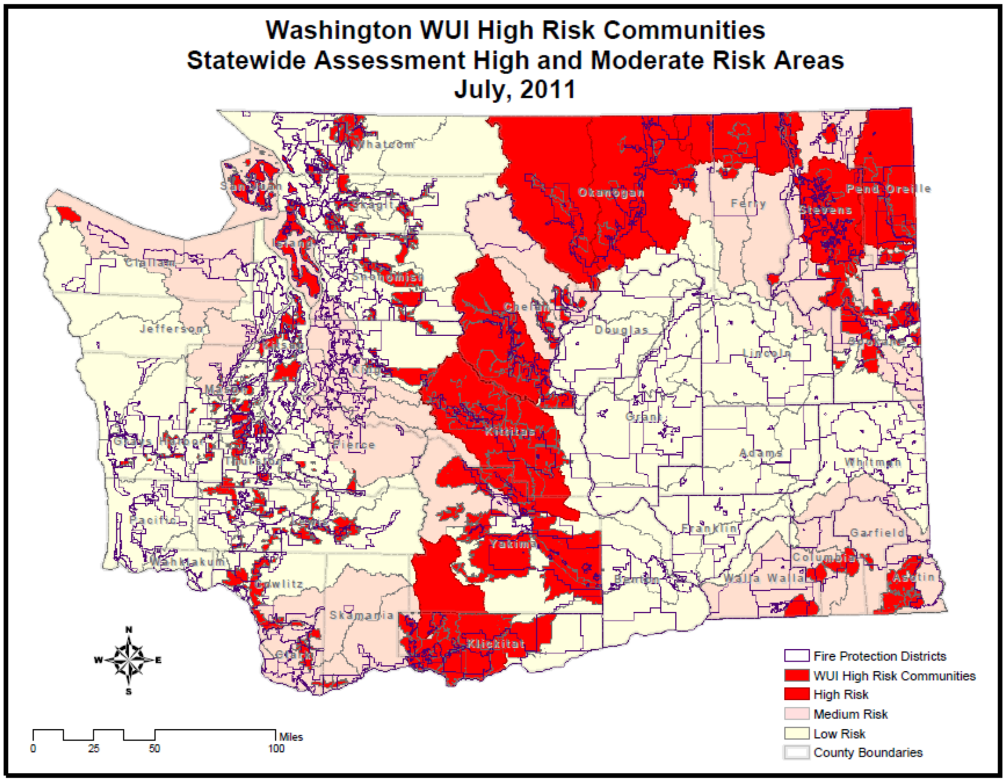


Figure 13-1. Washington WUI High Risk Communities (2011)

13.2 FIRE ECOLOGY

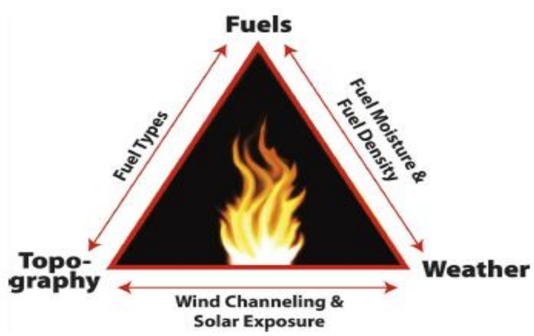
13.2.1 Wildfire Behavior

How a fire behaves depends on many factors, including, but not limited to the following:

- **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. In an effort to gain valid data, concurrent with the development of the mitigation plan and CWPP, the Tribe is also conducting a vegetation study, which data will support the efforts of the Tribe with respect to fuels management.

- **Topography —**Topography includes slope, elevation and aspect. The topography of a region influences the amount and moisture of fuel; the impact of weather conditions such as temperature and wind; potential barriers to fire spread, such as highways and lakes; and elevation and slope of land forms (fire spreads more easily uphill than downhill).
- **Weather**—Relevant weather conditions include temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount and duration, and the stability of the atmosphere. Of particular importance for wildfire activity are wind and thunderstorms:
  – Strong, dry winds produce extreme fire conditions. Such winds generally reach peak velocities during the night and early morning hours. East wind events can persist up to 48 hours, with wind speed reaching 60 miles per hour. Being a coastal community, the Reservation experiences significant winds on a fairly regular basis during all times of the year.
  – The thunderstorm season typically begins in June with wet storms, and turns dry with little or no precipitation reaching the ground as the season progresses into July and August.

The "wildfire behavior triangle" to the right illustrates how these three factors influence wildfire behavior. Each point of the triangle represents one of the three factors; the sides represent the interplay between the factors. For example, drier and warmer weather combined with dense fuel loads and steeper slopes will cause more hazardous fire behavior than light fuels on flat ground.



The Wildfire Behavior Triangle.
Image by Ron Kaufmann

Time of day also affects wildfire behavior, as a fire's peak burning period generally is between 1 p.m. and 6 p.m. Forest practices are an additional influence on wildfire behavior. In densely forested areas, stands of mixed conifer and hardwoods that have experienced thinning or clear-cut provide an opportunity for rapidly spreading, high intensity fires that are sustained until a break in fuel is encountered.

Fire behavior can be categorized as follows:

- **Smoldering**—Involves the slow combustion of surface fuels without generating flame, spreading slowly and steadily. Smoldering fires can linger for days or weeks after flaring has ceased, resulting in potential large quantities of fuel consumed. They heat the duff and mineral layers, affecting the roots, seeds, and plant stems in the ground. These are most common in peat bogs, but are not exclusive to that vegetation.
- **Crawling**—Surface fires that consume low-lying vegetation such as grass, forest litter, and debris.
- **Ladder**—Fires that consume material between low-level vegetation or forest floor debris and tree canopies, such as small trees, low branches, vines, and invasive plants.
- **Crown**—Fires that consume low level surface fuels, transition to ladder fuels, and then consume suspended materials at the canopy level. These fires can spread at an incredible pace through the top of a forest canopy, burning entire trees, and can be extremely dangerous (sometimes referred to as a "firestorm").

Wildfires may spread by jumping or spotting, as burning materials are carried by wind or firestorm. Burning materials can also jump over roadways, rivers, or even firebreaks and start distant fires. Updraft caused by large wildfire events draw air from surrounding area, and these self-generated winds can also lead to a firestorm.

13.2.2 Fuel

Wildfires require a combination of three factors in order to exist, including: fuel, topography and weather. Each of those three elements play a critical role, and fire cannot exist without all three. In the case of a wildfire, fuel is synonymous with vegetation.

Many factors are considered when determining the risk associated with the various types of vegetation including, but not limited to:

- The type fuel/vegetation, categories into four groups – timber, brush, grasses and slash, with the differences in fire behavior among these groups related to fuel load and its distribution among the fuel particle size classes.
- The type of tree—deciduous (leaf) or needles (Douglas Fir).
- The type of leaf – oil based.
- Fuel density—dense forests usually provide more shade, resulting in lower ambient temperatures and greater humidity, therefore, being less susceptible to wildfires.
- Rate of ignition—less dense materials, such as grasses and leaves, are easier to ignite because they contain less water than denser materials, such as branches and trunks.
- Rate of burn – the type of material (among other things) determines the rate at which fire will spread, and the intensity (heat) of the fire for continued ignition.
- The age of trees and associated diameter or size of the stands.
- The health of the forest.
- Forest canopy height – the average height of the top of a vegetated canopy.
- Forest canopy base height, which describes the average height from the ground to the forest stand's canopy bottom (the lowest height in a stand at which there is sufficient amount of forest canopy fuel to propagate fire vertically into the canopy).

Fire Prediction Modeling is a very precise science. Because of the precise science involved in determining all of these factors, in conjunction with the Healthy Forest Act, various agencies and organizations have been tasked with compiling the required information for local entities to use so as to assist in conducting wildfire risk assessments. Within Washington State, the Department of Natural Resources is tasked with determining the actual health of our forest. In August, 2012, a Health Hazard Warning was issued for several counties within Eastern Washington, which will allow the State to assist agencies and landowners to stabilize insect or disease damage. Over the course of the last 25+/- years, the number of acres of trees that have been damaged by forest insects and disease has increased by 200 percent since the 1980s. Review of the State's analysis of the health of the forest within the planning region shows minimal current impact relative to diseased forest areas within the Reservation as illustrated in Figure 13-2.

Parts of the Reservation have historically been logged, and there remains logging slash in place. The large amount of precipitation received on an annual basis increases vegetation growth, which increases fuel source. A key component of this fuel type is the amount of down and dead woody fuel, including slash.

The Reservation also has fuel consisting of brush, closed timber litter, hardwood litter and understory, which will burn with greater intensity. Some of the fires occurring on the Reservation have burned lands with harvestable stands.

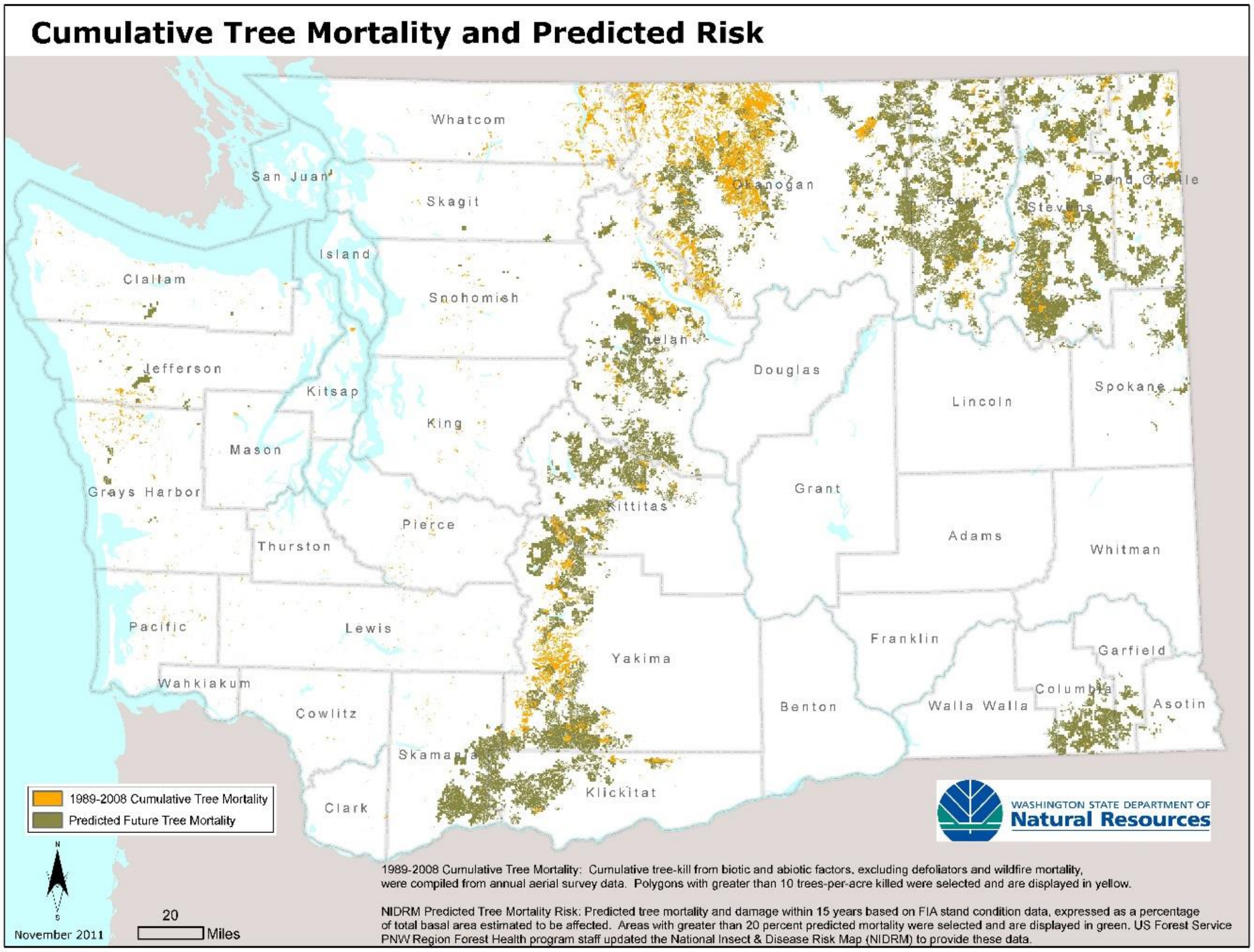


Figure 13-2. DNR Tree Mortality and Predicted Risk (2012)

Many years ago, the members of the tribe practiced controlled burns for ecological and cultural reasons. However, due to implemented restrictions by the State and Federal Governments, prescribed burns have not taken place for many, many years, thereby increasing the fire danger on the Reservation.

13.2.3 Topography

Understanding topography is a critical part of understanding the intensity, rate, and directions of a fire. Topography includes elevation, slop and aspect, which are features used to determine fire risk and behavior.

13.2.4 Slope

The steeper the slope, the faster the fire moves uphill. Flames become closer to the fuel source, increasing radiation and dehydration, preheating the vegetation and resulting in ignition sooner on steep slopes than on more level ground or less steep slopes. Slop is the ratio of rise over the run (area), or in simpler terms, it represents the height over distance of the rise of an area.

The geologic makeup of the Reservation consists of valleys and drainages running from the mountainous regions to the ocean. Composed of several watersheds and bordering densely wooded areas, precipitation in the area cuts down through the predominantly sedimentary rocks, carving both canyons and wide drainages into the ocean. These steep slopes increase a fire's rate of spread uphill and can create topographic influences on wind. The slope values associated with hazard classes based upon NFPA 1144 Standards for Protection of Life and Property from Wildfire (2002), as summarized in Table 13-1.

TABLE 13-1.
SLOPE AND ASSOCIATED HAZARD

Slope	Hazard Risk	Category
<10%	1	Minimal
10 – 20%	4	Low
21 – 30%	7	Moderate
31 – 40%	8	High
>40%	10	Extreme

Review of the slope data for the area of the Reservation ranges from minimal slope along the coastline, to more extreme slopes in the inner boundaries of the Reservation, much of which is forest lands.

The Tribe has initiated several environmental and watershed restoration projects which will protect and re-establish forestlands from non-forest uses. The restoration programs provide for not only traditional forest uses, but also enhance and protect the water, cultural resources, fish and wildlife. The intent is to protect the lands from development, and require sustainable forestry practices.

13.2.5 Aspect

Aspect is the direction the slope faces (north, east, south, west). The aspect determines the effect of solar heating, air temperature, and moisture. In the Northern Hemisphere, south facing slopes receive more solar heating, resulting in lower humidity, rapid moisture loss, and lighter fuels (grasses). Aspect has a noticeable influence on humidity and vegetation type in the region, particularly during the fire season.

Within in the Reservation, south- and west-facing slopes receive more solar radiation than slopes with a north aspect due to increased solar insolation at higher Due to its coastal presence, the level of precipitation helps influence or off set the impacts of aspect than if more inland, without the coastal influence. Therefore, the influence of aspect is lessened. The majority of the planning region has a low to moderate aspect, with areas of minimal aspect (Table TABLE **13-2**). While important, aspect is not a major driver of fire behavior on the Shoalwater Reservation.

TABLE 13-2.
ASPECT AND ASSOCIATED HAZARD

Aspect	Degrees	Hazard Points	Category
N	315.01 – 45	0	Low
E	45.01 – 135	2	Moderate
W	135.01 – 225	3	High
S	225.02 – 315	5	Extreme

13.2.6 Weather

Vegetative fuel moisture/temperature, air temperature, and relative humidity are the most important drivers of wildfire behavior. Precipitation within the planning area is usually at its lowest from July to August/September, which experience less than 2 inches of rain per month (average of 1.23 inches for July). During the dry summer months, the abundant vegetation dries out and becomes hazardous fuel. That fuel combined with any type of wind factor — especially in a hot and dry form—can produce extreme fire danger. While typically fire season ranges from July-September, historic fire regimes demonstrate that fires within the region can occur any time of the year.

The peak fire period of July, August and September are often times related to thunderstorms and lightning strikes. Thunderstorm activity, which typically begins with wet storms, turns dry with little or no precipitation reaching the ground as the season progresses into July and August. July and August are when local winds (slope winds and sea breezes) predominate, with the Pacific jet stream weak and well to the north. By mid or late September, east winds return, bringing in moist ocean air. These winds are more critical for bringing in moist ocean air than in the late spring, due to much lower large dead fuel moistures, and the stressed live fuels.

13.2.7 Roads and Fire-Response Network

Limited funding has not allowed the Tribe to obtain its own fire department, and therefore, response time to the Reservation is well below the standards established. The closest fire station is 6 miles away from the Reservation; however, it is a volunteer station. The closets staffed fire station is in West Port, approximately 20 miles away from the Reservation. A response network assessment, based on ESRI's StreetMap dataset allows a classification of higher hazard in areas that are more distant from timely response. The hazard time breakdowns are based on local and generalized parameters for what qualifies as a good response time (Table 13-3). In addition to the response time, response area is also considered. This includes the average distance an engine can provide service from a location while parked along a road (about 500 feet).

TABLE 13-3.
TRAVEL TIME AND ASSOCIATED HAZARD

Response Time	Hazard Points	Category
< 6 minutes	0	Minimal
6 – 10 minutes	1	Low
10 – 15 minutes	2	Moderate
15 – 60 minutes	3	High
> 60 minutes	5	Extreme

Due to the somewhat rural nature of the region, response times for fire crews are a critical factor in early suppression. The less-than-favorable road conditions in certain parts of the Reservation also pose a challenge for transportation of fire suppression resources and fire response activities to areas whose access is limited to logging roads and trails.

13.2.8 Historical Fire Regime

A 'fire regime' is the term given to the general pattern in which fires naturally occur in a particular ecosystem over an extended period of time. Scientists classify fire regimes using a combination of factors, including: frequency, intensity, size, pattern, season, and severity of the fire.

Individual fires can vary greatly in severity, and the specific effects and risks caused by a fire will depend on the specifics of its fire regime. A classification system, more appropriately referred to as the Fire Regime Condition Class (defined below) has been developed to help describe and characterize specific types of fire, determine which type of fire regime is common in a given ecosystem, and compare present fires with historical norms.

Four broadly accepted fire regime classifications are:

- *Understory fire regime*: Little change to the structure of the ecosystem -- 80% or more of the dominant vegetation is able to survive the fire.
- *Stand-replacement regime*: The most dramatic habitat modification - 80% or more of the dominant vegetation is killed as a result of fire. The structure of the above-ground vegetation is changed substantially.
- *Mixed-severity regime*: Habitat modification varies depending on the severity of the fire and the susceptibility of the dominant vegetation to fire. Variation can also occur within a single fire.
- *Non-fire regime*: Ecosystems where fire is not likely to occur.

Alterations of historical fire regimes and vegetation dynamics have occurred in many landscapes in the U.S., including the Shoalwater Reservation through the combined influence of land management practices, fire exclusion, insect and disease outbreaks, climate change, and the invasion of non-native plan species. Anthropogenic influences to wildfire occurrence have been witnessed through arson, incidental ignition from industry (e.g., logging, railroad, sporting activities), and other factors. Likewise, wildfire abatement practices has reduced the spread of wildfires after ignition.

The LANDFIRE Project produces maps of simulated historical fire regimes and vegetation conditions, producing maps of current vegetation and measurements of current vegetation departure from simulated historical reference conditions. These maps support fire and landscape management planning outlined in the goals of the National Fire Plan, Federal Wildland Fire Management Policy, and the Healthy Forests Restoration Act. The Simulated Historical Mean Fire Return Interval (MFRI) data layer quantifies the average number of years between fires under the presumed historical fire regime. This data layer is derived from vegetation and disturbance dynamics simulations using LANDSUM. LANDSUM simulates fire dynamics as a function of vegetation dynamics, topography, and spatial context, in addition to variability introduced by dynamic wind direction and speed, frequency of extremely dry years, and landscape-level fire characteristics.

The Simulated Historical Fire Regime Groups utilized in LANDFIRE (HFRG, 2006), categorize simulated MFRI and fire severities into five fire regimes defined in the Interagency Fire Regime Condition Class Guidebook, as follows (see Figure 13-3 and 13-4):

- Regime 1: 0-35 year frequency, low to mixed severity
- Regime II: 0-35 year frequency, replacement severity
- Regime III: 35-200 year frequency, low to mixed severity
- Regime IV: 35 -200 year frequency, replacement severity
- Regime V: 200+ year frequency, replacement/any severity

Review of the Fire Regime data for the Shoalwater Reservation shows a Fire Regime Group 5, meaning that the mean return interval is every 200 years for a fire similar to that classified within the condition class.

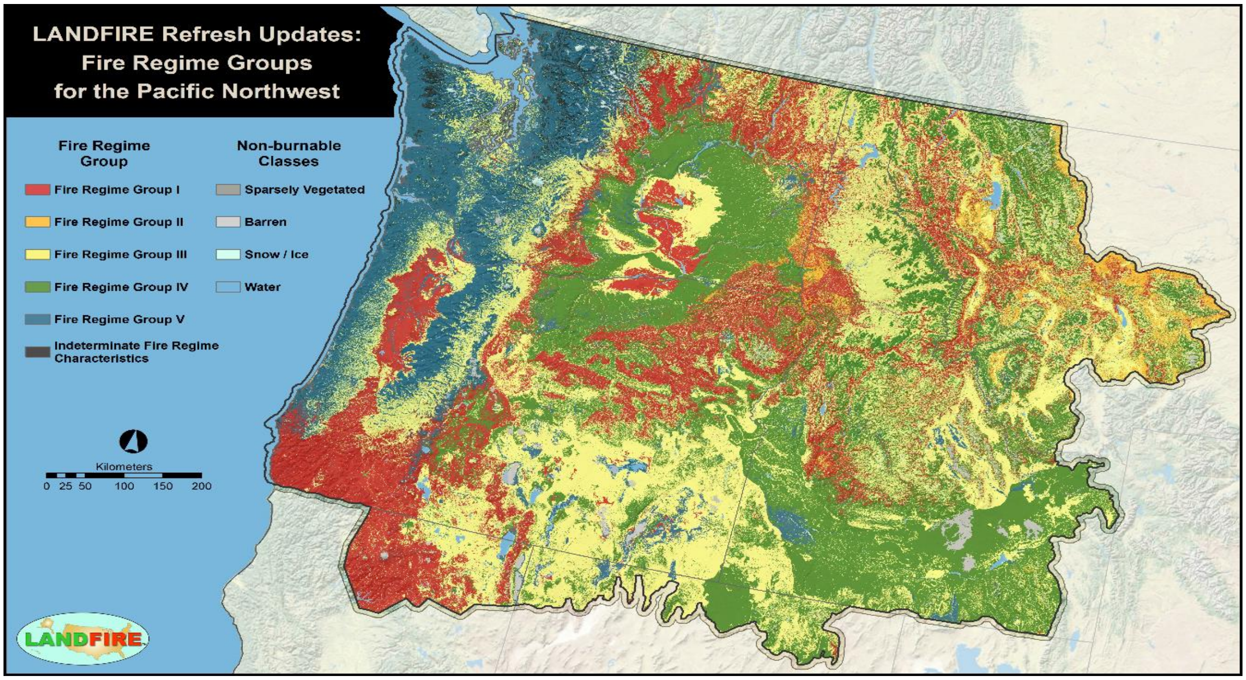


Figure 13-3. Fire Regime Groups for the Pacific Northwest

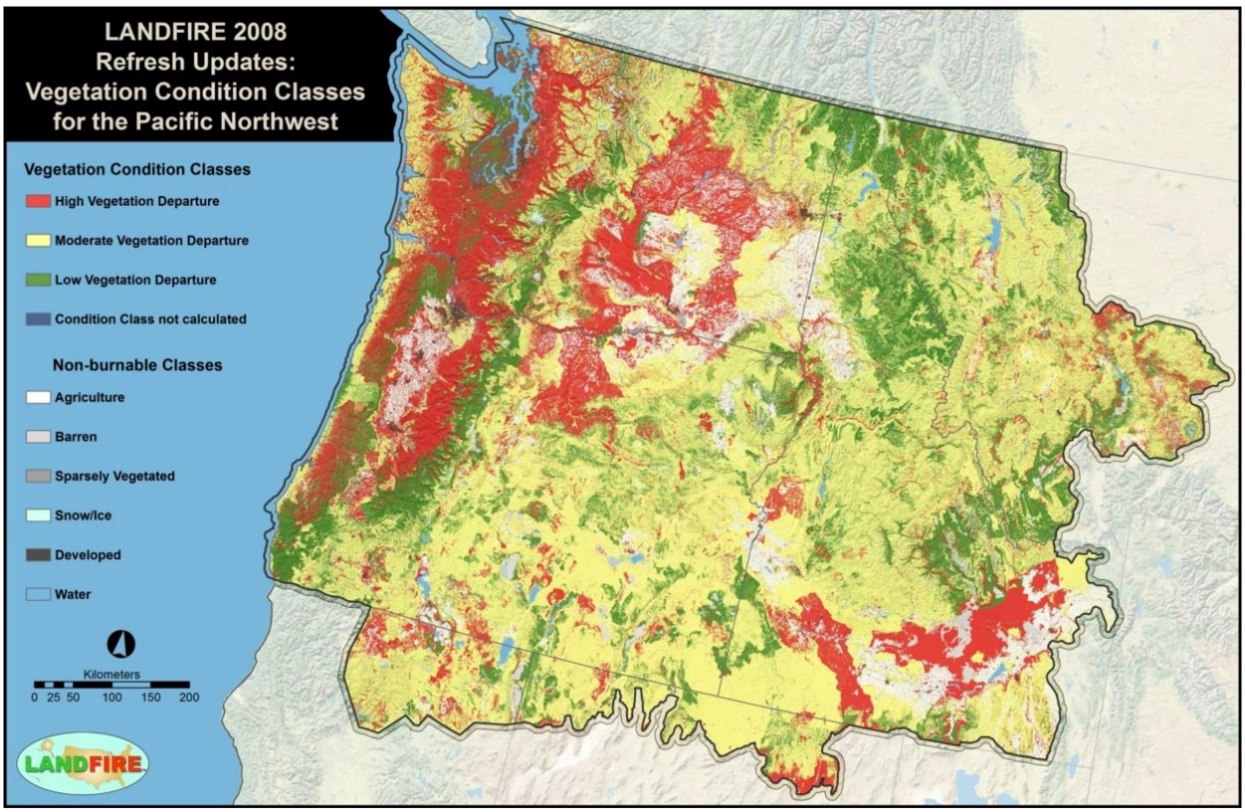


Figure 13-4. Vegetation Condition Class

13.2.9 Departure and Fire Regime Condition Class

Fire is a natural and critical process in most diverse terrestrial ecosystems, dictating, at least in part, the types, structure and spatial extent of native vegetation. Most ecosystems within the planning area are adapted to a historic fire regime as defined above, which characterizes the historic patterns of fire occurrence in a given area. Once the historic fire regimes are determined, variances from those historic regimes must also be assessed to determine the Fire Regime Condition Class. Fire regime condition classes reflect the current conditions' degree of departure from modeled reference conditions.

FRCC assessments measure departure in two main components of ecosystems: 1) fire regime (fire frequency and severity) and 2) associated vegetation. Managers can use the departure and condition class data to document possible changes to key ecosystem components (Schmidt and others 2002). Examples include vegetation characteristics (defined below) (e.g., species composition, structural stage, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other associated disturbances, such as insect and disease mortality, grazing, and drought.

- *Characteristic* conditions are defined as those occurring within the natural fire regime and associated vegetation (for example, low departure [FRCC 1]). Stated another way, characteristic conditions are those described in available biophysical settings models. In contrast, *uncharacteristic* conditions are those that did not occur within the natural regime, and hence produce an FRCC 3 (high departure) assessment outcome.

- *Uncharacteristic* conditions include (but are not limited to): invasive species (weeds and insects), diseases, "high graded" forest composition and structure (in which, for example, large fire-tolerant trees have been removed and small fire-intolerant trees have been left within a frequent surface fire regime), or overgrazing by domestic livestock that adversely impacts native grasslands or promotes unnatural levels of soil erosion.

TABLE 13-4.
FIRE REGIME CONDITION CLASS DESCRIPTIONS

Class	Description
Low: Condition Class 1	Fire regimes are within their historical range, with a low risk of losing key ecosystem components during a fire. Vegetation attributes (composition and structure) are well intact and functioning.
Moderate: Condition Class 2	Fire regimes have been moderately altered from their historical range, with a moderate risk of losing key ecosystem components during a fire. Fire frequencies are one or more fire return intervals away from historical frequencies.
High: Condition Class 3	Fire regimes have been significantly altered from their historical range, which a high risk of losing key ecosystem components. Fire frequencies are multiple return intervals away from historical frequencies. Vegetation attributes have been significantly altered from their historical range.

Historically, Native Americans often burned the lands for various cultural and ecological reasons to maintain the health of the lands. Fire would clear the understory of the forested areas, driving out insects and rodents. Fire also enhanced the grasses and forbs used to weave baskets. During the settlement period (1875-1897) European settlers used fire for enlarging and replenishing pasture/agricultural lands, but these fires often escaped their control. During the post-settlement era (1898-1940), logging was a dominant activity in much of the planning area, and these logged areas were often burned to remove logs and debris.

Over the course of time as suppression activities have become more effective, the suppression of wildfire has resulted in a buildup of fuel and has increased the potential for large fires, which burn with greater intensity than under "natural" conditions. These intense fire events generally result in greater resource damage than "natural" condition events. Large-scale watershed disturbance such as wildfire can result in loss of vegetative cover, increased runoff, and severe erosion and sediment production. Erosion following fires can cause large sediment loads in streams; the sediment may then be transported and deposited into rivers and contribute to further damage aquatic habitat in riparian areas.

The measure of the deviation from the range of natural variability is the Fire Regime Condition Class, which classifies the landscapes into three classes dependent on their degree of departure from the natural fire regimes as described in **Error! Reference source not found.**.

13.3 HAZARD PROFILE

13.3.1 Location

The Washington State Department of Natural Resources (DNR) is the agency responsible for fire management within the state of Washington. DNR annually reviews the fire danger statewide, and establishes the threat level based on their analysis. Figure 13-1 above demonstrates the most recent analysis conducted by Washington State DNR, which identifies the Shoalwater Reservation to be at a low hazard risk to wildfire.

The planning team concurs with DNR's finding in general terms, but feels that the densely wooded hilly area and the homes on SR 105 west of the Casino are at highest fire risk. Additionally, due to the lack of fire response capabilities by the Reservation itself, the planning team also feels that the risk factor is increased due to the lack of firefighting capabilities. Contributing to this determination by the planning team is also the fact that the Tribe has a fairly high volume of fireworks stands and sales during July, and also has a fairly large annual fireworks display which significantly increases the transient population on the Reservation during that time period.

Should a fire occur on the Reservation, the response time from surrounding agencies could exceed one hour, allowing the impact from a small fire to increase exponentially. Included in this analysis is the anticipated length of time involved in response with respect to firefighter volunteers that are utilized in the surrounding jurisdictions.

In addition to the damage from the fire itself, wildfires also cause hazardous air quality conditions many miles away. Temperature inversions are common during certain times of the year, which can cause the smoke from a wildfire to be trapped, causing hazardous air quality conditions present throughout the Reservation.

13.3.2 Past Events

Review of the DNR data of previous fire occurrences since 1972 does not identify any fires occurring on the Shoalwater Reservation since that time; however, there have been approximately 45 fires which have occurred within a five mile radius of the Reservation. The cause of those fires are identified as follows:

- 40 percent were caused by logging activities and debris burns
- 18 percent were caused by fireworks
- 27% were caused by hunters, campers, children and smokers

The most significant of the fires occurred in May 1972, when a 140 acres burned. The fire was caused by debris burning which went out of control. The fire was located in the hilly logging area northeast of the Reservation. In addition to the 1972 burn, there was also a five acre burn caused by a camper in September 1987. That fire occurred on the beach at Tokeland, approximately 1.5 miles from the Reservation.

13.3.3 Frequency

Historic fire regimes indicate a recurrence rate of ~200 years. Since 1972, no fires have occurred on the Reservation.

13.3.4 Severity

Potential losses from wildfire include human life, structures and other improvements, cultural and natural resources. The lack of immediate response times to reported fires does increase the likelihood of injuries and casualties, although the likelihood of a fire itself is minimal based on DNR analysis. Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations including children, the elderly and those with respiratory and cardiovascular diseases. Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke. In addition, wildfire can lead to ancillary impacts such as landslides in steep ravine areas and flooding due to the impacts of silt in local watersheds.

13.3.5 Warning Time

Wildfires are often caused by humans, intentionally or accidentally. There is no way to predict when one might break out. Since fireworks often cause brush fires, extra diligence is warranted around the Fourth of July when the use of fireworks is highest. Dry seasons and droughts are factors that greatly increase fire likelihood. Dry lightning may trigger wildfires. Severe weather can be predicted, so special attention can be paid during weather events that may include lightning. Reliable National Weather Service lightning warnings are available on average 24 to 48 hours prior to a significant electrical storm.

If a fire does break out and spread rapidly, residents may need to evacuate with little notice. A fire's peak burning period generally is between 1 p.m. and 6 p.m. Once a fire has started, fire alerting is reasonably rapid in most cases. The rapid spread of cellular and two-way radio communications in recent years has further contributed to a significant improvement in warning time. However, due to limited cell coverage on the Reservation, this has the potential to significantly impair the ability to report a fire.

13.4 SECONDARY HAZARDS

Wildfires 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 and indirect economic losses in reduced tourism. Wildfires cause the contamination of reservoirs, destroy transmission lines and contribute to flooding. They strip slopes of vegetation, exposing them to greater amounts of runoff. This in turn can weaken soils and cause failures on slopes. Major landslides can occur several years after a wildfire. Most wildfires burn hot and for long durations that can bake soils, especially those high in clay content, thus increasing the imperviousness of the ground. This increases the runoff generated by storm events, thus increasing the chance of flooding.

13.5 CLIMATE CHANGE IMPACTS

Fire in western ecosystems is determined primarily by climate variability, local topography, and human intervention. Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. Hot dry spells create the highest fire risk. Increased temperatures may intensify wildfire danger by warming and drying out vegetation. When climate alters fuel loads and fuel moisture, forest susceptibility to wildfires changes. Historical Climate change also may increase winds that spread fires. Faster fires are harder to contain, and thus are more likely to expand.

Historically, drought patterns in the West are related to large-scale climate patterns in the Pacific and Atlantic oceans. The El Niño–Southern Oscillation in the Pacific varies on a 5- to 7-year cycle, the Pacific Decadal Oscillation varies on a 20- to 30-year cycle, and the Atlantic Multidecadal Oscillation varies on a 65- to 80-year cycle. As these large-scale ocean climate patterns vary in relation to each other, drought conditions in the U.S. shift from region to region. El Niño years bring drier conditions to the Pacific Northwest and more fires.

Climate scenarios project summer temperature increases between 2ºC and 5°C and precipitation decreases of up to 15 percent. Such conditions would exacerbate summer drought and further promote high-elevation wildfires, releasing stores of carbon and further contributing to the buildup of greenhouse gases. Forest response to increased atmospheric carbon dioxide—the so-called "fertilization effect"—could also contribute to more tree growth and thus more fuel for fires, but the effects of carbon dioxide on mature forests are still largely unknown. High carbon dioxide levels should enhance tree recovery after fire and young forest regrowth, as long as sufficient nutrients and soil moisture are available, although the latter is in question for many parts of the western United States because of climate change.

13.6 EXPOSURE

The geography of wildfire depends on topography and the geography of vegetation. It does not depend on the geography of land ownership or political jurisdiction. Compared to the typical wildland-urban interface property, wildfire is significant. Large fires burn on a wide front, threatening many properties at essentially the same time. Scattered properties with defensible space make only a little difference in firefighters' abilities to save property. When properties in a neighborhood have been treated and preparations are integrated with each other, firefighters can hope to save most homes and the landscape from serious damage in a large fire under most conditions. Within the planning area, the lands are composed more of an intermix that interface, which is a cultural norm for the residents of the reservation, as historically, preservation of their natural resources has been, and continues to be, of paramount importance. This customary style of living has resulted in residents living within the natural boundaries of the landscape, with minimal interference. Through the development of this plan, tribal members hope to sustain their practice of living within the natural landscape while embracing the practices of fire suppression which will reduce their levels of exposure.

13.6.1 Population

The entire population of the Reservation, including transient populations, casino and hotel guests, would be at risk to impact from wildfire. With limited access on and off of the Reservation, evacuation - should a large fire occur - would be difficult with increased traffic attempting to leave. Should fire spread and block the transportation corridor going in either direction, evacuation would be more significantly impacted. With the relatively small size of the Reservation, smoke would also impact the entire Reservation's population, also potentially impacting visibility during evacuation.

13.6.2 Property

Property damage from wildfires can be severe and can significantly alter entire communities. The entire Reservation has some level of risk associated with the wildfire hazard, due both from the exposure and the limited response capabilities and time associated with surrounding fire districts responding onto the Reservation.

13.6.3 Critical Facilities and Infrastructure

In the event of wildfire, based on the limited infrastructure on portions of the Reservation, even the smallest impact would be significant to the sustainability of the Reservation. While most paved roadways would have limited damage except in the worst scenarios, the Tribe also has non-paved access roads, which could be potentially impacted due to increased water runoff from destruction of vegetation. In addition, while limited in nature, any pipelines running through the Reservation could provide a source of fuel and lead to a catastrophic event. Power lines are the most at risk to wildfire because most are made of wood and susceptible to burning. This is of significant concern on the Reservation due to the length of time which would be needed to re-establish the flow of power. Historically, due to the remoteness of the Tribe and the fact that they are at the end of the power line distribution, experience demonstrates that where surrounding communities may be out of power for a few hours, that same event can leave the Reservation without power for days, even weeks.

Of additional concern are hazardous material sites in wildfire risk zones. During a wildfire event, these materials could rupture due to excessive heat and act as fuel for the fire, causing rapid spreading and escalating the fire to unmanageable levels. In addition they could leak into surrounding areas, saturating soils and seeping into surface waters, or become airborne, creating toxic air quality – all having a disastrous effect on the environment.

13.6.4 Environment

Fire is a natural and critical ecosystem process in most terrestrial ecosystems, dictating in part the types, structure, and spatial extent of native vegetation. However, wildfires can cause severe environmental impacts:

- 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.

- 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.
- 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.
- Destruction of Watershed – Fires have the potential to significantly impact watersheds. Given the significance of the watersheds within the planning area, destruction of any of these ecosystems would have a devastating impact, including increasing landslide susceptibility and impact to streams, streambeds and fisheries.

Many ecosystems are adapted to historical patterns of fire occurrence. These patterns, called "fire regimes," include temporal attributes (e.g., frequency and seasonality), spatial attributes (e.g., size and spatial complexity), and magnitude attributes (e.g., intensity and severity), each of which have ranges of natural variability. Ecosystem stability is threatened when any of the attributes for a given fire regime diverge from its range of natural variability.

13.7 VULNERABILITY

Structures, above-ground infrastructure, critical facilities and natural environments are all vulnerable to the wildfire hazard. There is currently no validated damage function available to support wildfire mitigation planning. Except as discussed in this section, vulnerable populations, property, infrastructure, natural resources and environment are assumed to be the same as described in the section on exposure.

13.7.1 Population

The entire population of the Reservation is at risk to the wildfire hazard due to the remoteness of the tribe, potential issues with evacuation, and fire response limitations. Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

Smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive populations, including children, the elderly and those with respiratory and cardiovascular diseases. Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxics (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Public health impacts associated with wildfire include difficulty in breathing, leading to repertory infections or even failures; eye irritation; odor, and reduction in visibility, increasing the risk to (vehicle) accidents.

13.7.2 Property

Loss estimations for the wildfire hazard are not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing 10 percent, 30 percent and 50 percent of the assessed value of exposed structures. This allows emergency managers to select a range of economic impact based on an estimate of the percent of damage to the general building stock. Damage in excess of 50 percent is considered to be substantial by most building codes and typically requires total reconstruction of the structure. Table 13-5 lists the loss estimates for the existing structures on the Reservation that have an exposure to a fire hazard.

TABLE 13-5. LOSS ESTIMATES FOR WILDFIRE	
Exposed Value	$27.4 million
Estimated Loss Potential from Wildfire	
10% Damage	$2,740,000
30% Damage	$8,2220,000
50% Damage	$13,700,000

13.7.3 Critical Facilities and Infrastructure

Critical facilities of wood frame construction are especially vulnerable during wildfire events. In the event of wildfire, there would likely be little damage to most infrastructure. Most roads would be without damage except in the worst scenarios. Power lines are the most at risk from wildfire because most poles are made of wood and susceptible to burning, and the length of time needed to bring power back on-line. Fires can create conditions that block or prevent access and can isolate residents and emergency service providers. Wildfire typically does not have a major direct impact on bridges, but it can create conditions in which bridges are obstructed. Many bridges in areas of high to moderate fire risk are important because they provide the only ingress and egress to large areas and in some cases to isolated neighborhoods. While the Reservation does not have any bridges within its boundary, there are bridges along evacuation routes within Pacific County which could potentially be impacted by fire.

13.7.4 Response Capabilities

Fire response on the Reservation is very limited. The Tribe itself does not have firefighting capabilities and must rely on surrounding fire districts to provide this service for them. Due to its remote location, travel to areas where fires are occurring can take considerable response time.

13.8 FUTURE TRENDS IN DEVELOPMENT

While the planning area has experienced limited growth over the past 10 years, the Tribe has made significant strides in expanding government functions and business opportunities, such as with the casino and hotel. The Tribe is optimistic that marginal, sustained growth will return to the planning area as its economy strengthens, and more infrastructure is made available to the Reservation to allow for continued growth.

Expansion of the Reservation within the planning area will continue to have the wildfire intermix risk exposure until more resources are available to provide firefighting capabilities. While the expansion of the Reservation into the intermix area can, to some degree, be managed with smart development practices, land use and building codes, the lack of critical infrastructure with respect to additional roadways and communication will continue to be a significant factor, as viewshed, response and notification will prohibit proactive activities, and in fact, impede development in significant portions of the Reservation. Until infrastructure can be provided and improved, residents living on the Reservation in many areas will continue to live with the increased fire risk, while taking whatever actions they can to ensure their safety, such as establishing defensible space and constructing new structures with materials which are more resilient to fires, and in such a manner that reduces the potential for ignition.

13.9 SCENARIO

A major fire in the planning area might begin with a wet spring, adding to fuels already present on the forest floor. Flashy fuels would build throughout the spring. The summer could see the onset of insect infestation. A dry summer could follow the wet spring, exacerbated by dry hot winds. Carelessness with combustible materials or a tossed lit cigarette, or a sudden lighting storm could trigger a multitude of small isolated fires.

The embers from these smaller fires could be carried miles by hot, dry winds. The deposition zone for these embers would be deep in the forests and intermix zones. Fires that start in flat areas move slower, but wind still pushes them. It is not unusual for a wildfire pushed by wind to burn the ground fuel and later climb into the crown and reverse its track. This is one of many ways that fires can escape containment, typically during periods when response capabilities are overwhelmed. These new small fires would most likely merge. Suppression resources would be redirected from protecting the natural resources to saving more remote subdivisions.

The worst-case scenario would include an active fire season throughout the American west, spreading resources thin. Firefighting teams would be exhausted or unavailable. Many federal assets would be responding to other fires that started earlier in the season. While local fire districts would be extremely useful in the urban interface areas, they have limited wildfire capabilities or experience, and they would have a difficult time responding to the ignition zones on the Reservation. Even though the existence and spread of the fire is known, it may not be possible to respond to it adequately, so an initially manageable fire can become out of control before resources are dispatched.

To further complicate the problem, heavy rains could follow, causing flooding and landslides and releasing tons of sediment into rivers, permanently changing floodplains and damaging sensitive habitat and riparian areas. Such a fire followed by rain could release millions of cubic yards of sediment into streams for years, creating new floodplains and changing existing ones. With the forests removed from the watershed, stream flows could easily double. Floods that could be expected every 50 years may occur every couple of years. With the streambeds unable to carry the increased discharge because of increased sediment, the floodplains and floodplain elevations would increase.

13.10 ISSUES

The major issues for wildfire are the following:

- Public education and outreach to people living in or near the fire hazard zones should include information about and assistance with mitigation activities such as defensible space, and advance identification of evacuation routes and safe zones.
- Firefighting capabilities – staffing and equipment are needed to provide adequate response capabilities within standardized timeframes.
- Roadways and infrastructure of appropriate style and size.
- Wildfires could cause landslides as a secondary natural hazard.
- Climate change could affect the wildfire hazard.
- Future growth into intermix areas should continue to be managed.
- Vegetation management activities—this would include enhancement through expansion of the target areas as well as additional resources.
- Regional consistency of higher building code standards such as residential sprinkler requirements and prohibitive combustible roof standards.
- Expand certifications and qualifications for fire department personnel (including those which currently provide this service to the Shoalwater Reservation). Ensure that all firefighters are trained in basic wildfire behavior, basic fire weather, and that all company officers and chief level officers are trained in the wildland command and strike team leader level.

- It is the *condition* of the Home Ignition Zone (e.g., type of material) that influences the survivability of a home or structure more than its location. Firebrands (embers) can be carried a relatively far distance by winds, up to a mile or more, but, if the condition of the home ignition zone (e.g., roof) is a metal structure versus a shake roof, the potential for ignition is much, much lower.
- It is not always *where* the home is located that necessarily determines ignition risk, rather it is *how ignitable* the home is as determined by the home ignition zone.

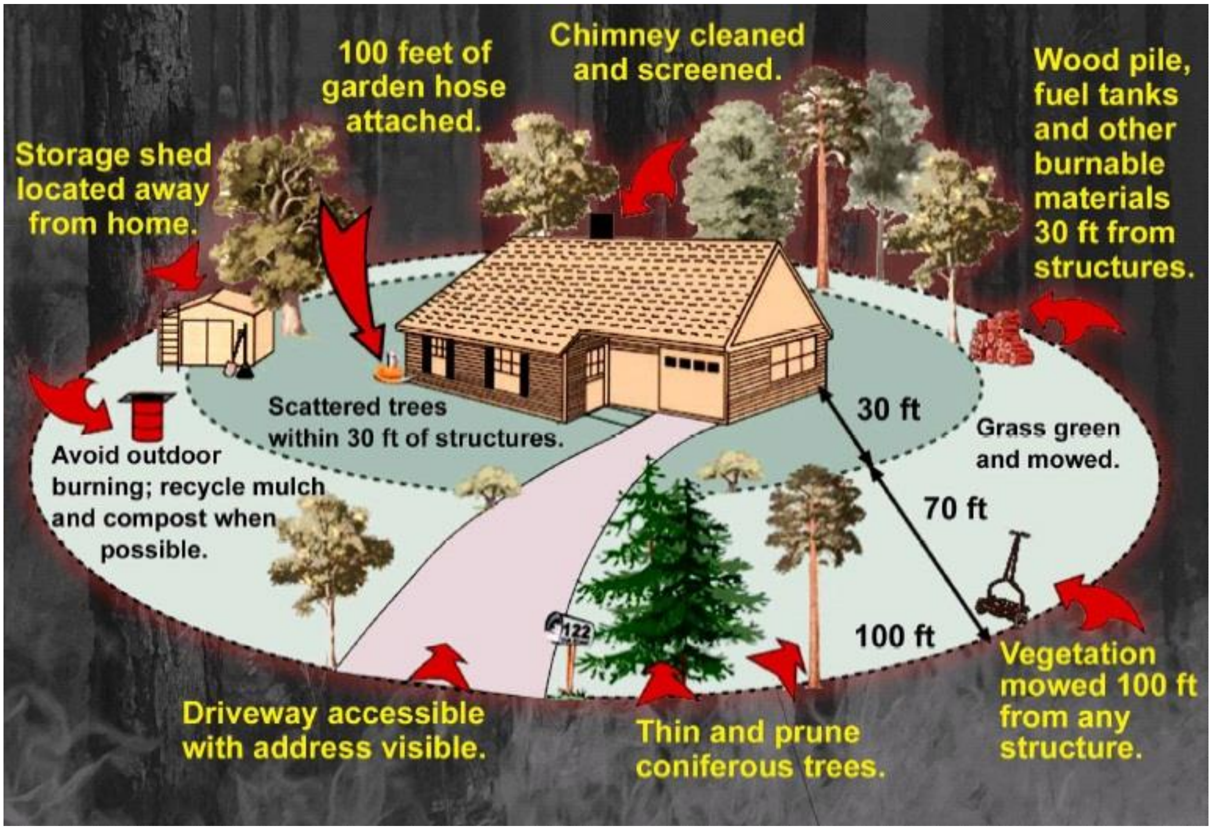


Figure 13-5. Fire Mitigation for Residential Structures

Chapter 14.
HUMAN-CAUSED THREATS

14.1 GENERAL BACKGROUND

Human-caused threats are those resulting from the intentional actions of an adversary, and can be either a *threatened or actual* incidents. These incidents are collectively referred to as terrorism. Terrorism incidents can include: civil disturbance, cyber incident, sabotage, and an active shooter/standoff situation. Terrorism can also include chemical, biological, radiological, nuclear and explosive (CBRNE) devices.

14.1.1 Terrorism

Characteristics

The three key elements to defining a terrorist event are as follows:

- Activities involve the use of illegal force.
- Actions are intended to intimidate or coerce.
- Actions are committed in support of political or social objectives.

While there are several components which distinguish terrorism threats from other types of hazards, relevant factors include:

- Terrorism evokes very strong emotional reactions, ranging from anxiety, to fear, to anger, to despair, to depression.
- In the case of chemical, biological, radioactive, nuclear and explosive agents, their presence may not be immediately obvious, making it difficult to determine when and where they may have been (or will be) released; who has been exposed, and what danger is present for first responders and emergency medical personnel.

14.1.2 Types of Terrorists

The Federal Bureau of Investigation (FBI) categorizes terrorism in the United States primarily as one of two types:

- International/foreign terrorism, which involves groups or individuals whose terrorist activities are foreign-based and/or directed by countries or groups outside the United States, or whose activities transcend national boundaries. Examples include the 1993 bombing of the World Trade Center, the U.S. Capitol, and Mobil Oil's corporate headquarters and the attacks of September 11, 2001 at the World Trade Center and the Pentagon.
- Domestic (homegrown) terrorism, which involves groups or individuals whose terrorist activities are directed at elements of our government or population without foreign direction. Domestic Terrorism as defined by the Congressional Research Service is described as "terrorist activity or plots perpetrated within the United States or abroad by American citizens, legal permanent residents, or visitors radicalized largely within the United States."[45] The bombing of the Alfred P. Murrah federal building in Oklahoma City is an example of domestic terrorism. The FBI is the primary response agency for domestic terrorism. The FBI

[45] Jessica Zuckerman, Steve Bucci, Ph.D and James Carafano, Ph.D. The Heritage Foundation. "60 Terrorist Plts Since 9/11: Continued Lessons in Domestic Counterterrorism, July 2013, http://www.heritage.org/research/reports/2013/07/60-terrorist-plots-since-911-continued-lessons-in-domestic-counterterrorism (Accessed August 17, 2013).

coordinates domestic preparedness programs and activities of the United States to limit acts posed by terrorists including the use of weapons of mass destruction (WMDs).

International terrorist (IT) organizations are said to be the result of a frustrated, extremist, culturally or mentally polarized group of individuals motivated by radical or unconventional thought. Extremists generally adopt converse concepts of violence, morality, and in the rationale of "means and ends" than that of mainstream Western societies. This characterization of International Terrorist organizations bears similar cognitive threads to those of Domestic Terrorist (DT) organizations. However, DT advocates and their organizations profess ideologies (left or right) which adamantly exaggerate extremist beliefs toward values held by Western democratic or American cultures.

Such terrorists groups would include:

- Ethnic, religious & racial, sexual separatists
- Left-Wing "Issue/Cause" organizations which embrace animal, environmental, religious, abortionist, anti-government, and anarchist (freedom)
- Right-Wing, Separatists, Militants, Survivalists, Anti-Government (freedom/rights protection & conformance); Sovereignty, and militant anti-police and regulatory authority organizations.

For the individual homegrown terrorist, personal motives may vary greatly. It could be a desire for collective revenge against the U.S. for the purported "war on Islam," poverty or social alienation, or brainwashing. There is no one path to radicalization. As DHS's Office of Intelligence and Analysis has indicated, motives and paths to radicalization can vary significantly depending on one's ideology and religious beliefs, geographic location, or socioeconomic condition.[46] Nevertheless, trends do seem to exist among those attempted homegrown terror plots thwarted since 9/11, most significantly a seeming aversion to suicide or martyrdom.[47]

When one hears the term *terrorism*, they often equate it to the use of weapons of mass destruction, which include chemical, biological, radiological, nuclear and explosive weapons. However, terrorism also includes: arson, incendiary and explosive devices, school shootings, sabotage (including industrial sabotage), hazardous materials releases, agro-terrorism and cyber-terrorism.

In the United States, we define cyber incidents in terms of cyber-attacks and cyber espionage. "A cyber-attack is a non-kinetic offensive operation intended to create physical effects or to manipulate, disrupt, or delete data. It might range from a denial-of-service operation that temporarily prevents access to a website, to an attack on a power turbine that causes physical damage and an outage lasting for days. Cyber espionage refers to intrusions into networks to access sensitive diplomatic, military, or economic information"[48].

Cyber Crimes/Cyber-criminals also threaten US economic interests, although their activities are not recognized necessarily as a terrorist-type event. Cyber criminals selling tools, via a growing black market, that might enable access to critical infrastructure systems or get into the hands of state and non-state actors. In addition, some commercial companies sell computer intrusion kits on the open market. These hardware and software packages can give governments and cybercriminals the capability to steal, manipulate, or delete information on targeted systems. Even more companies develop and sell professional-quality technologies to support cyber operations—often branding these tools as lawful-intercept or defensive security research products. Many individuals, groups and fforeign governments already use some of these tools to target national and local systems.

[46] Ibid
[47] Ibid
[48] James Clapper, Director of National Intelligence. Worldwide Threat Assessment. March 12, 2013 Statement for the Record. Available at: http://www.intelligence.senate.gov/130312/clapper.pdf. Accessed August 23, 2013.

14.1.3 Terrorism Related Threats

Table 14-1 provides a hazard profile summary for terrorism-related threats. For each type of threat, the following factors are addressed:

- **Application Mode**—Application mode describes the human acts or events necessary to cause the threat to occur.
- **Duration/Hazard Impact**—Duration is the length of time the threat is present. For example, the duration of a tornado (a hazard) may be just minutes, but a chemical warfare agent (threat) such as mustard gas, if un-remediated, can persist for hours or weeks under the right conditions.
- **Severity/Characteristics**—These characteristics of a threat describe tendency, or that of its effects, to either expand, contract, or remain confined in time, magnitude, and space. For example, the physical destruction caused by an earthquake (hazard) is generally confined to the place in which it occurs, and it does not usually get worse unless aftershocks or other cascading failures occur. In contrast, a cloud of chlorine gas leaking from a storage tank can change location by drifting with the wind and can diminish in danger by dissipating over time.
- **Mitigating or Exacerbating Conditions**—Mitigating conditions are characteristics of the target and its physical environment that can reduce the effects of a threat. These can range from deterrence or interdiction capabilities, such as fencing or security cameras, to sunlight, which can render some biological agents ineffective. These are also mechanisms which can minimize the likelihood of someone approaching a target unseen, or can reduce its effectiveness. In contrast, exacerbating conditions are characteristics that can enhance or magnify the effects of a hazard. For example, depressions or low areas in terrain can trap heavy vapors, and a proliferation of street furniture (trash receptacles, newspaper vending machines, mail boxes, etc.) can provide hiding places for explosive devices.

TABLE 14-1.
EVENT PROFILES FOR TERRORISM

Threat	Application Mode	Duration/Threat Impact	Severity	Mitigating and Exacerbating Conditions
Conventional Bomb	Detonation of explosive device on or near target; delivery via person, vehicle, or projectile.	Instantaneous; additional "secondary devices, and/or diversionary activities may be used, lengthening the time duration of the hazard until the attack site is determined to be clear.	Extent of damage is determined by type and quantity of explosive. Effects generally static other than cascading consequences, incremental structural failure, etc.	Overpressure at a given standoff is inversely proportional to the area of the distance from the blast; thus, each additional increment of standoff provides progressively more protection. Terrain, forestation, structures, etc., can provide shielding by absorbing and/or deflecting energy and debris. Exacerbating conditions include ease of access to target; lack of barriers and shielding; poor construction; and ease of concealment of device.

TABLE 14-1.
EVENT PROFILES FOR TERRORISM

Threat	Application Mode	Duration/Threat Impact	Severity	Mitigating and Exacerbating Conditions
Chemical Agent	Liquid/aerosol contaminants can be dispersed using sprayers or other aerosol generators; liquids vaporizing from puddles/ containers; or munitions.	Chemical agents may pose viable threats for hours to weeks depending on the agent and the conditions in which it exists.	Contamination can be carried out of the initial target area by persons, vehicles, water, and wind. Chemicals may be corrosive or otherwise damaging over time if not remediated.	Air temperature and humidity can affect the composition of some chemicals agents, as well as evaporation of aerosols. Ground temperature affects evaporation of liquids. Humidity can enlarge aerosol particles. While precipitation can dilute agents, it can also further disperse agents, spreading contamination. Wind can disperse vapors, in some cases rendering them less dangerous, but also increase the spread of the chemical agent used. The micro-meteorological effects of buildings and terrain can alter travel and duration of agents, but can also increase dosage by enclosing the agent within a structure. Shielding in the form of sheltering in place can protect people from harmful effects.
Arson/ Incendiary Attack	Initiation of fire or explosion on or near target via direct contact or remotely via projectile.	Generally minutes to hours.	Extent of damage is determined by type and quantity of device, accelerant, and materials present at or near target. Effects generally static other than cascading consequences, incremental structural failure, etc.	Mitigation factors include built-in fire detection and protection systems and fire-resistive construction techniques, or security measures which reduce exposure. Inadequate security can allow easy access to target, easy concealment of an incendiary device, and undetected initiation of a fire. Non-compliance with fire and building codes, as well as failure to maintain existing fire protection systems, can substantially increase the effectiveness of a fire weapon.
Armed Attack	Tactical assault or sniping from remote location, or random attack based on fear, emotion, or mental instability.	Generally minutes to days.	Varies based on the perpetrators' intent and capabilities.	Inadequate security can allow easy access to target, easy concealment of weapons, and undetected initiation of an attack. Screening devices, such as cameras, pass-through metal detectors or limited searches at entrances may decrease the likelihood of a weapon in some mass gathering facilities.

TABLE 14-1.
EVENT PROFILES FOR TERRORISM

Threat	Application Mode	Duration/Threat Impact	Severity	Mitigating and Exacerbating Conditions
Biological Agent	Liquid or solid contaminants can be dispersed using sprayers, aerosol generators or by point or line sources such as munitions, covert deposits, and moving sprayers. Biological agents may also be introduced into food and water supplies, or through direct application to skin.	Biological agents may pose viable threats for hours to years depending on the agent and the conditions in which it exists.	Depending on the agent used and the effectiveness with which it is deployed, contamination can be spread via wind and water. Infection can spread via human or animal vectors.	Altitude of release aboveground can affect dispersion; sunlight is destructive to many bacteria and viruses; light to moderate wind will disperse agents but higher winds can break up aerosol clouds; the micro-meteorological effects of buildings and terrain can influence aerosolization and travel of agents.
Cyber-attack or Cyber-Espionage	Unlawful attacks and threats of attack against computers, networks and information stored therein.	Minutes to days.	Generally no direct effects on built environment; secondary impact from system attacked (e.g., SCADA system regulating water release)	Inadequate security can facilitate access to critical computer systems, allowing them to be used to conduct attacks, or gather information to support other terrorist-related activities.
Agro-terrorism	Direct, generally covert contamination of food supplies or introduction of pests and/or disease agents to crops and livestock.	Days, months, years.	Varies by type of incident. Food contamination events may be limited to specific distribution or growing sites, whereas pests and diseases may spread widely. Generally no direct impact on built environment, but may increase fire danger in urban interface areas.	Inadequate security can facilitate adulteration of food and introduction of pests and disease agents to crops and livestock.

TABLE 14-1.
EVENT PROFILES FOR TERRORISM

Threat	Application Mode	Duration/Threat Impact	Severity	Mitigating and Exacerbating Conditions
Radiological Agent	Radioactive contaminants can be dispersed using sprayers/ aerosol generators, or by point or line sources such as munitions. Direct contamination may also occur at site if structures are damaged.	Contaminants may remain hazardous for years depending on material used.	Initial effects will be localized to site of attack; depending on meteorological conditions, subsequent behavior of radioactive contaminants may be dynamic. Agent may also unknowingly be transferred to other areas.	Duration of exposure, type of radiation, distance from source of radiation, and the amount of shielding between source and target determine exposure to radiation.
Nuclear Bomb	Detonation of nuclear device underground, at the surface, in the air, or at high altitude.	Light/heat flash and blast/shock wave last for seconds; nuclear radiation and fallout hazards can persist for years. Electromagnetic pulse from a high-altitude detonation lasts for seconds and affects only unprotected electronic systems.	Initial light, heat, and blast effects of a subsurface, ground, or air burst are static and determined by the device's characteristics and employment; fallout of radioactive contaminants may be dynamic, depending on meteorological conditions.	Harmful effects of radiation can be reduced by minimizing the time of exposure. Light, heat, and blast energy decrease logarithmically as a function of distance from seat of blast. Terrain, forestation, structures, etc. can provide shielding by absorbing and/or deflecting radiation and radioactive contaminants.
Intentional Hazardous Material Release (fixed facility or transportation)	Solid, liquid, and/or gaseous contaminants may be released from fixed or mobile containers	Hours to days.	Chemicals may be corrosive or otherwise damaging over time. Explosion and/or fire may be subsequent. Contamination may be carried out of the incident area by persons, vehicles, water, and wind.	As with chemical weapons, weather conditions directly affect how the threat develops. The micro-meteorological effects of buildings and terrain can alter travel and duration of agents. In some instances, sheltering in place can protect people from harmful effects. Established safety codes and reporting requirements, as well as safety plans can decrease danger. Chemical-specific containment and suppression devices, as well as building codes and safety standards which address protection and containment features, can substantially decrease the damage from a hazardous materials release.

Source: FEMA 386-7 (in part)

Science and the Internet have made information related to weapons of mass destruction (WMD) technology widely available to an increasing audience. It is known that terrorists, terrorist cells and criminal organizations have used the Internet for actual WMD experimentation and research. Experts offer that there are five general classifications for "major" terrorist incident planning:

- **Biological agents** pose a serious threat due to their accessibility and the rapid manner in which they can be spread within a population. The most commonly discussed agents include anthrax (sometimes found in sheep and cattle), tularemia (rabbit fever), cholera, the plague (sometimes found in prairie dog colonies), and botulism (found in improperly canned food). A biological incident is most likely first detected in the hospital emergency room, medical examiner's office, or within the public health community long after the terrorist act. The consequences of such an act will present communities with an unprecedented requirement to provide massive reactive and precautionary treatments to exposed populations, patient care facilities and to stage mass fatality management and environmental health clean-up operations, procedures and plans. Anthrax incidents that occurred in the U.S. in October 2001 demonstrate the potential for spreading terror through biological WMDs. The introduction of Newcastle disease in the United States demonstrates how an agent can be introduced to livestock, causing harm to public health and the economy.
- **Chemical agents** are compounds with unique chemical properties that can produce lethal or damaging effects in humans, animals, and plants. Most chemical agents can be introduced into an unaware population relatively easily using aerosol generator, explosive devices, container breakages, and other forms of covert application. Dispersed as an aerosol or inserted into a water system, chemical agents have their greatest potential for inflicting mass casualties. The agricultural community uses and stores significant amounts of chemicals for peaceful and productive means that could be used in destructive ways.
- **Nuclear threat** is the use, threatened use, or threatened detonation of a nuclear bomb or device. Presently, there is no known instance in which any non-governmental entity has been able to obtain or produce and assemble the components of a nuclear weapon. The most likely nuclear scenario is the detonation of a large conventional explosive that incorporates nuclear material or explosives detonation in close proximity to nuclear materials in use, storage, or transit. Of concern is the increasing frequency of radiological materials shipments throughout the U.S. and world. Major transportation arteries for vehicles or rail contribute to the risk of a radiological event as such products can unknowingly pass through any one of the regional transportation corridors. Eastern Washington's Hanford Nuclear site represents one of the world's largest nuclear use, waste storage, and potential radioactive contaminated sites. The site is approximately 300 miles west of the Reservation.
- **Incendiary devices** are either mechanical, electrical, or chemical devices used to intentionally initiate combustion and start fires. Their purpose is to destroy and ignite their target or other proximate materials and/or structures or as a diversion preceding an even larger terrorist or criminal act. These devices are detonated singularly or in series.
- **Explosive incidents** account for 70 percent of all terrorist attacks worldwide. Bombs are terrorist's weapon of choice. The Internet and even local libraries provide ample information for the design and construction of many forms of explosive devices. Elements necessary to construct a WMD are readily available. Additionally, the agricultural communities maintain sufficient products and quantities for use in explosive events. The FBI reported that during the time period October 2012 through April 2013 " 172 IED's" had been reported in the

United States. Residential properties are reported as one the most common bombing targets[49]. According to a White House Report released after the Boston Marathon bombing, "IEDs remain one of the most accessible weapons available to terrorists and criminals to damage critical infrastructure and inflict casualties.[50]"

WMD agents can be combined to have a greater total effect. When combined, the impacts of the event can be immediate and longer-term. Casualties will likely suffer from both immediate and long-term impact.

The effects of terrorism can vary from loss of life and injuries to property damage and disruptions in services such as electricity, water supplies, transportation, or communications. Any of the methods above may have an immediate effect or a delayed effect which lingers.

Terrorist Profile

In dealing with intentional human-caused threats, the unpredictability of human beings must be considered. People with a desire to perform criminal acts may seek out targets of opportunity that may not fall into established lists of critical areas or facilities. First responders train not only to respond to organized terrorism events, but also to respond to random acts by individuals who, for a variety of reasons ranging from fear to emotional trauma to mental instability, may choose to harm others and destroy property. Within the Shoalwater Bay Reservation and Pacific County, there are no known terrorist organizations; however, terrorism is a potential on the Reservation due to its coastline access, the casino and the unpredictable nature of individual terrorists.

14.2 HAZARD PROFILE

14.2.1 Past Events

Many of the terrorist events in the United States have been bombing attacks, involving detonated and undetonated explosive devices, tear gas, pipe bombs, and firebombs. During the time period of 1990- through 2013, the Federal Bureau of Investigation reports that in excess of 50 bomb incidents have occurred nationwide (see Figure 14-1 below). According to the Global Terrorism Database maintained by the University of Maryland's National Consortium for the Study of Terrorism and Response to Terrorism, in excess of 200 terrorist related events (all incidents, regardless of doubt) have occurred during the time period 2001-2011[51]. These include active-shooter incidents, including school shootings; bombings; arson, etc.

Of the terrorist incidents reported, several have occurred within Washington State. A brief description of some of the more significant incidents occurring throughout the State and planning region follow. This list is not all-inclusive of events occurring, but rather represents only open-source references.

- Two incidents occurring in Tacoma in July 1993 involved the American Front Skinheads, who detonated pipe bombs in Tacoma on July 20 and July 22 of that year.
- In Spokane County, the Phineas Priesthood, a domestic terrorism organization, exploded a pipe bomb at the Valley Branch offices of Spokane *Spokesman Review* newspaper on April 1, 1996 and robbed a Spokane Valley branch of the US Bank ten minutes later. The Phineas Priesthood repeated this method of operation three months later when they placed a pipe bomb at a Planned Parenthood office in Spokane on July 12. They then robbed the same branch of the US Bank using an AK-47, a 12-gauge shotgun, a revolver, and a 25-pound propane tank bomb. The proceeds of the criminal acts committed by the Phineas Priesthood were used to further their

[49] Bombs frequent in U.S.; 172 IED Incidents in Last 6 Months, By 1 Count. McClatchy Newspapers. (April 16, 2013). Available at: http://www.mcclatchydc.com/2013/04/16/188733/bombs-frequent-in-us-172-ied-incidents.html#.Uht7VBuTgWY#storylink=cpy Accessed August 26, 2013

[50] ibid

[51] University of Maryland Global Terrorism Data available at: http://www.start.umd.edu/gtd/

domestic terrorist activity and ideology. In addition, there was the placement and explosion of a bomb at Spokane City Hall in 1996.

- The FBI and Bellingham Police interdicted a group of terrorists affiliated with the Washington State Militia on July 27, 1996. The group planned to bomb various infrastructure targets including a radio tower, bridge, and a train tunnel while the train was inside.
- In December 1999, a 33-year-old Algerian man – Ahmed Ressam -- was arrested by U.S. Customs officials while entering the United States in Port Angeles, Washington, aboard a ferry from Victoria, British Columbia. He was subsequently charged with smuggling explosive material into the United States. The CIA noted that the timing devices and nitroglycerine in his possession were the "signature devices" of groups affiliated with Afghan-based Osama bin Laden, the world's most highly recognized and influential Islamic militant who choreographed the 911 disaster in NYC. It was highly unlikely the explosive materials could be smuggled onto commercial aircraft; Ressam was scheduled to depart for Seattle the next day and he was booked into a motel blocks from Seattle Center. Law-enforcement officials investigated the possibility of a terrorist bombing during the Year 2000 New Year's Eve celebration at the Space Needle. The Space Needle traditionally draws tens of thousands of revelers. Ressam has since been sentenced for his crimes and when interviewed during his custody became one of this nation's most informative terrorism sources leading federal investigators to many individuals and terrorist cells around the world.
- In 2005, two Hummers were damaged at the George Gee Auto Dealership within the planning region, in Liberty Lake. The joint terrorism task force determined it was domestic terrorism as someone claiming to be affiliated with the Environmental Liberation Front (ELF) claimed responsibility.
- July 2006 gunman fires on women at the Jewish Federation of Greater Seattle
- In 2006 the US Postal Annex in the Eastern Washington city of Clarkston detected a powdery substance in a piece of mail addressed to President Bush. Investigation determined that identical letters were sent to several Post Offices throughout the US.
- January 17, 2011 – Kevin William Harpham placed improvised explosive devices (IED) along the planned route of the Martin Luther King Jr. Day Unity March in Spokane. The IED was capable of inflicting serious injury or death according to laboratory analysis conducted by the FBI. The blast was intended to detonate during the march. Harpham pleaded guilty and faces 27-32 years in prison[52].
- In June 2011, the FBI raided a warehouse in Seattle, which housed two suspects who had arranged to purchase weapons from an anonymous informant in contact with the Seattle Police Department. Abu Khalid Abdul-Latif and Walli Mujahidh were seeking to purchase automatic machine guns and grenades in preparation for an attack on a military recruiting station in Seattle. After the arrests, authorities learned that Abdul-Latif, a felon and Muslim convert, had initially planned to attack the Joint Base Lewis–McChord with Los Angeles resident Mujahidh. The target was later changed to the Seattle Military Entrance Processing Station for undisclosed reasons.[53] The men were charged with conspiracy to murder officers and employees of the United States government, conspiracy to use a weapon of mass destruction, and possession of firearms in furtherance of crimes of violence. Abdul-Latif was also charged with two counts of illegal possession of firearms. Mujahidh pleaded guilty in December 2011 to a conspiracy to murder officers and agents of the United States, to a conspiracy to use weapons of mass destruction, as well as to being a felon in possession of a firearm. He was sentenced in April 2013 to 17 years in

[52] FBI, Seattle Division (2011). Attempted Bomber Pleads Guilty to Federal Hate Crime Charge and Weapons Charge. (September 7, 2011). Available at: http://www.fbi.gov/seattle/press-releases/2011/attempted-bomber-pleads-guilty-to-federal-hate-crime-and-weapons-charges. Accessed August 17, 2013

[53] FBI Seattle Division (2011). "Two Men Charged in Plot to Attack Seattle Military Processing Center." June 23, 2011. Available: http://www.fbi.gov/seattle/press-releases/2011/two-men-charged-in-plot-to-attack-seattle-military-processing-center (Accessed August 17, 2013).

prison and 10 years of supervised release. Abu Khalid Abdul-Latif was sentenced to 18 years in prison and 10 years of supervised release.

- May 2013, five letters containing active ricin were mailed from Spokane to various federal agencies, three of which were located in Spokane: a Federal District Court Judge in Spokane; the W. Riverside Post Office in Spokane, and the Fairchild Air Force Base, also in Spokane. The same suspect mailed similar letters containing ricin to the President of the United States and the Central Intelligence Agency[54].

Civil Disorders

The United States has a long history of civil disorders and civil unrest. It is part of our nation's history. Unlike other large scale emergencies that bring communities together, civil disorders are divisive. Since the 1960's, this division is often racial. These disturbances often follow a protest or high profile event affecting local communities. These disturbances are classified as communal riots and are considered to be conflicts between two or more ethnic groups. At the time the incidents occurred, commodity riots emphasize the economic and political distribution of power among groups, and Congressional commissions in the 1960's attempted to categorize civil disorders based on size of crowds, the length of the violence, its intensity, and the level of force needed to restore order.

Washington State witnessed race riots in the 1960s, protests against the Vietnam War in the 1970s, abortion clinic demonstrations in the 1980s, and disturbances stemming from allegations of police brutality in the 1990s. In Seattle, a small-scale riot occurred after the 1992 Rodney King verdict. On the night the jury rendered its decision, small groups of people roamed the downtown streets smashing windows, lighting dumpster fires, and overturning cars. The following day some Seattle residents went to Capitol Hill where they set fires and attacked the West Precinct Police Headquarters.

More recent, on May 3, 1998, the Washington State Emergency Operations Center (EOC) was activated in response to a civil disturbance that occurred at Washington State University in Pullman. The disturbance developed when student's end-of-year celebrations got out of hand. The disturbances consisted of large crowd of students throwing rocks, debris, beer bottles, and starting fires. Students lined the streets throwing bottles, rocks, and debris and starting fires. Local and state law enforcement officials were assembled to restore order and several officials were injured. Washington National Guard units were placed on standby status. The state EOC returned to normal operations later in the day.

After Seattle's declaration of emergency created by disturbance and violence during the World Trade Organization meeting, the Washington State EOC activated on November 30, 1999. A Washington State proclamation of emergency allowed commitment of state resources to support affected local jurisdictions. Washington State Patrol, Department of Transportation, National Guard, department of Natural resources, Emergency Management Division, and an Incident Management Team provided support. The November 30, 2000 anniversary of Seattle's WTO meeting resulted in repeat disturbance, violence and property damage.

The Shoalwater Reservation has no history of civil disorders; however, major events have occurred Western Washington's Seattle metro corridor.

14.2.2 Location

Terrorists often choose targets that offer limited danger to themselves and areas with relatively easy public access. Foreign terrorists look for visible targets where they can avoid detection before and after an attack such as international airports, large cities, major special events, and high-profile landmarks.

[54] FBI, Seattle Division (2013). Additional Threatening Letters Now Part of Spokane, Washington Ricin Investigation (May 30, 2013). Available at: http://www.fbi.gov/seattle/press-releases/2013/additional-threatening-letters-now-part-of-spokane-washington-ricin-investigation (Accessed August 17, 2013)

Terrorists are also now known to advance two techniques of growing concern within the public safety arena: the targeting of first responders employing secondary timed (or multiple) explosive devices and Weapons of Mass Destruction (WMD) hoaxes

Communities are vulnerable to both IT and DT terrorist acts. Targets are often located near high traffic/high-visibility routes with convenient transportation access. Examples of targets include:

- Tribal or other government office buildings, court houses, schools, hospitals, and shopping centers – and “symbolic” targets whose operations, practices or associations represent values in conflict with the terrorists ideology;
- Casinos and gaming facilities, or facilities/events drawing in large volumes of people.
- Dams, water supplies, electrical and gas distribution systems, pipelines, chemical facilities;
- Military installations and suppliers;
- Railheads, interstate highways, tunnels, airports, ferries, bridges, seaports, overpasses;
- Recreational facilities such as sports stadiums, theaters, parks, casinos, concert halls, public venues;
- Financial institutions and banks;
- Sites of historical and symbolic significance;
- Scientific research facilities, academic institutions, museums;
- Telecommunications, newspapers, radio and television stations;
- Chemical, industrial, and petroleum plants; business offices, convention centers;
- Law, fire, emergency medical services, and responder facilities and operations centers;
- Special events, parades, religious services, festivals, celebrations;
- Planned Parenthood facilities and abortion clinics.

Shoalwater Bay Reservation does not contain a large number of any of these potential targets; however, they do have a casino, and annually have events which draw large crowds, such as the Tokeland Parade and the annual 4^{th} of July fireworks show. They also have several locations which are of cultural and historic significance.

Targets become more appealing when high profile personalities and dignitaries visit them. Evidence of this occurred within Washington during visits by Presidents Obama and Clinton and Vice President Cheney, which resulted in demonstrations by anti-war and pro-immigration activists.

Large annual sporting events such as Hoopfest in Spokane County which draws in excess of 225,000 fans, teams and volunteers to the area during the three day event; or the 2014 post-season Seahawks football games in the CenturyLink Stadium with in excess of 70,000 individuals in attendance at the stadium, require threat assessments against the probability of terrorist event for each event.

Additionally, international meetings and conventions provide a similar opportunity to terrorist organizations. The last decade has also seen increased civil disturbances, including rioting and looting following major-league sports events throughout the United States. Seattle, home of major sport teams, has the potential to have similar disturbances, while remote areas have less potential for sports-related disturbances as they related to rioting of these types.

The probability of a civil disturbance on the Reservation is low.

14.2.3 Frequency

While education, heightened awareness, and early warning of unusual circumstances may deter crime and terrorism, intentional acts that harm people and property are possible at any time. Public safety entities would then react to the threat, locating, isolating, and neutralizing further damage and investigating potential scenes and suspects to bring criminals to justice.

The various terrorism trends have resulted in a threat environment more complex and diverse than ever before. In the past 4-5 years, al Qaeda, its affiliates, and homegrown terrorists all have attempted attacks on the homeland. New tactics and tradecraft have emerged that further complicate the myriad of threats facing the United States as a whole. The increased availability of information on the Internet has allowed terrorist groups to overcome their geographic limits and plays an increasing role in facilitating terrorist activities in any geographic location. Due to this more decentralized threat environment, the next attack could come at the hands of a well-trained al Qaeda operative equipped with a sophisticated improvised explosive device (IED) or a lone homegrown domestic terrorist using an automatic weapon to attack a shopping mall.

In the past 12 years, terrorists have succeeded in attacking the various areas in the United States several times, which have resulted in several fatalities and injuries, including: (1) the intentional driving of an SUV into a crowd of students at the University of North Carolina–Chapel Hill in 2006; (2) the shooting at an army recruitment office in Little Rock, Arkansas, in 2009; (3) the shooting by U.S. Army Major Nidal Hasan at Fort Hood, also in 2009; and, most recently, (4) the bombings in Boston.[55]

Of the various attempts which have been identified by the FBI and other agencies nationwide, a large portion of these incidents are considered homegrown terror plots. This means that one or more of the actors were American citizens, legal permanent residents, or visitors radicalized predominately in the United States when applying the Congressional definition of domestic or homegrown terrorist. Of those 50 plots, primary target focal points included: military facilities; highly populated targets (such as the Seattle Space Needle); and the third most common target was mass gatherings (like the Boston Marathon, nightclubs and bars, and shopping malls)[56].

[55]*http://www.fbi.gov/stats-services/publications/law-enforcement-bulletin/september-2011/the-evolution-of-terrorism-since-9-11*

[56] Jessica Zuckerman, Steve Bucci, Ph.D and James Carafano, Ph.D. The Heritage Foundation. "60 Terrorist Plots Since 9/11: Continued Lessons in Domestic Counterterrorism, July 2013, http://www.heritage.org/research/reports/2013/07/60-terrorist-plots-since-911-continued-lessons-in-domestic-counterterrorism (Accessed August 17, 2013).

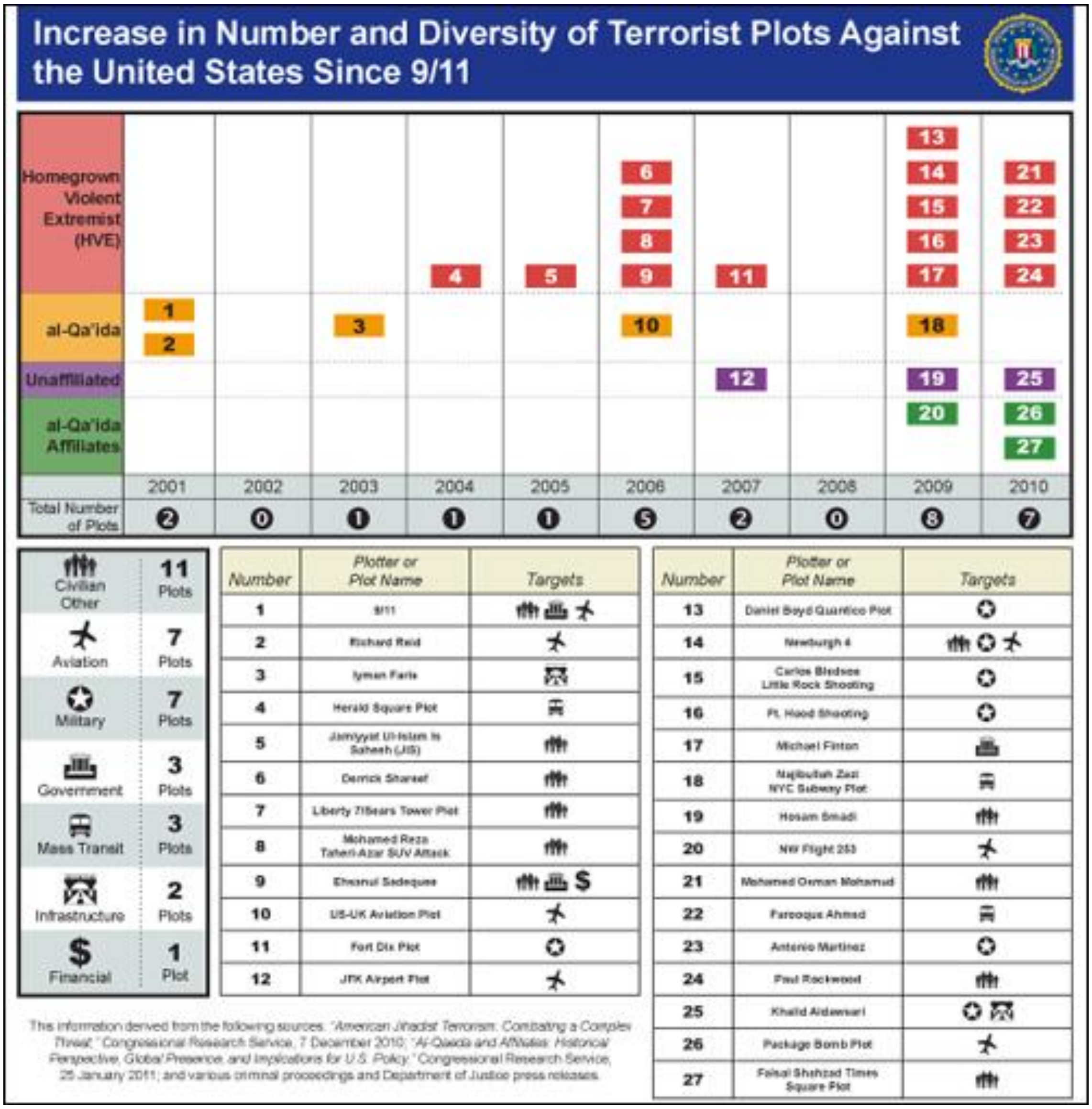


Figure 14-1. Number of Terrorist Plots against United States

Cyber-attacks on infrastructure can originate from adversaries such as hostile governments, criminal organizations, or lone individuals; however, it is important to differentiate a *cyber-attack* from that of *cyber-terrorism*. *As* a Nation, "the United States has not seen a cyber-terrorist threat from terrorists using information warfare techniques."[57] While there have been Cyber-attacks against governments, they have not been for the purpose of gaining warfare information or access. The Office of the Comptroller of the Currency, which regulates national banks, has issued warnings to banks and business of their potential risk. Since September (2012), "attacks have been increasingly aimed at businesses with fewer than 250 employees"[58]. According to the same report, financial institutions are reluctant to provide details and information about potential cyber-attacks for fear of becoming a greater target; therefore, attacks often go unreported. Software manufactures estimate that cyber-attacks against U.S. businesses have increased 42 percent over the course of the last year.[59]

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[57] http://www.crime-research.org/library/Cyber-terrorism.htm

[58] Associated Press. (2013). As Cyber Attacks Detonate, Banks Grid for Battle. Available at: http://www.krem.com/news/national/215674771.html. Accessed August 22, 2013.

[59] ibid

According to the 2013 Intelligence Report:

> The Intelligence Agency determined "that there is a remote chance of a major cyber-attack against US critical infrastructure systems during the next two years that would result in long-term, wide-scale disruption of services, such as a regional power outage. The level of technical expertise and operational sophistication required for such an attack—including the ability to create physical damage or overcome mitigation factors like manual overrides—will be out of reach for most actors during this time frame.
>
> However, isolated state or non-state actors might deploy less sophisticated cyber-attacks as a form of retaliation or provocation. These less advanced but highly motivated actors could access some poorly protected US networks that control core functions, such as power generation, during the next two years, although their ability to leverage that access to cause high-impact, systemic disruptions will probably be limited. At the same time, there is a risk that unsophisticated attacks would have significant outcomes due to unexpected system configurations and mistakes, or that vulnerability at one node might spill over and contaminate other parts of a networked system.
>
> Within the past year, in a denial-of-service campaign against the public websites of multiple US banks and stock exchanges, company servers were flooded with traffic and prevented some customers from accessing their accounts via the Internet for a limited period, although the attacks did not alter customers' accounts or affect other financial functions. Incidents such as the Target, Inc., (as well as other) interception of transmission and access to personal account information which occurred for several months during the end of 2013 and beginning of 2014, while financially significant, is not categorized as a terrorist-related incident.
>
> Hacktivists continue to target a wide range of companies and organizations in denial-of-service attacks, but we have not observed a significant change in their capabilities or intentions during the last year. Most hacktivists use short-term denial-of-service operations or expose personally identifiable information held by target companies, as forms of political protest. However, a more radical group might form to inflict more systemic impacts—such as disrupting financial networks—or accidentally trigger unintended consequences that could be misinterpreted as a state-sponsored attack[60].

Reports by the National Intelligence Agency to the Senate Intelligence Committee in March 2013 indicate that "U.S. agencies judge that there is only a 'remote chance' over the next two years of a 'major cyber-attack against US critical infrastructure' such as a regional power grid. Less sophisticated attacks, such as denial-of-service attacks against bank websites, could be more likely[61].

14.2.4 Severity

The severity of human-caused threats is challenging to measure due to the human nature involved and the unpredictability of the type of threat. In most cases, the intent behind a terrorist event is to cause high impact to people through death and injury, followed by economic impact (through property damage, loss of income, etc.) and loss of continuity of government.

[60] James Clapper, Director of National Intelligence. Worldwide Threat Assessment. March 12, 2013 Statement for the Record. Available at: http://www.intelligence.senate.gov/130312/clapper.pdf. Accessed August 23, 2013.

[61] http://www.khq.com/story/21586758/spy-agencies-say-cyber-attacks-top-current-threats-against-us

With respect to explosive devices, in general, the largest credible explosive size is a function of the security measures in place. Each line of security may be thought of as a sieve, reducing the size of the weapon that may gain access. Therefore, the largest weapons are considered in totally unsecured public spaces (e.g., in a vehicle on the nearest public street), and the smallest weapons are considered in the most secured areas of the building (e.g., in a briefcase smuggled past the screening station). It should also be noted that the likely target is often not the building under consideration by the risk assessment, but a high-risk building that is nearby. Historically, more building damage has been due to collateral effects than direct attack. Based upon access to the agent, the degree of difficulty, and past experience, it can be stated that the chance of a large-scale explosive attack occurring is extremely low and that a smaller explosive attack is far more likely[62].

From the standpoint of structural design, the vehicle bomb is the most important consideration and has been a favorite tactic of terrorists. Ingredients for homemade bombs are easily obtained on the open market, as are the techniques for making bombs. The severity of impact is based on the amount and type of explosive materials used (Figure 14-2).

Mass-casualty incidents (MCI) could result from any human-caused threat, including random acts of violence such as shootings or hostage situations, detonation of explosive devices, such as the recent Boston Marathon bombing, or release of a WMD, including a chemical, biological or radiological incident, contaminating persons and requiring mass decontamination. Effects may include serious injuries, loss of life, and associated property damage. Because large numbers of patients may be involved, significant MCIs may tax local emergency medical and hospital resources, and therefore require a regional response.

[62] www.**fema**.gov/pdf/plan/prevent/rms/155/e155_unit_v.pdf

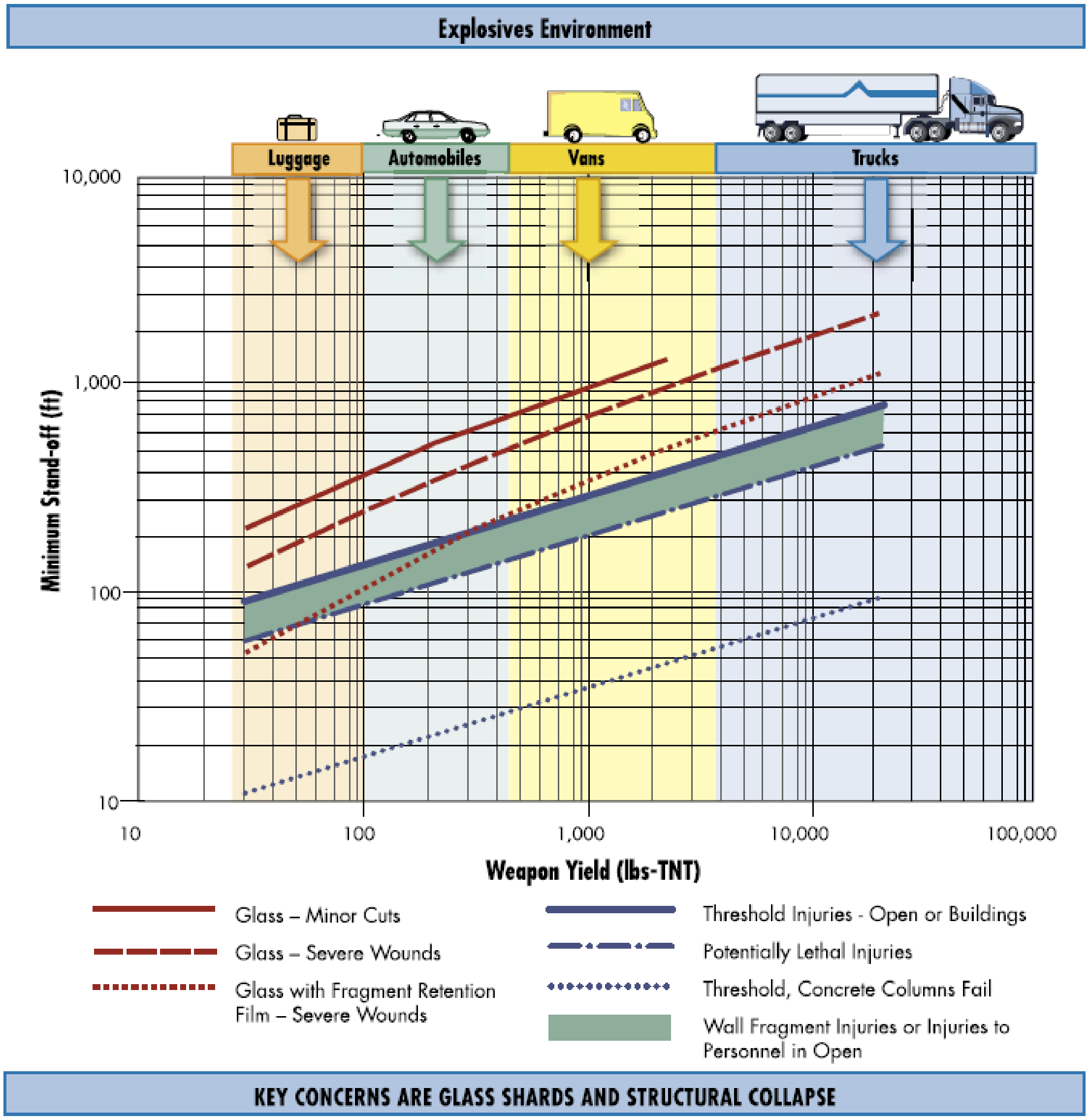

Figure 14-2. Vehicle / Explosive Capacity

14.2.5 Warning Time

Only a very small percentage of all terrorism incidents are preceded by a warning from the terrorists themselves. However, as in the case of the various terrorist activities nationwide which have been thwarted, citizens are much more aware of their surroundings, and are providing key information to law enforcement, which greatly enhances the ability of public officials to provide critical advanced warning information. Likewise, law enforcement, through the sharing of information and establishment of new terrorist-related programs like state fusion centers, law enforcement personnel are able to gather intelligence information which is more reliable, allowing for precautionary measures to be taken to help reduce or eliminate the impact from terrorist incidents.

14.3 SECONDARY HAZARDS

In most instances, the largest secondary impact caused by human-caused threats would be economic impact. Economic impacts from human-caused threats have demonstrated themselves to be significant as it includes not only the actual direct impact to businesses, but the potential for secondary economic loss from the inability of government to function fully. The impact from the World Trade Center bombings demonstrates how such a terrorist event can have global impacts on the economic front. While the primary impact of a terrorist act would be felt in terms of loss of life and injuries (mass casualties), property damage, disruption of business activity and long-term emotional impacts would take significant resources and expense at the local level, significantly impacting recovery.

14.4 EXPOSURE

Terrorist targets can vary based on the intended outcome. The risk assessment for a terrorist incident is based on a system that measures a specific facility's or system's criticality and physical vulnerability. Criticality for these purposes is customarily a measure of the potential consequence of an event, either accidental or intentional.

The criticality of each facility or system assessed is determined based on various factors, including, but not limited to:

- Awareness—How aware is the public of the existence of the facility, site, system, or location?
- Economic Impact – To what extent does the loss of the facility impact the economy of region, state, or nation? This would also include the replacement cost of the facility, and the downtime or functionality of the structure or system.
- Hazardous Materials—Are flammable, explosive, biological, chemical and/or radiological materials present on site?
- Collateral Damage Potential—What are the potential consequences for the surrounding area if the asset is attacked or damaged?
- Casualty Impact —What is the potential for mass causalities based on the capacity of the facility and the impact to the surrounding area?
- Public or Emergency Response Functions—Does the facility perform a function during an emergency? Is this facility or function capable of being replicated elsewhere?

The vulnerability determination is based, in part, on a measure of the physical opportunity for an adversarial attack, taking into consideration physical design, existing countermeasures, and site layout. The vulnerability for each critical facility can be based on the following:

- Accessibility—How accessible is the facility or site to the public?
- Automobile Proximity—How close can an automobile get to the facility? How vulnerable is the facility to a car bomb attack?
- Asset Mobility—Is the facility or asset's location fixed or mobile? If mobile, how often is it moved, relocated, or repositioned?
- Proximity to other critical facilities—If the facility is close to other critical facilities then there could be an increased probability of the facility receiving collateral damage.
- Secure design—General evaluation of areas of obstruction, air intake locations, parking lot and road design and locations and other site design aspects.

Due to the limited infrastructure and facilities on the Reservation, all structures are potentially exposed to some degree to a terrorist event either from primary or secondary impacts. Likewise, vulnerability to structures is also a probability, although certain deterrence mechanisms in place, such as restricted access or surveillance equipment, security guards, etc., have the potential to limit potential impacts.

14.4.1 Population

Impact to a human-caused event could range from an isolated incident to a highly coordinated act of destruction by multiple agents upon multiple targets. Large-scale incidents have the potential to kill or injure many citizens in the immediate vicinity, and may also affect people a relative distance from the initial event. Variables affecting exposure for a WMD attack include the type of product, the physical and chemical properties of the substance, the physical state of the product (solid, liquid, or gas), and the ambient temperature, wind speed, wind direction, barometric pressure, and humidity. In addition to the residents living on the Reservation, consideration must also be given to the increased transient population of tourists that travel to and through the area. Should an incident occur, these individuals would require assistance from first responders. With limited resources available, this would be difficult for the Tribe to provide.

14.4.2 Property

Depending on the incident involved, property damage resulting from a human-caused threat could involve both private residences and business, and public facilities. The majority of structures on the Shoalwater Reservation are owner-occupied or renter-occupied housing units. The majority of the structures are single family units. For the public facilities, the opportunity for access, unmonitored areas, and the proximity of many structures to transportation corridors and underground pipelines (which are limited on the Shoalwater Reservation restricted primarily to gas/fuel lines from the gas station main tanks to the pumps, and from Propane tanks at individuals' residence) all have the potential to increase exposure of structures to human-caused threats.

14.4.3 Critical Facilities and Infrastructure

Critical infrastructure are customarily defined as assets, systems and networks, whether physical or virtual, so vital that the incapacity or destruction of such asset, system or network would have a debilitating impact on security, economy, public health or safety, or any combination of those matters[63].

In general terms, the majority of all critical facilities carry some level of risk because of their accessibility, including vehicle accessibility, and lack of a secure or hardened design.

Large gathering places, including the Tribe's Casino, are vulnerable to a human-caused hazard due to several factors:

- They are accessible to the general public, both in an effort to accommodate aesthetically pleasing urban design and for customer service, featuring few limitations to access by the foot or vehicles
- Design features, including types of building materials, and screened enclosures for mechanical equipment and solid waste, customarily have limit visibility and may contribute to the damage incurred should an intentional or accidental event occur.

[63] http://www.dhs.gov/what-critical-infrastructure

14.4.4 Environment

The risk of human-caused threats to the environment is considerable when considering the potential use of CBRNE materials. Reducing the exposure to the built environment will help mitigate potential losses to the natural environment.

14.5 VULNERABILITY

All of the Shoalwater Bay Reservation is vulnerable to terrorist activity, although to a low degree. There are no identified terrorist events which have occurred either on the Reservation, or in Pacific County. Terrorists go to great lengths to ensure their actions result in disproportionate impact, even if it means destroying an entire structure or killing and wounding thousands of persons proximate to the intended target. Commercially available materials and agents can be developed into WMD. This means that while no incidents have occurred, the potential always exists.

14.5.1 Population

Although terrorism and civil disturbance have not resulted in any deaths in this area, this type of hazard can be deadly and widespread. Any individuals exposed to these hazards are considered to be at risk, particularly those working as first responder professionals.

14.5.2 Property

All structures are physically vulnerable to a human-caused threats. The emphasis on accessibility, the opportunity for roof access, driveways underneath some structures, unmonitored areas, the proximity of many structures to transportation corridors and underground pipelines or storage tanks, and the potential for a terrorist to strike any structure randomly all have an impact on the vulnerability of structures.

14.5.3 Critical Facilities and Infrastructure

All critical facilities wide spread throughout the Reservation are vulnerable to attack.

14.5.4 Environment

Human-caused events have caused significant damage to the environment; however, estimating damage is difficult due to the variables of the threat itself. Loss estimation platforms such as ALOHA are able to measure potential environmental impacts based on inputs existing at the time of the event. For planning purposes, review of damages from past human-caused events provides credible information concerning potential environmental impact.

14.5.5 Economic Impacts

Economic impacts from human-caused hazards could be significant. The cost of a terrorist act would be felt in terms of loss of life and property, disruption of business activity and long-term emotional impacts. Recovery would take significant resources and expense at the Tribal level.

Chapter 15.
TECHNOLOGICAL HAZARDS

15.1 GENERAL BACKGROUND

Technological hazards are customarily associated to accidents associated with human activities during which an unintentional incident occurs with unintended consequences, or potentially resulting as a secondary impact from another hazard incident. Technological hazards are generally categorized as follows:

- Hazardous materials incidents
- Infrastructure and utility losses
- Air, rail and highway transportation accidents
- Dam/levee failure
- Commodity flow

For purposes of this assessment, commodity flow is referenced within the various hazards assessed, but is not addressed as a separate hazard.

15.1.1 Hazardous Materials Incidents

Title 49 of the Code of Federal Regulations lists thousands of hazardous materials, including gasoline, insecticides, household cleaning products, and radioactive materials. Entitles are required to report use, manufacture and storage of hazardous materials based on the type and quantity of materials. The use of hazardous materials is associated with almost every industry to some degree, increasing the potential for a hazardous material incident. These hazardous materials incidents can be associated with the manufacture, transportation, storage and the daily use of hazardous materials. Within the boundaries of the Shoalwater Reservation, review of current facilities are identified in Figure 15-1and include:

The Tribe, within the boundaries of the Tribal Reservation, operates four (4) backup, or emergency, generators with diesel fuel tanks supplying fuel. All four fuel tanks are equipped with secondary containment in the form of double-walled fuel tanks.

Other tribal facilities and many tribal homes (including all Elders' homes) also contain propane tanks used for heating and cooking as well as back-up power.

All facilities and homes in the area, including those off-reservation, are on septic sewerage systems.

Off-Reservation, commercial fish processing and agriculture businesses utilize hazardous materials that may be transported through the Reservation on SR 105 and Tokeland Road.

Off-shore, oil and other hazardous materials are transported via ships to major regional ports.

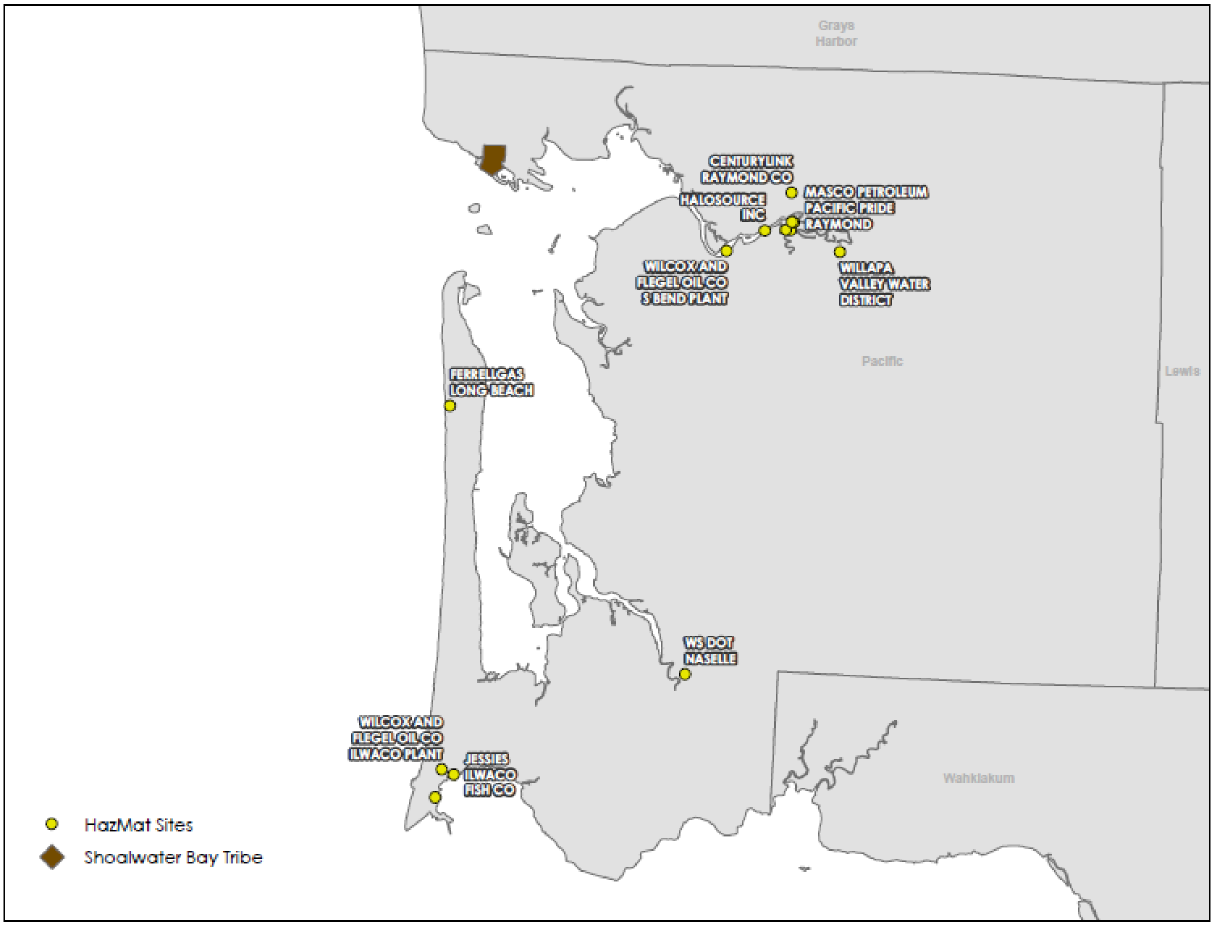

Figure 15-1. Shoalwater Bay Reservation Haz-Mat Locations

As of 2014, there are no regulated facilities subject to EPCRA (Tier II facilities) within a 10 mile radius of the Shoalwater Bay Reservation. However, for future planning purposes, Tier II facilities include facilities that produce, store, or utilize chemicals as in course of business. For example, water treatment plants use chlorine on-site to eliminate bacterial contaminants. Hazardous materials are transported along interstate highways and railways daily. Even the natural gas used in every home and business is a dangerous substance when a leak occurs.

The following are the most common type of hazardous material incidents:

- **Fixed-Facility Hazardous Materials Incident**—This is the uncontrolled release of materials from a fixed site capable of posing a risk to health, safety and property as determined by the Resource and Conservation Act. It is possible to identify and prepare for a fixed-site incident because federal and state laws require those facilities to notify state and local authorities about what is being used or produced at the site.
- **Hazardous Materials Transportation Incident**—A hazardous materials transportation incident is any event resulting in uncontrolled release of materials during transport that can pose a risk to health, safety, and property as defined by Department of Transportation Materials Transport regulations. Transportation incidents are difficult to prepare for because there is little if any notice about what materials could be involved should an accident happen. Hazardous materials transportation incidents can occur at any place within the country,

although most occur on the interstate highways or major federal or state highways, or on the major rail lines.

In addition to materials such as chlorine that are shipped throughout the country by rail, thousands of shipments of radiological materials, mostly medical materials and low-level radioactive waste, take place via ground transportation across the United States. Many incidents occur in sparsely populated areas and affect very few people. There are occasions, however, when materials are involved in accidents in areas with much higher population densities, such as the January 6, 2005 train accident in Graniteville, South Carolina that released chlorine gas killing nine, injuring 500, and causing the evacuation of 5,400 residents. Or the April 2013 West Fertilizer Company plant explosion in West, Texas which killed 15 people and injured hundreds more, flattening buildings and prompting widespread evacuations. Fortunately, such events are rare.

- **Interstate Pipeline Hazardous Materials Incident**—There are a significant number of interstate natural gas, heating oil, and petroleum pipelines providing natural gas to utilities and transporting these materials from production facilities to end-users.

The Washington State Hazardous Materials Program consists of several agencies, each responsible for specific elements of the program. A number of strategies have evolved to limit risk, response to, and recovery from hazardous materials releases, intentional discharges, illegal disposals, or system failures. A comprehensive system of laws, regulations, and resources are in place to provide for technical assistance, environmental compliance, and emergency management.

The Shoalwater Bay Tribe participates in the State's Tribal Emergency Response Commission (TERC) and Local Emergency Planning Committee (LEPC). The LEPC, in concert with the Department of Emergency Management, conduct hazard identification, vulnerability analysis, and risk analysis activities for its jurisdiction. Federal and state statutes require LEPCs to develop and maintain emergency response plans based on the volumes and types of substances found in, or transported through, their districts. While the Tribe itself does not have any Tier II facilities, they do have some hazardous materials on the Reservation, and in 2012, completed a Hazardous Materials Response Plan.

15.1.2 Infrastructure and Utility Failure

Technological hazards can impact all utilities within the Shoalwater Reservation. Impact can occur as a result of system failure – such as a Supervisory Control and Data Acquisition (SCADA) computer system which is used to monitor and control plant or equipment industries, or as a result of an accidental incident severing lines. For future planning efforts, all types of utilities are identified, but not all are currently available on the Reservation (e.g., gas)

- **Electrical Power—**A power failure is any interruption or loss of electrical service due to disruption of power generation or transmission caused by an accident, natural hazards, equipment failure, or fuel shortage. These interruptions can last anywhere from a few seconds to several days. Power failures are considered significant only if the local emergency management organization is required to coordinate basic services such as the provision of food, water, and heating as a result. Power failures are common with severe weather and winter storm activity.
- **Natural Gas –** The loss of natural gas or interruption of service caused by an accident natural hazards, equipment failure – including lines or SCADA systems, or commodity shortage. These interruptions can last a short period of time to several days. The loss of natural gas when a primary heat source can have significant impact on the population if the event occurs during periods of a cold-weather.

- **Cyber Failure - Data and Telecommunications—**The loss of data (non-terrorist related event) and/or telecommunications is often a secondary hazard to natural and or technological hazards. Data and telecommunications provide a primary method for service to the community by the government and the private sector. A loss of data and telecommunications could result in loss of emergency dispatch capabilities, emergency planning services, infrastructure monitoring capabilities, access to statistical data, and loss of financial and personnel records. Sustained loss of data could impact continuity of governmental operations. Random hackers are one source common to cyber-attacks, as are organized crime syndicates who also engage in cyber-attacks for monetary gain, primarily through the use of stealing personal information such as credit card numbers (identity theft).
- **Water Disruption—**A breach in water pipelines in the County would have significant temporary impacts until alternative water sources are obtained. Long-term disruption of the water supply would have significant impacts on residences and businesses should demand exceed secondary supplies and water conservation measures not provide enough relief to reduce demand to equal the secondary supplies.
- **Wastewater Disruption—**Disruption of wastewater collection and treatment would have significant regional impacts. Wastewater treatment plants may also have emergencies internal to the plant such as chlorine gas leaks or oxygen deficiencies that render them incapable of treating waste. The disruption of service may also have significant environmental impacts on the waterways adjacent to the treatment plants.

Loss of these services due to accidents would mean a potential life-threatening situation in the case of electricity for medically dependent residents, and a public health threat if the services are disrupted for some time. Loss of services could also impact the continuity of government operations. As previously indicated, as a result of being at the end of the power distribution lines, the Tribe regularly experiences prolonged power outages on the Reservation. In an effort to mitigate potential issues with power failure and to protect the residents of the Reservation, the Tribe has purchased several generators for use during times of power outages.

15.1.3 Transportation Accidents

Transportation accidents are incidents involving air, rail or marine vessel passengers resulting in death or serious injury. Incidents can occur on in the air, on waterways, highway/roadways, bridges and overpasses, all of which have the potential to shut down transportation for extended periods of time.

Airports

There are no airports on the Reservation; however, Pacific County does have a number of heliports associated with hospitals, as well as Willapa Harbor Airport. The location of these facilities are not in direct proximity to the Reservation; however, increased air traffic would enhance the potential for an air disaster for in-bound and out-going flights which travel over the Reservation air space.

Highways

Several major transportation routes, including U.S. Highways 101, 103, 105 and 109 either run through the Reservation, or provide primary ingress and egress. The potential for transportation accidents that block ingress, egress, and commodity-flow movement through the Reservation and Pacific and Grays Harbor Counties are significant, and also increase the likelihood of hazardous materials incidents resulting from a traffic accident.

Bridges

According to the U.S. Dept. of Transportation, Federal Highway Administration, and the National Transportation Safety Administration, there are no bridges on the Shoalwater Reservation. Pacific

County, however, has 113 Federal Bridges, five of which are identified as structurally deficient, and 21are identified as functionally obsolete[64],[65] . As previously indicated, there are currently two bridges which are on the Washington State Department of Transportation's list for replacement: the Smith Creek and North River bridges. Both of these bridges provide direct access onto the Reservation.

Rail

There are no rail lines which traverse the Reservation.

15.2 HAZARD PROFILE

Hazardous Materials

All areas of the Reservation located near major transportation corridors of whatever type are subject to the increased probability of a hazardous materials release. Hazardous materials are transported over or near numerous wetlands, environmentally sensitive areas, and through densely populated centers.

Natural disasters like floods, landslides, and earthquakes can trigger hazardous material incidents. Illegal drug labs used for methamphetamine manufacturing, and illegal dumping of drug paraphernalia and items used to cook drugs present yet another hazardous materials concern. Recent history also shows an increase in the national threat from terrorist use of hazardous materials. The combination of possible sources of exposure to our sizable population and workforce presents complex problems to responders.

Infrastructure and Utility Failure

Societal norms indicate that we are fully dependent upon information technology and information infrastructure. At the core of the information infrastructure upon which we rely is the Internet, which connects one computer to another, networking the nation's infrastructure and essential services. Services such as electrical transforms, water distribution centers, security systems (radar), and economic sectors (stock markets) all exist with the infrastructure at its nexus.

While a technological incident of cyber-failure can occur internal to organizations or be a widespread incidents due to an accident or resulting from a natural hazard, loss of information networks can have serious consequences, such as disruption of critical operations, loss of revenue or intellectual property, or loss of life. Of primary concern is the lack of redundant systems (or security measures) which could impact infrastructure to the extent capable of causing debilitating disruption, including compromising computer functions, and prolonged disruption of service. Those impacted by such cyber failures, including potential data loss, can include government and private sector owned control systems for transportation and communications, industrial processes, power and other utility generation and distribution.

Transportation

The range of magnitude of impact from transportation incidents varies depending upon the mode of transportation involved. Incidents involving commercial vehicles carrying hazardous materials; impact from incidents involving structural integrity of bridges; air traffic traveling over jurisdictions, or maritime traffic passing by the coastline of the Reservation can have a devastating impact on the Tribe. Given the amount of rail freight and other cargo moved over public access routes, the potential for a major transportation issue is relatively high.

[64] National Transportation Safety Board. http://www.fhwa.dot.gov/bridge/nbi/no10/county.cfm. Accessed January 30, 2014

[65] US Dept. of Transportation, Federal Highway Administration. Available at: http://www.fhwa.dot.gov/bridge/nbi/county09c.cfm#wa. Accessed January 30, 2014.

15.2.1 Past Events

Hazardous Materials

There have been no significant hazard material releases on the Shoalwater Bay Reservation.

Infrastructure and Utility Failure

Infrastructure and utility failure can result from a multitude of incidents covering large areas. Incidents can range from computer input or operator error to a lone vehicle striking a major power distribution line as a result of an accident.

Cyber failure can and does occur on the Reservation. The most frequent local cyber issue involves disruption of service due to internal problems, or as a result of connectivity issues to communication lines; the incidents are more centralized in location of impact. However, with the reliability on fiber optic cables, the exchange of information relying on the Internet, and the reliability on control systems for delivery of service illustrates that impacts from technological incidents do not have to be focused on incidents occurring on the Reservation, or even Washington State, but can occur great distances away.

The failure of the North Eastern power grid of 2003 resulting from operator error impacted 50 million customers in eight US states and the province of Ontario. The September 2011 event impacting portions of the Western power grid - Arizona, Southern California, Baja California and Mexico - affected nearly three million customers. Inter-dependence on critical infrastructure such as power generation encompasses mass areas susceptible to potential impact from a technological incident. Fortunately, our region has not experienced similar type wide-spread disruptions. Rather, the majority of disruptions occur as a result of natural hazard impact such as a severe weather event, and is more locally focused.

Transportation Issues

Transportation issues can occur regularly anywhere on the Reservation or throughout the counties leading onto the Reservation. Daily accidents can disrupt not only commutes, but also commodities being delivered.

15.2.2 Location

Hazardous Materials

With respect to locations of impact or concern from hazardous materials incidents, the most vulnerable areas are those associated with the storage of hazardous materials, and those areas adjacent to the major transportation corridors. The Shoalwater Reservation, during certain times of the year, maintains a high quantity of fireworks both for sale and use during events which draw large crowds of spectators. The major transportation routes traveling through the Reservation carry various types of hazardous materials en route for delivery for areas off of the Reservation.

Also of concern are illegal operations such as laboratories for methamphetamine pose a significant threat. Laboratory residues are often dumped along roadways, left in rented hotel rooms, transported in the back of vehicles, or cooked within residential structures. All of these scenarios create a serious health threat to unsuspecting individuals, first responders, hazmat clean-up entities, and to the environment.

Illegal dumping sites for hazardous wastes such as used motor oil, solvents, and paint often dumped in remote areas or along roadways, creating a potential health threat to unsuspecting individuals and to the environment. Chemicals leaking from containers seep into ground-water, or are carried distances by vehicles traveling through the sites. These chemicals also increase fire danger as many are highly flammable and can cause fires to spread more quickly by acting as a fuel source.

Accidental releases of pesticides, fertilizers, and other agricultural chemicals may be harmful to both humans and the environment. Some of the area surrounding the Reservation includes cranberry bogs, which make use of such types of chemicals. Again, those products have traveled through the Reservation en route for delivery. Given the proximity to the coastline and connected watersheds, spills occurring even at a distance away have the potential to impact the Reservation if the chemicals flow into the waterbodies.

Infrastructure and Utility Failure

All areas of the Reservation are susceptible to infrastructure failure or disruption of service as a result of technological hazard. The impact to computer systems can include government and private sector owned control systems for transportation and communications, industrial processes, power and other utility generation and distribution.

Transportation Routes

All transportation facilities all have the potential for impact related to a technological hazards, which have the potential to impact commodity flow. Shoalwater Tribe Transportation routes include:

- Highway
- Marine
- Air
- Bridges (off Reservation but providing access)
- Commodity Flow

As a major transportation corridor along the coast, all areas and modes of transportation can be impacted from the various technological hazards. Air and marine transportation can be disrupted through cyber-failures; highway and marine traffic can be impacted from hazardous materials incidents. Bridges can be shut down as a result of a vehicle striking the bridge structure itself.

Commodity Flow:

Pipelines

There are no known pipelines which travel through the Reservation. The Tribe does not have natural gas, nor are there any fuel or diesel lines (other than those associated with the Tribe's gas station) as illustrated in Figure 15-2 below[66].

[66] Washington Utilities and Transportation Commission. Available at: http://www.utc.wa.gov/regulatedIndustries/utilities/energy/Pages/default.aspx. Accessed August 20, 2013.

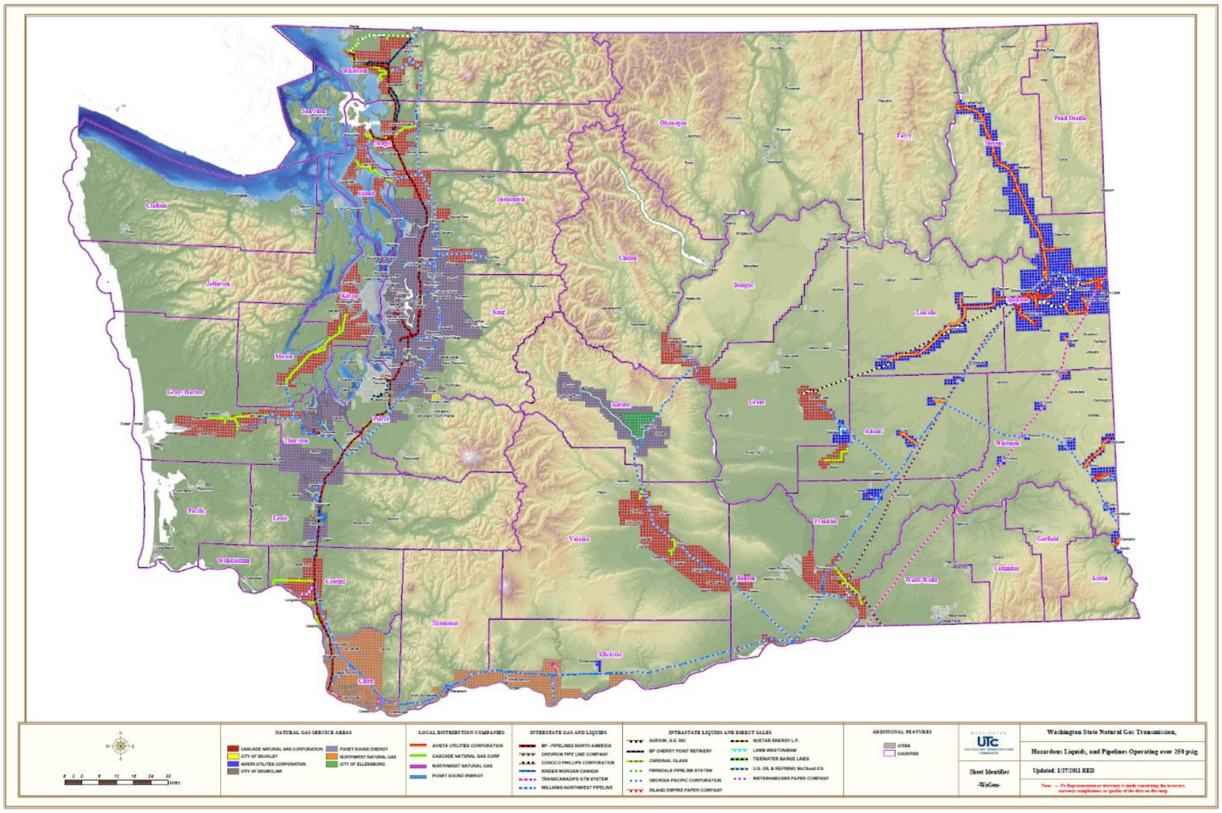

Figure 15-2. Washington State Pipeline Data

15.2.3 Frequency

Hazardous Materials

Hazardous material incidents may occur at any time on the Reservation as materials are transported on the major arterials traveling through the area. In addition, annually, the Tribe has large quantities of fireworks for sale within its boundaries. To determine an actual frequency interval is not possible given the presence of transportation routes crossing the Reservation which carry hazardous materials in unknown quantities and at unknown intervals. Additionally, the locations of businesses and industry, hospitals, medical facilities and laboratories in the area that use hazardous materials, as well as the presence of scattered illegitimate clandestine drug laboratories and the improper disposal of hazardous waste demonstrate unknown risk factors which make frequency determination in a quantitative manner impossible due to the unknown variables. However, based on the review of the existing data, in a qualitative assessment, the likelihood of occurrence of some level of hazardous material incident is relatively low.

While the increased transportation of various chemicals through the Reservation has, and will continue to increase, on a positive note, statewide, according to the Department of Ecology, methamphetamine and associated clean-up site locations have decreased after reaching an all-time high in 2001. (This data represents the most accurate data available as of the time of this plan development, but individual county-level data demonstrates that this trend is continuing since 2009 through 2010.)

Spill Response Clandestine Drug Lab and Dump Site Cleanup Activity
1990 through 2009

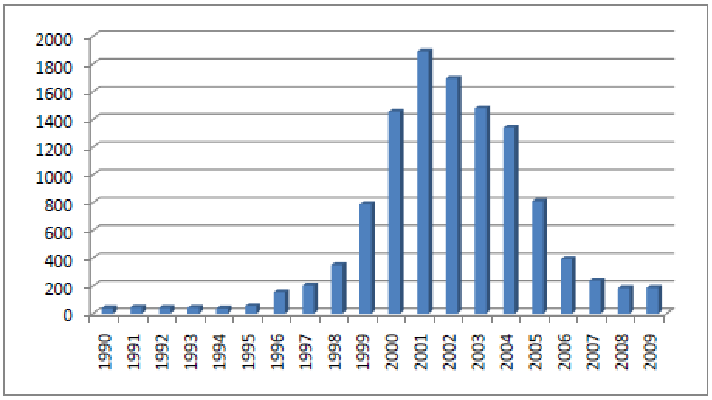

Figure 15-3. WA State Dept. of Ecology Spill Response History

Infrastructure and Utility Failure

The utility infrastructure may also be impacted as a result of various hazard-related events, or through accidental events. Routinely, the Tribe can expect at least one incident of prolonged power failure annually based on review of historic records. The length associated with the power disruption can vary from a few hours, to in excess of weeks as was the case with the 1996 power outage resulting from an ice storm and the 2007 windstorm.

Cyber-infrastructure failure resulting from non-terrorist related attacks against computers, networks and/or information stored thereon, can occur at any time with no advanced warning. Cyber failure occurs with regular frequency as a result of server failure, power outages, lines being severed, etc. The time involved can be from minutes, to days depending on the issue.

Transportation

Over the course of time, the number of transportation conveyances has grown significantly throughout the Pacific County and the Shoalwater Reservation, with increased populations traversing the roadways; however, review of the National Highway Transportation Safety Administration statistics in Table 15-1 demonstrates that since 1994, the number of fatalities resulting from vehicle accidents has decreased throughout the Washington State[67].

[67] NHTSA http://www-fars.nhtsa.dot.gov/Trends/TrendsGeneral.aspx

TABLE 15-1
NATIONAL HIGHWAY TRANSPORTATION SAFETY ADMINISTRATION FATALITIES

1994-2011

	Occupants by Vehicle Type							Nonmotorists					
Year	Passenger Cars	Light Trucks	Large Trucks	Motorcycles	Buses	Other/ Unknown	Total	Pedestrian	Pedalcyclist	Other	Total	Unknown Person Type	Total
1994	339	150	10	35	0	4	503	84	15	3	102	0	640
1995	367	151	8	37	0	3	529	72	13	2	87	0	653
1996	360	186	10	41	1	5	562	92	14	3	109	0	712
1997	357	184	13	28	0	2	556	72	16	2	90	0	674
1998	354	159	11	51	0	0	524	77	10	0	87	0	662
1999	325	188	11	38	0	5	529	60	9	1	70	0	637
2000	344	158	9	37	0	3	514	65	12	3	80	0	631
2001	343	160	6	55	0	2	511	73	8	2	83	0	649
2002	324	178	10	54	0	9	521	69	11	3	83	0	658
2003	263	182	2	59	0	6	453	75	10	3	88	0	600
2004	253	161	5	73	0	7	426	60	7	1	68	0	567
2005	305	160	11	74	0	9	485	72	13	5	90	0	649
2006	286	170	14	80	0	4	474	67	7	5	79	0	633
2007	239	162	10	69	1	13	425	60	14	3	77	0	571
2008	230	121	10	81	0	6	367	63	9	1	73	0	521
2009	197	141	9	70	0	4	351	59	9	3	71	0	492
2010	200	113	2	70	0	6	321	61	6	2	69	0	460
2011	180	111	7	72	2	4	304	64	11	6	81	0	457

15.2.4 Severity

The severity of technological hazards is challenging to measure because of the multitude of variables that are involved, and in many instances, the lack of data supporting such incidents. Effects may include serious injuries or loss of life (mass casualty incident), associated property damage, impacts to commodity flow, and lack of continuity of government.

Due to a potentially large number of patients which may be involved in a technological incident, significant mass casualties may tax local emergency, medical and hospital resources, and therefore require a regional response. The first responders, including fire, police, emergency room personnel at local hospitals, and coroner's offices develop and plan for response of such incidents; however, as in most cases, resources are limited.

Hazardous Materials

Hazardous material incidents, while not a large threat, are of concern on the Shoalwater Bay Reservation due, in part, to the unknown quantities and types being shipped through the area. While hazardous material incidents can be both intentional and/or unintentional releases of a material, because of their chemical, physical, or biological nature, they pose a potential greater risk to life, health, environment, or property. Each incident's impact and resulting response depend on a multitude of interrelated variables that range from the quantity and specific characteristic of the material to the conditions of the release and area/population centers involved. Releases may be small and easily handled with local response resources or rise to catastrophic levels with long-term consequences, such as the 2013 incident experienced in West, Texas with the destruction of the West Fertilizer Company. Fifteen people were killed as a result of the explosion, with hundreds injured. Approximately 37 square blocks of the surrounding community was destroyed, including businesses, schools, residences and a nursing home. The USGS recorded the explosion as a M2.1 tremor. Damage from the explosion was estimated by the Insurance Council of Texas to exceed $100 million of insured losses; the town received a Presidential Disaster Declaration and sought recovery in excess of $57 million.

While no such events have previously occurred on the Reservation, the potential for an explosive event does exists due to the amount of fireworks/chemicals stored and transported throughout the Reservation.

Infrastructure and Utility Failure

The length associated with the power disruption can vary from a few hours, to in excess of weeks as was the case with the 1996 power outage resulting from an ice storm. The issues surrounding the primary cause of the power failure has the potential to increase severity, such as extreme heat or cold weather, which has the potential to increase impact to health and safety.

Cyber Failure

Cyber-Failure on information networks can have serious consequences, such as disruption of critical operations, loss of revenue or intellectual property, or loss of life. Of primary concern is the threat that malicious actors attack our critical information infrastructure to the extent capable of causing debilitating disruption, including compromising computer functions, and promoting fear. Cyber failures occur with some regularity to at least some degree. The severity of impact from such a failure is associated with damage to equipment and loss of data, as well as the system itself as would be the case for a system regulating power, water flow, etc. The time involved can range from minutes to days depending on the issue. The longer the system remains down, the greater the severity of impact.

Transportation

Several of the primary critical infrastructure routes have the potential for a mass-casualty incident (MCI) because of the heavy volume of traffic, although no highway or surface street is exempt from this hazard. MCIs may also result from hazardous materials incidents due to the potential number of individuals impacted. Adverse weather may also play a role in roadway, air, or maritime accidents, enhancing the potential for an MCI incident. However, MCIs can occur throughout the Reservation, day or night, at any time of the year.

15.2.5 Warning Time

Technological hazard accidents occur without predictability under circumstances that give responders little time to prepare.

15.3 SECONDARY HAZARDS

Technological hazards are not like natural hazards that have measurable secondary impacts. Beyond casualties, the largest secondary impact caused by technological hazards would be economic impact. Economic impacts from technological hazards could be significant and include:

- Continuity of government could be impacted as a result of the loss of revenue to maintain specific services.
- Utility losses could cause a reduction in employment, wholesale and retail sales, utility repairs, and increased medical risks. Local jurisdictions may lose sales tax and property taxes and the finances of private utility companies and the businesses that rely on them would be disrupted.
- The economic impact of computer issues associated with data and telecommunications losses can be staggering.
- The economic impacts should a transportation facility be rendered impassable would be significant. The loss of a roadway or railway would have serious effects on the local economy and ability to provide services. Loss of travel routes on Interstate 90 in particular would result in loss of commerce statewide, and could impact emergency services by delaying response

times or limiting routes for equipment such as fire apparatus, police vehicles, and ambulances. The ability to receive fuel deliveries would also be impacted.

- The effects of re-routed traffic could have a serious impact on local roadways. Heavy traffic on routes through urban areas already occurs at peak commute times. Traffic control may burden local public works departments. Mass transit services would also be impacted as routes may be delayed or forced to be detoured causing economic impacts.

15.4 EXPOSURE

All citizens in the planning area could be susceptible to the technological hazards discussed in this chapter. A large incident could have devastating effects on the population of Reservation.

15.4.1 Population

Large-scale technological incidents have the potential to kill or injure many citizens in the immediate vicinity, and may also affect people a relative distance from the initial event. Utility failures during extreme weather events have the potential to impact a significant amount of the population, and cause significant economic loss. This report does not include an in-depth analysis of the potential impact to population for the technological hazards due to the unknown variables associated with each threat.

In terms of assessing the potential impact on population for general planning purposes, variables affecting exposure for a hazardous material accident include: the type of product, the physical and chemical properties of the substance, the physical state of the product (solid, liquid, or gas), the ambient temperature, wind speed, wind direction, barometric pressure, and humidity. Computer models can be used to provide data to first responders to advise for evacuation planning purposes, or sheltering in place during an incident. Real time information of the variables would be used to make the assessment. Certain fixed facilities are also required to develop operational response plans to determine impact based on the chemicals on site. In addition, residences and business in close proximity to major transportation corridors are at enhanced risk for exposure as a result of a transportation incident.

In a response capacity, hazardous materials pose a significant risk to emergency response personnel. All potential first responders and follow-on emergency personnel must be properly trained to the level of emergency response actions required of their individual position at the response scene. Hazardous materials also pose a serious long-term threat to public health and safety, property and the environment.

15.4.2 Property

All property throughout the planning region has the potential for being impacted as a result of a technological hazard occurring. For instance: disruption of service of utilities can increase fire danger due to diminished water-flow capacity, or increase health risks due to heat or cold exposure as a result of a power failure. Reduced cyber capacity can leave security features inoperable. A transportation accident involving hazardous materials can contaminate property for an extended period of time; in the case of agricultural lands and crops – potentially rendering it useless.

15.4.3 Critical Facilities and Infrastructure

All structures on the Reservation are considered critical as a result of limited resources, and therefore carry some level of exposure risk because of their potential impact from the various hazards of concern. A potential cyber failure could impact the majority of all transportation facilities, including air and highways, potentially limiting accessibility, thereby impacting commodity flow. Utility infrastructure could disrupt water, waste-water and fuel and heating supplies. In addition, several structures on the Reservation are located adjacent to pressurized underground pipelines (gas station) or storage tanks (propane).

A significant number of facilities such as the Tribe's primary Emergency Operations Center/ Administration Building and Health Center are close to the major roadways passing through the Reservation. An unintentional release of a chemical during transport could have far-reaching impact depending on the chemical agent involved.

15.4.4 Environment

Hazardous materials spilled along roads or railways could easily pollute rivers, streams, wetlands, riparian areas and adjoining fields. Other hazardous materials released into the air could severely impact plant and animal species. Reducing the risk exposure to the built environment will also mitigate potential losses to the natural environment.

15.5 VULNERABILITY

15.5.1 Population

Although technological hazards have not resulted in any deaths in this area, this type of hazard can be deadly and widespread. Any individuals exposed to technological hazards are considered to be at risk.

15.5.2 Property

All structures are physically vulnerable to a technological hazard to some level or degree. However, redundant systems, security measures, back-up power supplies and site hardening will reduce the impact from any potential threat.

15.5.3 Critical Facilities and Infrastructure

Numerous facilities on the Reservation are vulnerable to technological hazards. This includes exposure and impact from hazardous materials spills or technological failure of security systems which otherwise protect access to secured areas. In general terms, it is difficult to identify which structures are at greatest risk without performing a structure-by-structure assessment to determine deterrence mechanisms in pace, especially when one considers that the location of hazardous materials being shipped throughout the Reservation is unknown, but potentially in direct proximity to facilities and infrastructure.

15.5.4 Environment

The environment vulnerable to a technological hazard is the same as the environment exposed to the hazard. While technological disasters have caused significant damage to the environment, estimating damage can be difficult. Loss estimation platforms such as HAZUS-MH are not equipped to measure environmental impacts of these types of hazards. The best gauge of vulnerability of the environment would be a review of damage from past technological hazard events. Loss data for damage to the environment were not available at the time of this plan update. Capturing this data from future events could be beneficial in measuring the vulnerability of the environment for future updates.

15.5.5 Economic Impacts

Economic impacts from technological hazards could be significant. The cost of a hazardous materials incident would be felt in terms of loss of life and property, disruption of business activity and long-term emotional impacts. Recovery would take significant resources and expense at the local level.

Utility losses could cause a reduction in employment, loss of sales revenue, utility repairs, and increased medical risks. All of the businesses in the area that lack back-up generators and rely on utility providers would sustain disruption and economic impacts.

The economic impacts should a transportation facility be rendered impassable would also be significant. The loss of a roadway or railway would have serious effects on the Tribe's tourism economy and ability to provide services. Loss of travel routes on would result in loss of commerce, and may impact the Tribe's ability to provide and receive emergency services by delaying response times or limiting routes for equipment such as fire apparatus, police vehicles, and ambulances. The ability to receive fuel deliveries would also be impacted.

Chapter 16.
RISK RANKING

A risk ranking exercise was performed for the hazards of concern described in this plan. In conformance with both 44 CFR 201.7 and the National Response Goal (NRG, 2012), this process provides a comprehensive approach to identifying and assessing the hazards and associated risk to which the Tribe is vulnerable. The results of this process as presented are used in establishing mitigation priorities for the Tribe.

This risk ranking exercise assesses the probability of each hazard's occurrence as well as its likely impact on the people, property, and economy of the planning area. Also of significant concern to the Shoalwater People is the impact of these hazards on the environment, and that factor was also taken into consideration during this process. The risk ranking process was conducted by Planning Team members. For some hazards, estimates of risk were generated with data from HAZUS-MH, using methodologies promoted by FEMA. For other hazards, Planning Team members with an extensive historic perspective and knowledge base concerning the impact of hazards on the Tribe provided invaluable information during this process. That information had a significant impact on the risk ranking process.

Several factors make the Shoalwater Tribe unique when compared to other jurisdictions. Most do not face many of the hardships faced by the Shoalwater People on a daily basis. Limited infrastructure, including transportation corridors, redundant power systems and limited cellular communication, as well as limited capabilities, such as firefighting, make the Shoalwater Bay Tribe unique when attempting to utilized standard methods of risk assessment, as in many instances, normal efforts to mitigate impact are not a viable option for Tribal members living on the Reservation.

It should be noted that while natural, man-made and technological hazards are identified within this document, 44 CFR 201.7(c)(2) requires a prioritization of natural hazards for mitigation planning purposes, and therefore, emphasis remains on the natural hazards.

16.1 RISK RATING AND RANKING

In ranking the hazards, the Planning Team completed a Calculated Priority Risk Index (CPRI) Work Sheet representing each hazard. The CPRI examines four criteria for each hazard (probability, magnitude/severity, warning time, and duration); the risk index for each according to four levels, then applies a weighting factor as illustrated in Table 16-1. The result is a score that has been used to rank the hazards. Each hazard profile presents its CPRI score with a cumulative score sheet included in Table 16-2 presents the results of the CPRI scoring for all hazards.

The Planning Team felt that with the CPRI ranking did not quite accurately represent the Tribe's priorities; therefore, the list of hazards was re-prioritized as shown below during the May 22, 2014 planning team meeting.

1 - Earthquake
1 - Tsunami
2 - Severe Weather
3 – Coastal Erosion (initially ranked #5)
4 - Landslide
5 – Flood (initially ranked #4)
6 – Wildfire
7 – Technological Hazards
7 – Human Caused Hazards (including terrorism)

TABLE 16-1.
CALCULATED PRIORITY RISK INDEX

CPRI Category	Degree of Risk: Level ID	Degree of Risk: Description	Degree of Risk: Index Value	Assigned Weighting Factor
Probability	Unlikely	▪ Rare with no documented history of occurrences or events. ▪ Annual probability of less than 0.01.	1	45%
	Possibly	▪ Infrequent occurrences with at least one documented or anecdotal historic event. ▪ Annual probability that is between 0.1 and 0.01.	2	
	Likely	▪ Frequent occurrences with at least two or more documented historic events. ▪ Annual probability that is between 1 and 0.1.	3	
	Highly Likely	▪ Common events with a well documented history of occurrence. ▪ Annual probability that is greater than 1.	4	
Magnitude/ Severity	Negligible	▪ Negligible property damages (less than 5% of critical and non-critical facilities and infrastructure). ▪ Injuries or illnesses are treatable with first aid and there are no deaths. ▪ Negligible quality of life lost. ▪ Shut down of critical facilities for less than 24 hours.	1	30%
	Limited	▪ Slight property damages (greater than 5% and less than 25% of critical and non-critical facilities and infrastructure). ▪ Injuries or illnesses do not result in permanent disability and there are no deaths. ▪ Moderate quality of life lost. ▪ Shut down of critical facilities for more than 1 day and less than 1 week.	2	
	Critical	▪ Moderate property damages (greater than 25% and less than 50% of critical and non-critical facilities and infrastructure). ▪ Injuries or illnesses result in permanent disability and at least one death. ▪ Shut down of critical facilities for more than 1 week and less than 1 month.	3	
	Catastrophic	▪ Severe property damages (greater than 50% of critical and non-critical facilities and infrastructure). ▪ Injuries or illnesses result in permanent disability and multiple deaths. ▪ Shut down of critical facilities for more than 1 month.	4	
Warning Time	Less than 6 hours	Self explanatory.	4	15%
	6 to 12 hours	Self explanatory.	3	
	12 to 24 hours	Self explanatory.	2	
	More than 24 hours	Self explanatory.	1	
Duration	Less than 6 hours	Self explanatory.	1	10%
	Less than 24 hours	Self explanatory.	2	
	Less than one week	Self explanatory.	3	
	More than one week	Self explanatory.	4	

TABLE 16-2. CALCULATED PRIORITY RANKING INDEX SUMMARY					
Hazard	**Probability**	**Magnitude and/or Severity**	**Warning Time**	**Duration**	**CPRI Score**
Earthquake	Highly likely	Catastrophic	< 6 hours	> 1 week	4.00
Tsunami	Highly likely	Catastrophic	< 6 hours	< 1 week	4.00
Severe Weather	Highly likely	Critical	12-24 hours	< 24 hours	3.20
Landslide	Likely	Limited	< 6 hours	< 6 hours	3.05
Flood	Possibly	Limited	< 6 hours	< 6 hours	2.45
Coastal Erosion	Possibly	Limited	< 6 hours	< 6 hours	2.35
Wildfire	Likely	Negligible	> 24 hours	> 1 week	2.30
Human Caused/ Terrorist Incidents	Possibly	Limited	< 6 hours	< 6 hours	2.30
Technological Hazards	Unlikely	Negligible	< 6 hours	< 6 hours	2.30

The Calculated Priority Risk Index scoring method has a range from 0 to 4. “0” being the least hazardous and “4” being the most hazardous situation.

SECTION 4 —
MITIGATION STRATEGY

Chapter 17.
MITIGATION INITIATIVES

17.1 2008 HAZARD MITIGATION STRATEGIES

During development of the 2008 Hazard Mitigation Plan, the Shoalwater Bay Tribe identified a number of mitigation strategies and action items which, when implemented, would help reduce the impact of the hazards of concern on the Tribe. Over the course of the last five years since adoption of the 2008 plan, the Tribe has been very successful in completing many of those original initiatives. The 2008 strategies and their current status are identified in Table 17-1 below.

TABLE 17-1.
2014 STATUS OF 2008 HAZARD MITIGATION ACTION PLAN

Mitigation Strategy		Associated Hazards							2008 Timeline	2014 Project Summary	2014 Status			
		Coastal erosion	Earthquakes	Floods	Landslides	Severe Weather	Tsunami	Wildland Fire			Completed	Continual /On-going Nature	Removed /No Longer Relevant/No Action	Carried Over to 2014 Plan
T-1	Flood elevate homes and buildings	✓	✓	✓		✓	✓		On-going	No elevations completed during 2008-2014. Carried over to 2014	✓			✓
T-2	Acquire properties in low hazard areas in order to locate new development or relocate existing vulnerable structures and critical facilities	✓	✓	✓	✓	✓	✓	✓	Long-term	216 acres of land has been acquired since 2008 plan. Funding was through BIA and Tribal Funds.	✓	✓		✓
T-3	Increase communications capabilities	✓	✓	✓	✓	✓	✓	✓	On-going	Tribe has made progress in this area; HAM radio operators have been trained; has become more interoperable, but still has difficulties with communication re: cell phones. Carry over to 2014.		✓		✓
T-4	Develop a system to protect and maintain historical and archival Tribal records	✓	✓	✓	✓	✓	✓	✓	On-going	No action completed during 200-2014. Carried over to 2014 plan.	✓	✓		✓
T-5	Create a back-up water supply system	✓	✓	✓	✓	✓	✓	✓	On-going	No action completed during 200-2014. Carried over to 2014 plan		✓		✓

TABLE 17-1.
2014 STATUS OF 2008 HAZARD MITIGATION ACTION PLAN

Mitigation Strategy		Associated Hazards							2008 Timeline	2014 Project Summary	2014 Status			
		Coastal erosion	Earthquakes	Floods	Landslides	Severe Weather	Tsunami	Wildland Fire			Completed	Continual /On-going Nature	Removed /No Longer Relevant/No Action	Carried Over to 2014 Plan
T-6	Develop and/or improve Emergency Plans such as Evacuation Plans, Tribal Records Protection Plan, Continuity of Operations Plan etc.	✓	✓	✓	✓	✓	✓	✓	On-going	Some progress was made during 2006-2014 time period. Strategy will be carried forward in 2014 plan update. During 2008-2014 time period, the COOP plan was completed, which was funded through a DHS FEMA grant. A Wireless Mesh Project was also completed, which provides police the ability to communicate with outside agencies wirelessly throughout the entire reservation.	✓	✓		✓
T-7	Seismic retrofit of tribal buildings and infrastructure, including a reservation wide back-up generator system	✓	✓	✓	✓	✓	✓	✓	On-going	Some seismic retrofits were completed in public buildings; generators purchased for some buildings. An H-VAC retrofitting was done with some updates to outdoor coolant systems. This was funded through an ARRA EPA grant. Will be carried over to 2014.	✓	✓		✓
T-8	Create new, and expand existing Evacuation Routes, including better signage	✓	✓	✓	✓	✓	✓	✓	On-going	Completed for existing reservation boundary; with purchase of new land, will have to update to include that area. Carried over to 2014.	✓	✓		✓
T-9	Build an Emergency Operations Center (with helipad) and Evacuation Shelter in hazard-free area	✓	✓	✓	✓	✓	✓	✓	long-term	New EOC project development in progress (no helipad); Evacuation shelter was established. Portions of these funds were from tribal funds; grant funding from HUD, DHS, and BIA also provided assistance.	✓	✓		✓
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	39 CERT members have been trained. Funding provided through EMPG in part. Will continue to train members. Carried over to 2014.	✓			✓

TABLE 17-1.
2014 STATUS OF 2008 HAZARD MITIGATION ACTION PLAN

Mitigation Strategy		Associated Hazards							2008 Timeline	2014 Project Summary	2014 Status			
		Coastal erosion	Earthquakes	Floods	Landslides	Severe Weather	Tsunami	Wildland Fire			Completed	Continual /On-going Nature	Removed /No Longer Relevant/No Action	Carried Over to 2014 Plan
T-11	Partner with local jurisdictions and agencies in developing and implementing mitigation and emergency response strategies and actions.	✓	✓	✓	✓	✓	✓	✓	On-going	Great progress was made during the 2008-2014 cycle. Efforts have included Pacific County, Westport Fire and South Bend Ambulance. Will continue to make progress during next 5 year cycle. EMPG funds helped finance portions of these activities. Carried over to 2014.	✓	✓		✓
T-12	Develop interlocal agreements with local agencies and other jurisdictions for disaster planning and emergency preparedness and response	✓	✓	✓	✓	✓	✓	✓	Short-term	Interoperable MOUs were established.	✓		✓	
T-13	Identify Elders and other vulnerable populations to prioritize for mitigation and disaster assistance	✓	✓	✓	✓	✓	✓	✓	Short-term	Completed. However, will continue to gather information to ensure up-to-date data is maintained.	✓	✓		✓
T-14	Expand protective berm along coastline	✓		✓			✓		Long-term	Yes, some work was completed but additional work is needed. Carried over to 2014.	✓	✓		✓
T-15	Create and/or expand culverts to allow better drainage of marshy and frequently flooded areas	✓		✓			✓		long-term	Some work in this area was completed, but will be carried forward to 2014 as well.	✓			✓
T-16	Develop Building Codes and a Development/Master plan that focuses new development and construction on less hazard vulnerable locations	✓	✓	✓	✓	✓	✓	✓	on-going	Buildings codes currently under development. New land outside of immediate hazard zone was also acquired during 2008-2014 period. Strategy will be carried forward. Will utilize information from this HMP update to provide guidance with respect to hazard prone areas.		✓		✓

**TABLE 17-1.
2014 STATUS OF 2008 HAZARD MITIGATION ACTION PLAN**

Mitigation Strategy		Associated Hazards							2008 Timeline	2014 Project Summary	2014 Status			
		Coastal erosion	Earthquakes	Floods	Landslides	Severe Weather	Tsunami	Wildland Fire			Completed	Continual /On-going Nature	Removed /No Longer Relevant/No Action	Carried Over to 2014 Plan
T-17	Create a community-wide comprehensive education program to educate the Tribe about hazards and hazard mitigation	✓	✓	✓	✓	✓	✓	✓	on-going	This strategy is perpetual in nature; several events, such as the annual Tsunami/Health Walk was conducted during the 2008-2013 timeframe. DOH helps fund this project annually, as well as other state agencies such as WA EMD (provide hand-outs and give-away items) and tribal funds	✓	✓		✓
T-18	Implement Vegetation and other natural resource management practices to reduce landslides and coastal erosion	✓			✓				On-going	Some progress has been made in this area. With development of this HMP, landslide areas have been identified. This information will continue to support this activity, which will be carried forward in the 2014 plan.				✓
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	No berms or other flood protection systems were established to protect cultural and historic sites on the Reservation due to lack of funding; however, this remains a significant focus for the tribe. Strategy will be carried forward in 2014 plan.		✓		✓

17.2 2014 MITIGATION ALTERNATIVES

During development of the 2014 update, catalogs of hazard mitigation alternatives were developed that present a broad range of alternatives to be considered for use in the planning area, in compliance with 44 CFR (Section 201.7(c)(3)(ii)). One catalog was developed for each hazard of concern evaluated in this plan and for each of three types of infrastructure project (roads, culverts and bridges). The catalogs for each hazard and infrastructure project type are listed in Appendix C. The catalogs present alternatives that are categorized in two ways:

- By what the alternative would do:
  - Manipulate a hazard
  - Reduce exposure to a hazard

  - Reduce vulnerability to a hazard
  - Increase the ability to respond to or be prepared for a hazard
- By who would have responsibility for implementation:
  - Individuals
  - Businesses
  - Government.

In addition to the attached catalog, the Planning Team also reviewed FEMA's most current mitigation strategy catalog, dated 2013.

The Tribe's 2008 Hazard Mitigation Plan referenced a number of mitigation initiatives, some of which were carried over to this edition and are referenced as such. As this current plan update is of a totally new format and organizational structure, the planning team elected to use this opportunity to modify the structure of the projects, and to reword existing strategies to make them more viable and hazard specific. It was determined that streamlining the strategies will assist in maintenance activities in the future, and allow for ease in annual reporting of its mitigation strategies.

In addition, many of the hazard mitigation initiatives recommended in this plan were selected from among the examples presented in the referenced catalogs, as well as existing planning and strategic documents. The catalogs provide a baseline of mitigation alternatives that are backed by a planning process, are consistent with the goals and objectives, and are within the capabilities of the Shoalwater Bay Tribe to implement with the assistance of some grant funding opportunities.

17.3 SELECTED MITIGATION INITIATIVES

The planning team identified initiatives that could be implemented to provide hazard mitigation benefits. Initial assessment of the mitigation alternatives were evaluated against the following criteria:

- **Social criteria**—Community acceptance of the mitigation activities (the public must support the overall implementation strategy and specific mitigation activities)
- **Technical criteria**—The technical feasibility of the proposed mitigation activity to reduce losses in the long term with minimal secondary impact
- **Administrative criteria**—Anticipated staffing, funding, and maintenance required for each mitigation activity
- **Political criteria**—Decision-maker acceptance of the mitigation activities (the local political leadership must support the overall implementation strategy and specific mitigation activities)
- **Legal criteria**—The City's legal authority to implement the proposed mitigation activities
- **Economic criteria**—Budget constraints
- **Environmental criteria**—Environmental impacts caused by implementing specific mitigation activities.

Table 17-2 lists the recommended 2014 initiatives, the lead agency for each, and the proposed timeline. The parameters for the timeline are as follows:

- Short Term = to be completed in 1 to 5 years
- Long Term = to be completed in greater than 5 years
- Ongoing = currently being funded and implemented under existing programs.

TABLE 17-2.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-1—Develop a post-disaster action plan for all hazards of concern that addresses debris management, cultural/historical data gathering, substantial damage assessment, and grant management. This plan would be an appendix to the Tribe's Emergency Management Plan.							
N	New and existing	All Hazards	3, 6, 7	Emergency Management, Outdoor Maintenance Dept., GIS, Planning and Land Use Office, THPO	Low	Discretionary Fund, FEMA Hazard Mitigation Grant, HMGP, Emergency Management Performance Grant, BIA	Short-term, depends on funding
S-2—Adopt the Shoalwater Bay Tribe Hazard Mitigation Plan as an element of any comprehensive plan that the Tribe will create, in order to ensure linkage between the two documents.							
N	New and existing	All Hazards	2, 3, 5,	Emergency Management, Outdoor Maintenance Department, Planning and Land Use Office	Low	Discretionary Fund	Short-term ongoing
S-3—Work with NOAA to develop an updated Tsunami model once new FEMA flood maps are adopted.							
N	New	Coastal Erosion, Climate Change, Tsunami and Flood	1, 3, 5	Emergency Management, Outdoor Maintenance Department, Land Use Dept., Housing, Realty	Medium	FEMA Hazard Mitigation Grant programs	Short-term, Ongoing
S-4—Pursue feasible, cost-effective home elevation or acquisition projects, targeting identified repetitive loss (none currently) or frequently flooded (including nuisance flooding) properties on the Reservation.							
N	Existing	Coastal Erosion, Flood	1, 10, 11	Emergency Management, Outdoor Maintenance, Land Use Office, Natural Resources, Housing, Realty	High	HMGP, BIA/HUD funding w/ tribal Discretionary Fund contribution for local match	Long-term, depends on funding
S-5—As climate change will undoubtedly impact water supplies in the future, consider working with local water providers and local jurisdictions to begin developing concepts and regulations regarding water							
N	New	Coastal Erosion, Climate Change, Flood, Severe Weather	2, 3, 4, 5, 10	USACE, Outdoor Maintenance, Planning Department, GIS, FEMA	Low	Discretionary Fund,	Long-term, depends on funding

TABLE 17-2.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-6—Consider codes and ordinances which positively influence the resiliency of the tribe from the hazards of concern, such as land use development; landscaping ordinance for fire fuel reduction; building codes for minimum seismic stability; flood damage prevention ordinance to cumulatively track substantial improvements and damage, etc.							
Y- 2008 HMP enhanced	New and Existing	All	1, 9, 10, 11	Emergency Management, Housing, Water, Environmental, Forestry, Outdoor Maintenance, Planning, Tribal Council	Low	Discretionary Fund	Short-term
S-7—Considered adopting a regulatory freeboard standard for new construction to elevate homes above flooding.							
N	New and existing	Flood	1, 9, 10, 11	Emergency Management, Housing, Land Use Dept., Planning Dept., Outdoor Maintenance, Tribal Council	Low	Discretionary Fund	Short-term
S-8—Consider stream bank and hillside stabilization projects to protect infrastructure, including natural plantings.							
Y-2008 HMP; 2014 enhanced	New and Existing	Coastal Erosion Flood, Landslide, Erosion	2, 3, 4, 5, 10	Emergency Management, Housing, Land Use Dept., Environmental, Forestry, Planning Dept., Outdoor Maintenance, Tribal Council	High	Discretionary Fund	Long-term, ongoing
S-9—Secure funding to acquire additional generators to maintain critical infrastructure on reservation, including for water systems, especially for new facilities being constructed or older facilities being renovated that do not already have generators.							
Y-2008 HMP	New and existing	Coastal Erosion, Flood	1, 2, 3, 4, 5, 7, 9	Emergency Management, Housing, Land Use Dept., Planning Dept., Outdoor Maintenance, Tribal Council	Medium	Discretionary Fund, BIA, HUD, FEMA Grant Funds, Homeland Security Grants	Short-term
S-10—Develop a stormwater management plan as development continues on the Reservation and in relation to the Casino site and new development.							
N	New and Existing	Coastal Erosion, Flood, Severe Weather	3, 4, 6, 8, 10	Outdoor Maintenance Department, Land Use Office, Planning Dept., Enterprise/Economic Development Dept. Tribal Government	Medium	Stormwater Utility	Short-term

TABLE 17-2.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-11—Consider a building setback/spacing requirement for new construction in areas susceptible to wildfire exposure.							
N	New	Wildfire	1, 2, 4	Outdoor Maintenance Department, Land Use Office, local Fire Depts., Planning Dept., Tribal Council	Low	Discretionary Fund	Short-term
S-12—Join the Firewise program by adopting the program's policies for managing wildland-urban interface areas on the Reservation.							
N	New and existing	Wildfire	2, 3, 4, 5, 10	Emergency Management, Outdoor Maintenance Dept., Land Use Office, Planning Dept., Tribal Council, Housing, Fire Department, THPO	Low	Discretionary Fund	Short-term
S-13—Consider planting standards in wildland buffer areas to include fire-resistant plants with loose branching habits, non-resinous woody material, high moisture content leaves and limited seasonal accumulation of dead vegetation.							
N	New and existing	Wildfire	4, 10	Land Use Department, Housing, Outdoor Maintenance, Planning Dept. Tribal Government, Local Fire Depts.	Low	Discretionary Fund	Short Term
S-14— Work with the National Tsunami Hazard Mitigation Program to develop vertical evacuation routes for tsunami hazard.							
N	New	Tsunami	1, 2, 3, 5, 10	Emergency Management, Outdoor Maintenance Department, Natural Resources Department, Housing	Low	Discretionary Fund	Short-term
S-15—Consider building codes that would harden new and existing structures from the potential impacts of earthquakes.							
N	New and existing	Earthquake	1, 3, 4	Emergency Management, Outdoor Maintenance Dept., Planning Dept., Natural Resources Department, Housing,	Low	Discretionary Fund	Short-term
S-16—Conduct seismic vulnerability studies of all infrastructure, including critical facilities...							
Y 2008 enhanced	Existing	Earthquake	3, 6, 7	All	High	FEMA HMGP & PDM, Homeland Security, BIA & HUD	Long-Term

TABLE 17-2.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-17—Promote the structural and non-structural seismic retrofit of structures built before 1974 by a targeted outreach to the owners of these structures, including a Reservation-wide tie-down program.							
N	Existing	Earthquake, Landslide, Severe Weather	1, 5, 10	Planning, Outdoor Maintenance, Emergency Mgmt., Housing,	Low	Discretionary Fund, Grants, BIA, HUD, CDBG	Long-term
S-18—Continue and enhance where feasible the Tribe's drainage system maintenance program to reduce or minimize the impacts of stormwater flooding on the Reservation.							
N	New and existing	Flood, Coastal Erosion, Severe Weather	3, 6, 8	Outdoor Maintenance, Housing, Realty, Emergency Mgmt.	Medium	Land Use Permitting Fees, Grant Funds, Discretionary Funds, CIP	Long-term, ongoing
S-19—Work with the Federal and State Departments of Transportation and two surrounding counties to identify landslide-risk areas along major roadways. Promote increased inspections on roadways along and on the Reservation to reduce risk from landslides and washouts. Seek ways to improve slope stability and drainage, and seek funding to plan for and repair future slope failures to reduce the potential for isolation and to provide for additional access to the Reservation.							
N	New and Existing	Landslide, Coastal Erosion Flood, Severe Storm	6, 8, 10	Outdoor Maintenance, Transportation Dept., Federal and WA State Dept., of Transportation, Grays Harbor and Pacific Counties, Forestry, Emergency Mgmt.	High	CIP, Discretionary Fund, Discretionary Funds, Federal programs, HMGP, PDM, BIA, HUD	Long-term
S-20—Develop a public outreach strategy of ongoing programs providing multiple messages that support all phases of emergency management, including the maintenance of a 7-day supply of food and water. This should include CERT training. Training program should also include an outreach program for elders and sensitive populations to provide assistance as needed.							
N	New and Existing	All Hazards	1, 2, 3, 5, 10	All	Low	Discretionary Fund, FEMA HMGP, BIA, HUD, TEMPG, US ADA	Short-Term, Ongoing
S-21—Prior to new development, conduct a vulnerability assessment of water and wastewater utilities for exposure to all identified hazards of concern.							
N	Existing	All Hazards	3, 6, 7	Outdoor Maintenance, Planning Dept., Housing, Tribal Government	High	FEMA Hazard Mitigation Grant, HUD, BIA	Long-term, depends on funding

TABLE 17-2.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-22—Review utility designs and standards for safety and competence under natural and human-caused disasters, utilizing information from this hazard mitigation plan. Once vulnerability determined, work with tribal and local providers to site harden utility service.							
N	New and Existing	All hazards	1, 2, 4	Outdoor Maintenance, Planning Dept. GIS, Land Use Department, Housing	Low	Discretionary Fund, Grants	Long-Term, ongoing
S-23—Develop a Reservation-wide comprehensive education program to educate tribal members about: hazards of concern on the Reservation, hazard mitigation opportunities, and evacuation routes.							
N	New and existing	All hazards	1, 2, 3, 5, 10	Emergency Management Department, Outdoor Maintenance Department, Housing, Health, Tribal Government, FEMA	Low	Discretionary Fund, Grant funds when available	Short-term, ongoing
S-24— Assess the Tribe's evacuation and primary response routes, and work with Tribal, County and Federal Departments of Transportation to develop alternate routes; develop right of way agreements as necessary, and negotiate removal or unlocking of gates with locks.							
Y-2008 HMP but enhanced	New	All hazards	1, 2, 4	Emergency Management, Outdoor Maintenance Dept., Planning Dept., Legal Dept., Natural Resources Dept., THPO, Land Use Office	Low	Discretionary Fund, Land Use Permit Fees, PDM & HMGP	Long-term, depends on funding
S-25 Assess potential debris accumulations along coastline and in water channels, to include debris from the 2011 Japanese tsunami, in an effort to develop recovery and response plans.							
N	Existing	Coastal Erosion, Flood, Earthquake, Landslide, Tsunami, Severe Weather	1, 6, 11	Emergency Management, Tribal and County Health Depts. Outdoor Maintenance, WA State Dept. of Ecology, Grays Harbor and Pacific Counties, Tribal Environmental Dept., Planning Dept.	High	FEMA Hazard Mitigation Grant; State	Long-term, depends on funding

**TABLE 17-2.
HAZARD MITIGATION ACTION PLAN MATRIX**

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-26— Support and participate in State and County efforts for public education programs, as well as self-sustainability campaigns and emergency preparedness.							
N	New and existing	All hazards	1, 2, 3, 5, 10	Emergency Management, Health, Housing, Land Use, Outdoor Maintenance Department, BIA, Indian Health Service, FEMA	Low	Discretionary Fund, State, Pacific and Grays Harbor County programs funding	Short-term, ongoing
S-27— Update emergency response plans based on the information contained in this plan. Those plans should then be practiced and exercised so community members know the areas of concern and can evacuate appropriately when a disaster occurs.							
N	New and existing	All hazards	All	Emergency Management, Land Use Office, Housing, Outdoor Maintenance Department, FEMA	Medium	Discretionary Fund, FEMA funding and FEMA grants; THLS grants, EMPG, HMGP	Long-term, ongoing
S-28—Develop a protocol and system for capturing damage data on the Reservation for disaster reporting. Consider including flood depth data, dollar losses for all hazards impacting the Reservation, and duration of impact from the event. The data should be used to update the hazard mitigation plan.							
N	New and existing	All hazards	1, 2, 3, 5, 10	Emergency Management Department, Land Use Office, Planning Dept., Outdoor Maintenance Dept. IT Dept., FEMA	Low	Discretionary Fund, FEMA grant programs, BIA, HUD	Short-term, development, long term maintenance
S-29—Conduct LIDAR studies on any newly acquired properties to provide enhanced data for determining vulnerability to hazards of concern. Data acquired should be used to update this hazard mitigation plan as needed.							
N	New and existing	All hazards	1, 2, 3, 5, 10	Emergency Management, Forestry, Fisheries, Natural Resources (Environmental Department), Outdoor Maintenance, and Planning Depts., Land Use Office	High	Discretionary Fund, Land Use Permit Fees, PDM & HMGP	Long-Term, depends on funding

TABLE 17-2.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-30— If owners are willing, relocate private and public residences or other facilities that have been repeatedly flooded to areas outside the floodplain through acquisition projects funded by the Hazard Mitigation Grant Program or Flood Mitigation Assistance.							
N	New	Coastal Erosion, Flood	1, 2, 4	Emergency Management, Outdoor Maintenance Department, Natural Resources Department, Land Use Office	High	Discretionary Fund, Land Use Permit Fees, PDM & HMGP	Long-Term, depending on funding
S-31— Continue participation in NOAA's StormReady Program.							
N	New	Severe Weather, Tsunami	1, 2, 4	Emergency Management, Housing Department, Outdoor Maintenance Department, Environmental Department, Planning Dept. Land Use Office	Low	Discretionary Fund, Land Use Permit Fees, PDM & HMGP	Long-Term
S-32— Seismically retrofit water towers and water storage structures to reduce the potential for collapse during an earthquake or significant flood event, and enhance water lines for firefighting. Once completed, the tower can be used to store water for firefighting on the Reservation.							
N	Existing	Earthquake, Tsunami, Coastal Erosion, Flood, Severe Weather, Wildfire	1, 2, 3, 4, 6 8, 9, 11	Emergency Management, Outdoor Maintenance Department, Environmental Department, Planning Dept. Land Use Office	High	Discretionary Fund, PDM HMGP, BIA, HUD, Fire Grants	Long-Term
S-33 – Develop Fire Safe Council(s) to assist neighborhoods and communities in become more resilient to the impacts of fire.							
N	New and Existing	Severe Weather, Wildfire	1, 2, 4	Emergency Management, Outdoor Maintenance Department, Environmental Department, Planning Dept., local Fire Depts., Land Use Office	Low	Discretionary Fund, Permit or Utility Fees, PDM, HMGP, Fire Grants, BIA, HUD	Long-Term

**TABLE 17-2.
HAZARD MITIGATION ACTION PLAN MATRIX**

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-34 Enhance water systems on Reservation to increase capacity of water storage facilities; obtain alternate sources (wells) and increase capacity to enable ability to utilize fire hydrants without damaging existing infrastructure and reducing capacity for residents.							
Y (Enhanced from 2008 HMP)	New and Existing	EQ, Flood, Severe Weather, Wildfire	1, 2, 4	Emergency Management, Outdoor Maintenance Department, Natural Resources Department, Environmental, Forestry, Planning Dept., local Fire Dept., Land Use Office	High	Discretionary Fund, EPA, PDM, HMGP, Fire Grants, BIA, HUD	Long-Term
S-35 Establish policy which sets forth requirements for identifying and using suction supply water sources in areas without fire hydrants on the Reservation to assist in firefighting abilities. This may include working with outside agencies and federal departments to make certain all environmental requirements are considered. This initiative will include enhancing fire response apparatus capacity to support hauled water operations.							
N	New and Existing	Wildfire	1, 2, 4	Emergency Management, Housing Outdoor Maintenance Department, Environmental Department, Planning Dept. ,	Medium	Discretionary Fund, Land Use Permit Fees, PDM, HMGP, Fire Grants, BIA, HUD	Long-Term
S-36 Purchase portable water storage tanks equipped with fire suppression supply connections which will be strategically located in areas with high fire danger for use in firefighting.							
N	New	Wildfire	1, 2, 4	Emergency Management, Outdoor Maintenance Department, Natural Resources Department, Environmental, Forestry, Planning Dept., local Fire Dept., Land Use Office	High	Discretionary Fund, Land Use Permit Fees, PDM, HMGP, Fire Grants, BIA, HUD	Long-Term
S-37 Train residents on use of portable water tanks to assist in firefighting efforts until first responders arrive.							
N	New	Wildfire	1, 2, 4	Emergency Management, Outdoor Maintenance Department, Environmental Department, Planning Dept., local Fire Dept., Land Use Office	Low	Discretionary Fund, Land Use Permit Fees, PDM, HMGP, Fire Grants, BIA, HUD	Long-Term

TABLE 17-2.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-38 Obtain hand tools which can be placed in community centers throughout Reservation which residents can check out to help maintain defensible space around residences, and to maintain areas along roadways.							
N	New	Wildfire	1, 2, 4	Emergency Management, Outdoor Maintenance Department, Natural Resources Department, Environmental, Forestry, Planning Dept., Fire Dept., Land Use Office	Low	Discretionary Fund, Land Use Permit Fees, PDM, HMGP, Fire Grants, BIA, HUD	Short-Term
S-39 Review potential to purchase a chipper for the Reservation which can be used to reduce fire fuel.							
N	New and Existing	Wildfire	1, 2, 4	Emergency Management, Outdoor Maintenance Department, Natural Resources Department, Environmental, Forestry, Planning Dept., Fire Dept., Land Use Office	Low	Discretionary Fund, Land Use Permit Fees, PDM, HMGP, Fire Grants, BIA, HUD	Short-Term
S-40 Develop policy and plan for litter removal Reservation wide. This will be a multi-year plan which ultimately encompasses the entire Reservation, and includes private residents' participation.							
N	New and Existing	Severe Weather, Wildfire	1, 2, 4	Emergency Management, Outdoor Maintenance Department, Environmental Department, Planning Dept., Fire Dept., Land Use Office Tribal Residents	Low	Discretionary Fund, Land Use Permit Fees, PDM, HMGP, Fire Grants, BIA, HUD	Short-Term
S-41 Seek funding opportunities to assist homeowners in landslide areas to structurally retrofit homes, or for acquisition or relocation of homes currently in high landslide areas to other areas of the Reservation.							
N	New and Existing	Severe Weather, Flooding, Landslide, Wildfire	1, 2, 4	Emergency Management, Housing, Outdoor Maintenance Department, Environmental Department, Planning Dept. Fire Dept., Land Use Office Tribal Residents	High	Discretionary Fund, PDM, HMGP, Fire Grants, BIA, HUD	Long-Term

TABLE 17-2.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-42 Work with community members within fire units to determine areas where Shaded Fuel projects would be most beneficial in reducing fire severity. Prioritize projects and establish community events/work projects to focus on specific areas.							
N	New and Existing	Wildfire	1, 2, 4	Emergency Management, Outdoor Maintenance Department, Natural Resources Department, Environmental, Forestry, Planning Dept., Fire Dept., Land Use Office Tribal Residents	Low	Discretionary Fund, PDM, HMGP, Fire Grants, BIA, HUD	Long-Term
S-43 Work with Pacific County to widen (Firewise recommendation ~ 24 feet) and clear bridges and roadways for fuel breaks and evacuation routes. Projects should be prioritized based on local emergency response and fire plans for prioritized evacuation routes.							
N	New and Existing	All	1, 2, 4	Emergency Management, Transportation Dept., Outdoor Maintenance Dept., Natural Resources Dept., Environmental, Forestry, Planning Dept., Fire Dept., Land Use Office	Low	Discretionary Fund, PDM, HMGP, Fire Grants, BIA, HUD	Long-Term
S-44 Seek funding opportunities to assist with signage needs for streets for emergency response and evacuation.							
N	New and Existing	All	1, 2, 4	Emergency Management, Housing, Transportation Dept. Outdoor Maintenance Dept., Environmental Dept., Planning Dept., Pacific County Fire Dept., Land Use Office Tribal Residents	Low	Discretionary Fund, PDM, HMGP, Fire Grants, BIA, HUD, E9-1-1 Grants	Long-Term

**TABLE 17-2.
HAZARD MITIGATION ACTION PLAN MATRIX**

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-45 Work with local Fire Safe Councils to pursue SNAP or NAP grants for low-income residents for defensible space.							
N	New and Existing	Wildfire	1, 2, 4	Emergency Management, Housing, Outdoor Maintenance Dept., Environmental Dept., , Planning Dept., Fire Dept., Land Use Office Pacific and Grays Harbor County Fire Safe Councils	Low	Discretionary Fund, PDM, HMGP, Fire Grants, BIA, HUD, Fire Safe Councils	Long-Term
S-46 Seek funding opportunities to assist homeowners in home retrofitting projects for projects such as: new roofs, window and siding replacement, netting of eves, aluminum wrapping of structures or other fuel reduction projects; seismic retrofits, flood reduction, and home tie-down projects.							
N	New and Existing	All	1, 2, 4	Emergency Management, Outdoor Maintenance Department, Environmental Department, Planning Dept., Fire Dept., Land Use Office Tribal Residents	Low	Discretionary Fund, PDM, HMGP, Fire Grants, BIA, HUD	Long-Term
S-47 Complete inventory of known cultural resources located in or near identified hazard areas.							
N	New	All	1, 2, 4	Emergency Management, , Natural Resources Dept., Environmental, Forestry, Planning Dept., Fire Dept.,	Low	Discretionary Fund, BIA, HUD	Short-Term
S-48 Create Access and Functional Needs Working Group to increase community education concerning potential impacts from hazards on special needs population.							
N	New and Existing	All	1, 2, 4	Emergency Management, Housing Dept., Environmental Dept., Planning Dept., Fire Dept., Tribal Residents	Low	Discretionary Fund, BIA, HUD, US ADA	Long-Term
S-49 Install additional early warning and updated communication systems reservation wide, focusing in areas without adequate radio and telephone coverage. This includes mechanisms to address interoperability issues with Pacific County.							
Y (2008 HMP)	New and Existing	All	1, 2, 4	Emergency Management, Environmental Dept., Planning Dept., Fire Dept.	High	Tsunami Program, Homeland Security Funds, Discretionary Fund, BIA, HUD	Long-Term

TABLE 17-2.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-50 Establish additional shelter capabilities which include generators due to lack of electrical infrastructure on much of the Reservation. These shelter locations which include, at a minimum, kitchen, shower facilities, and heating systems, and should meet the access and functional needs of all individuals.							
N	New and Existing	All	1, 2, 4	Emergency Management, Natural Resources Dept., Environmental, Planning Dept.	High	Discretionary Fund, BIA, HUD, FEMA Grant Funds, Homeland Security Grant Funds	Long-Term
S-51 Work with Army Core of Engineers to conduct additional assessment work on erosion issue to make certain issue has not progressed.							
Y- 2008 HMP (Enhanced)	New and Existing	Coastal Erosion, Flood, Severe Storm	1, 2, 4	Emergency Management, Housing Environmental, Planning Dept., GIS Dept.	Medium	Discretionary Fund	Long-Term
S-52 Seek grant funding to obtain additional NOAA weather radios for each facility and resident on the Reservation. This will provide advanced notice of approaching storms, tsunami evacuation and wildfire danger.							
Y 2008 HMP	New and Existing	All	1, 2, 4	Emergency Management, Environmental, Planning Dept.	Medium	Discretionary Fund, BIA, HUD, FEMA Grant Funds, Homeland Security Grant Funds, Tsunami Program	Short-Term
S-53 Seek grant funding to construct a public safety facility to include a police and fire station, court house, meeting facility and EOC on the Reservation, and acquire personnel and equipment that can also accommodate the expansion to include wildland fire services on the Reservation.							
N	New and Existing	All	1, 2, 4	Emergency Management, Environmental Dept., Planning Dept., local Fire Depts., Tribal Council	High	Discretionary Fund, BIA, HUD, FEMA Grant Funds, Homeland Security Grant Funds, Fire Grants	Long-Term
S-54 Fund a wildland engine crew, supervisors and equipment to assist in firefighting capabilities.							
N	New and Existing	Wildfire	1, 2, 4	Emergency Management, Environmental Dept., Planning Dept., local Fire Depts., Tribal Council	High	Discretionary Fund, BIA, HUD, FEMA Grant Funds, Homeland Security Grant Funds, Fire Grants	Long-Term

**TABLE 17-2.
HAZARD MITIGATION ACTION PLAN MATRIX**

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-55 Seek grant funding to purchase two new fire trucks and a water tender to help with firefighting capabilities on the Reservation, as well as surrounding communities.							
N	New and Existing	Wildfire	1, 2, 4	Emergency Management, Environmental Dept., Planning Dept., local Fire Depts., Tribal Council	High	Discretionary Fund, BIA, HUD, FEMA Grant Funds, Homeland Security Grant Funds, Fire Grants	Long-Term
S-56 Work with local utility service providers to install underground utility lines (power, phone, internet) to minimize disruption of service throughout Reservation.							
N	New and Existing	All	1, 2, 4	Emergency Management, Environmental Dept., Planning Dept., local Fire Depts.	High	Discretionary Fund, BIA, HUD, FEMA Grant Funds, Homeland Security Grant Funds, Community Development Block Grants	Long-Term
S-57 Pursue grant and other funding opportunities to assist communities in becoming more resilient to the impacts of hazards through educational public outreach on defensible space.							
N	Existing	All	1, 2, 3, 4, 6, 8, 9, 11	Emergency Management, Outdoor Maintenance Department, Environmental Dept., Land Use Office, BIA	Medium	Discretionary Fund, PDM & HMGP, Fire Grants, BIA, HUD	Long-Term, depending on funding

17.4 BENEFIT/COST REVIEW

The action plan must be prioritized according to some form of a benefit/cost analysis of the proposed projects and their associated costs. The benefits of proposed projects were weighed against estimated costs as part of the project prioritization process. The benefit/cost analysis was not of the detailed variety required by FEMA for project grant eligibility under the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) grant program. A less formal approach was used because some projects may not be implemented for up to 10 years, and associated costs and benefits could change dramatically in that time. Therefore, a review of the apparent benefits versus the apparent cost of each project was performed. Parameters were established for assigning subjective ratings (high, medium, and low) to the costs and benefits of these projects.

Cost ratings were defined as follows:

- **High**—Existing funding will not cover the cost of the project; implementation would require new revenue through an alternative source (for example, bonds, grants, and fee increases).
- **Medium**—The project could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
- **Low—**The project could be funded under the existing budget. The project is part of or can be part of an ongoing existing program.

Benefit ratings were defined as follows:

- **High—**Project will provide an immediate reduction of risk exposure for life and property.
- **Medium—**Project will have a long-term impact on the reduction of risk exposure for life and property, or project will provide an immediate reduction in the risk exposure for property.
- **Low—**Long-term benefits of the project are difficult to quantify in the short term.

Using this approach, projects with positive benefit versus cost ratios (such as high over high, high over medium, medium over low, etc.) are considered cost-beneficial and are prioritized accordingly.

For many of the strategies identified in this action plan, the Shoalwater Bay Indian Tribe may seek financial assistance under the HMGP or PDM programs, both of which require detailed benefit/cost analyses. These analyses will be performed on projects at the time of application using the FEMA benefit-cost model. For projects not seeking financial assistance from grant programs that require detailed analysis, the Shoalwater Bay Indian Tribe reserves the right to define “benefits” according to parameters that meet the goals and objectives of this plan.

17.5 ACTION PLAN PRIORITIZATION

Table 17-3 lists the priority of each initiative, using the same parameters used in selecting the initiatives. A qualitative benefit-cost review was performed for each of these initiatives. The priorities are defined as follows:

- **High Priority**—A project that meets multiple objectives (i.e., multiple hazards), has benefits that exceed cost, has funding secured or is an ongoing project and meets eligibility requirements for the HMGP or PDM grant program. High priority projects can be completed in the short term (1 to 5 years).
- **Medium Priority**—A project that meets goals and objectives, that has benefits that exceed costs, and for which funding has not been secured but that is grant eligible under HMGP, PDM or other grant programs. Project can be completed in the short term, once funding is secured. Medium priority projects will become high priority projects once funding is secured.

- **Low Priority**—A project that will mitigate the risk of a hazard, that has benefits that do not exceed the costs or are difficult to quantify, for which funding has not been secured, that is not eligible for HMGP or PDM grant funding, and for which the time line for completion is long term (1 to 10 years). Low priority projects may be eligible for other sources of grant funding from other programs.

17.6 ANALYSIS OF MITIGATION INITIATIVES

Each planning partner reviewed its recommended initiatives to classify each initiative based on the hazard it addresses and the type of mitigation it involves. Mitigation types used for this categorization are as follows:

- **Prevention**—Government, administrative or regulatory actions that influence the way land and buildings are developed to reduce hazard losses. Includes planning and zoning, floodplain laws, capital improvement programs, open space preservation, and stormwater management regulations.
- **Property Protection**—Modification of buildings or structures to protect them from a hazard or removal of structures from a hazard area. Includes acquisition, elevation, relocation, structural retrofit, storm shutters, and shatter-resistant glass.
- **Public Education and Awareness**—Actions to inform citizens and elected officials about hazards and ways to mitigate them. Includes outreach projects, real estate disclosure, hazard information centers, and school-age and adult education.
- **Natural Resource Protection**—Actions that minimize hazard loss and preserve or restore the functions of natural systems. Includes sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
- **Emergency Services**—Actions that protect people and property during and immediately after a hazard event. Includes warning systems, emergency response services, and the protection of essential facilities.
- **Structural Projects**—Actions that involve the construction of structures to reduce the impact of a hazard. Includes dams, setback levees, floodwalls, retaining walls, and safe rooms.

TABLE 17-3.
PRIORITIZATION OF MITIGATION INITIATIVES

Initiative #	# of Objectives Met	Benefits	Costs	Do Benefits Equal or Exceed Costs?	Is Project Grant Eligible?	Can Project be Funded Under Existing Programs/ Budgets?	Priority (High, Med., Low)
1	3	Medium	Low	Yes	Yes	No	Medium
2	3	Medium	Low	Yes	No	Yes	High
3	3	High	Medium	Yes	Yes	No	Medium
4	3	High	High	Yes	Yes	No	Medium
5	5	High	Low	Yes	No	No	Medium

TABLE 17-3.
PRIORITIZATION OF MITIGATION INITIATIVES

Initiative #	# of Objectives Met	Benefits	Costs	Do Benefits Equal or Exceed Costs?	Is Project Grant Eligible?	Can Project be Funded Under Existing Programs/ Budgets?	Priority (High, Med., Low)
6	4	High	Low	Yes	No	Yes	High
7	4	High	Low	Yes	No	Yes	Medium
8	5	High	High	Yes	Yes	No	Low
9	7	Medium	Medium	Yes	Yes	No	Medium
10	5	Medium	Medium	Yes	No	Yes	High
11	3	High	Low	Yes	No	Yes	High
12	4	High	Low	Yes	No	Yes	High
13	2	High	Low	Yes	No	Yes	High
14	4	High	Low	Yes	Yes	Yes	High
15	3	High	Low	Yes	No	Yes	High
16	3	High	High	Yes	Yes	No	Medium
17	3	Medium	Low	Yes	No	Yes	High
18	3	Medium	Medium	Yes	No	Yes	High
19	3	High	High	Yes	Yes	No	Medium
20	4	Medium	Low	Yes	No	Yes	High
21	3	High	High	Yes	Yes	No	Medium
22	3	High	Low	Yes	No	Yes	High
23	4	High	Low	Yes	No	Yes	High
24	3	High	Low	Yes	No	Yes	High
25	3	Medium	Medium	Yes	Yes	No	Medium
26	4	Medium	Low	Yes	No	Yes	High
27	All	High	Medium	Yes	Yes	Yes	High
28	5	Medium	Low	Yes	No	Yes	High
29	5	High	High	Yes	Yes	No	Medium
30	3	High	High	Yes	Yes	No	Medium
31	3	Low	Low	Yes	No	Yes	Medium

TABLE 17-3.
PRIORITIZATION OF MITIGATION INITIATIVES

Initiative #	# of Objectives Met	Benefits	Costs	Do Benefits Equal or Exceed Costs?	Is Project Grant Eligible?	Can Project be Funded Under Existing Programs/ Budgets?	Priority (High, Med., Low)
32	8	High	High	Yes	Yes	No	Medium
33	3	High	Low	Yes	No	Yes	High
34	3	High	High	Yes	Yes	No	High
35	3	High	Medium	Yes	Yes	Yes	High
36	3	High	High	Yes	Yes	No	Low
37	3	Medium	Low	Yes	No	Yes	High
38	3	Medium	Low	Yes	Yes	Yes	High
39	3	Medium	Lo	Yes	No	Yes	High
40	3	Low	Low	Yes	No	Yes	High
41	3	High	High	Yes	Yes	No	Medium
42	3	Medium	Low	Yes	No	Yes	High
43	3	Medium	Low	Yes	Yes	Yes	High
44	3	Medium	Low	Yes	No	Yes	High
45	3	Low	Low	Yes	No	Yes	High
46	3	Low	Low	Yes	No	Yes	High
47	3	Low	Low	Yes	No	Yes	High
48	3	Low	Low	Yes	No	Yes	High
49	3	High	High	Yes	Yes	No	Medium
50	3	High	High	Yes	Yes	No	Medium
51	3	Medium	Medium	Yes	Yes	No	Medium
52	3	High	Medium	Yes	Yes	No	Medium
53	3	High	High	Yes	Yes	No	Medium
54	3	High	High	Yes	Yes	No	Medium
55	3	High	High	Yes	Yes	No	Medium
56	3	High	High	Yes	Yes	No	Medium
57	8	Medium	Medium	Yes	Yes	No	Medium

TABLE 17-4.
ANALYSIS OF MITIGATION INITIATIVES

	Initiative Addressing Hazard, by Mitigation Type[a]					
Hazard Type	1. Prevention	2. Property Protection	3. Public Education and Awareness	4. Natural Resource Protection	5. Emergency Services	6. Structural Projects
Coastal Erosion	1, 2, 3,4, 5, 6, 8, 21, 22, 34, 43, 45, 51, 56	2,3, 4, 6, 8, 21, 22, 43, 45, 53, 56, 57	2, 6, 20, 23, 26, 27, 45, 49, 50	2, 6, 8, 43, 56	2, 6, 9, 21, 22, 23, 25, 26, 28, 43, 44, 45, 49, 50, 52, 56	2, 6, 7, 8, 10, 18, 19, 21, 22, 30, 32, 43, 46, 50, 51, 56
Earthquake	1, 2, 6, 9, 15, 16, 21, 22, 29, 34, 43, 45, 51, 56	2, 6, 9, 15, 16, 17, 21, 22, 29, 43, 45, 56	2, 6, 15, 17, 20, 23, 26, 45, 49, 50	2, 6, 9, 17, 43, 56	2, 6, 9, 16, 17, 21, 22, 24, 26, 28, 43, 44, 45, 49, 50, 52, 56	2, 6, 9, 15, 16, 17, 21, 22, 30, 32, 43, 46, 50, 56
Flood	1, 2, 3, 4, 6, 8, 9, 19, 21, 22, 29, 30, 34, 43, 45, 51, 56	2, 3, 4, 6, 8, 18, 19, 21, 22, 29, 30, 43, 45, 51, 56	2, 3, 4, 6, 20, 23, 26, 31, 45, 49, 50, 51	2, 5, 6, 8, 9, 19, 30, 43, 51, 56	2, 5, 6, 9, 17, 18, 19, 20, 21, 22, 24, 26, 31. 32, 43, 44, 45, 49, 50, 52, 56	2, 3, 4, 6, 8, 9, 10, 18, 19, 21, 22, 30, 32, 43, 46, 50, 56
Landslide	1, 2, 6, 7, 9, 17, 19, 21, 22, 29, 43, 45, 51, 56	1, 2, 7, 8, 18, 19, 21, 22, 29, 43, 45, 56	1, 2, 20, 23, 26, 45, 49, 50	1, 2, 8, 9 19, 43, 56	1, 2, 9, 17, 19, 21, 22, 24, 26, 28, 43, 44, 45, 49, 50, 52, 56	1, 2, 7, 8, 9, 10, 17, 18, 19, 21, 22, 32, 43, 46, 50, 56
Severe Weather	1, 2, 8, 9, 6, 18, 19, 21, 22, 29, 34, 41, 42, 43, 45, 51, 52, 56	2, 8, 9, 19 29, 43, 45, 51, 56	2, 20, 23, 26, 31, 45, 49, 50, 51	2, 6, 8, 9 19, 43, 41, 56	2, 6, 9, 19, 24, 26, 28, 31, 43, 44, 45, 49, 50, 51, 52, 56	2, 8, 9, 10, 18 19 21, 22, 32, 43, 46, 50, 56
Tsunami	1, 2, 3, 4, 6, 8, 9, 19, 21, 22, 29, 30, 34, 43, 45, 51, 53, 54 56	2, 3, 4, 6, 8, 14, 18, 19, 21, 22, 25, 29, 30, 43, 45, 51, 56	2, 3, 4, 6, 14, 20, 23, 25, 26, 31, 45, 49, 50, 51	2, 5, 6, 8, 9, 13, 19, 25, 30, 43, 51, 56	2, 5, 6, 9, 14, 17, 18, 19, 20, 21, 22, 24, 25, 26, 28, 31. 32, 43, 44, 45, 49, 50, 52, 56	2, 3, 4, 6, 8, 9, 10, 14, 18, 19, 21, 22, 30, 32, 43, 46, 50, 56
Wildfire	1, 2, 8, 9, 11, 12, 13, 16, 21, 22, 33, 34, 35, 36, 37, 38, 39, 40 41, 42, 43, 45, 51, 56	2, 6, 8, 9, 11, 12, 13, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 42, 45, 53, 54, 56, 57	2, 11, 12, 13, 20, 23, 26, 31, 35, 36, 37, 38, 39, 40, 41, 42, 45, 49, 50	2, 8, 9 11, 13, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 47, 53, 56	2,6, 9, 11, 12, 24, 26, 28, 31, 32, 34, 35, 36, 37, 38, 39, 43, 44, 45, 49, 50, 52, 53, 54, 55, 56, 57	2, 6, 8, 9, 11, 12, 21, 22, 34, 41, 43, 46, 50, 53, 56

a. See Section 17.5 for description of mitigation types

Chapter 18.
IMPLEMENTATION

18.1 PLAN ADOPTION

A hazard mitigation plan must document that it has been formally adopted by the governing body of the jurisdiction requesting federal approval of the plan (44 CFR Section 201.7(c)(5)). DMA compliance and its benefits cannot be achieved until the plan is adopted. This plan was adopted by the Tribal Council in May 2014, with language allowing for plan modification if requested by FEMA without the necessity of re-adoption by the Tribe.   A copy of the resolution is provided in Figure 18-1.

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

SHOALWATER BAY INDIAN TRIBE
RESOLUTION # 09-12-2014- 54

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 2014 Tribal Hazard Mitigation Plan for the Shoalwater Bay Indian Tribe.

CERTIFICATION

The above Resolution was passed at a regular Council meeting held 09-12-2014 at the Shoalwater Bay Tribal Center at which a quorum was present. 5 FOR 0 AGAINST 0 ABSTAIN

Doug Davis, Chairman
Shoalwater Bay Indian Tribe

Lynn Clark, Secretary
Shoalwater Bay Indian Tribe

Figure 18-1. Resolution Adopting Hazard Mitigation Plan

18.2 PLAN MAINTENANCE STRATEGY

A hazard mitigation plan must present a plan maintenance process that includes the following (44 CFR Section 201.7(c)(4)):

- A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan over a 5-year cycle
- A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate
- A discussion on how the community will continue public participation in the plan maintenance process.

This chapter details the formal process that will ensure that the Hazard Mitigation Plan remains an active and relevant document and that the Shoalwater Bay Tribe maintains its eligibility for applicable funding sources. The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing an updated plan every five years. This chapter also describes how public participation will be integrated throughout the plan maintenance and implementation process. It also explains how the mitigation strategies outlined in this Plan will be incorporated into existing planning mechanisms and programs, such as comprehensive land-use planning processes, capital improvement planning, and building code enforcement and implementation. The Plan’s format allows sections to be reviewed and updated when new data become available, resulting in a plan that will remain current and relevant.

18.2.1 Plan Implementation

The effectiveness of the hazard mitigation plan depends on its implementation and incorporation of its action items into existing local plans, policies and programs. Together, the action items in the Plan provide a framework for activities that the Shoalwater Bay Tribe can implement over the next 5 years. The planning team has established goals and objectives and have prioritized mitigation actions that will be implemented through existing plans, policies, and programs.

The Emergency Management Director will lead responsibility for overseeing the Plan implementation and maintenance strategy. Plan implementation and evaluation will be a shared responsibility among all agencies identified as lead agencies in the mitigation action plan.

18.2.2 Planning Team

The Planning Team is a total volunteer body that oversaw the development of the Plan and made recommendations on key elements of the plan, including the maintenance strategy. The Tribe’s previous plan provided for a similar process, which was followed on a limited basis (e.g., review of strategies for grant opportunities, review of hazards after disasters, implementation of some strategies as identified in Table 17-1, etc.). Failure to fully follow the maintenance strategy resulted from limited resources available to fully incorporate the previous strategy. For the 2014 plan, it was the Planning Team’s position that a similar body as that which developed this plan update should maintain an active role in the Plan maintenance strategy. Therefore, it is recommended that the Planning Team (not necessarily the same members but a similar body) remain a viable body involved in key elements of the plan maintenance strategy. The new steering committee should include representation from stakeholders in the planning area.

The principal role of the planning team in this plan maintenance strategy will be to review the annual progress report and provide input to the Emergency Management Director and Tribal Council (when appropriate) on possible enhancements to be considered at the next update. Future plan updates will again be overseen by a planning team similar to the one that participated in this plan development process, so keeping an interim team intact will provide a head start on future updates. It will be the planning team's role to review the progress report in an effort to identify issues needing to be addressed by future plan updates.

18.2.3 Annual Progress Report

The minimum task of the ongoing annual planning team meeting will be the evaluation of the progress of its individual action plan during a 12-month performance period. This review will include the following:

- Summary of any hazard events that occurred during the performance period and the impact these events had on the planning area
- Review of mitigation success stories
- Review of continuing public involvement
- Brief discussion about why targeted strategies were not completed
- Re-evaluation of the action plan to determine if the timeline for identified projects needs to be amended (such as changing a long-term project to a short-term one because of new funding)
- Recommendations for new projects
- Changes in or potential for new funding options (grant opportunities)
- Impact of any other planning programs or initiatives that involve hazard mitigation.

The planning team has created a template for preparing a progress report (see Appendix C). The plan maintenance planning team will provide feedback on items included in the template. The planning team will then prepare a formal annual report on the progress of the plan. This report should be used as follows:

- Posted on the Tribe's website page dedicated to the hazard mitigation plan
- Provided to the local media through a press release
- Presented to Tribal Council to inform them of the progress of actions implemented during the reporting period

Annual progress reporting is not a requirement specified under 44 CFR. However, it may enhance opportunities for funding. While failure to implement this component of the plan maintenance strategy will not jeopardize compliance under the DMA, it may jeopardize the opportunity to leverage funding opportunities with other agencies.

18.2.4 Plan Update

Tribal hazard mitigation plans must be reviewed, revised if appropriate, and resubmitted for approval in order to remain eligible for benefits under the DMA (44 CFR, Section 201.7(d)(3)). The Shoalwater Bay Tribe intends to update the hazard mitigation plan on a 5-year cycle from the date of initial plan adoption. This cycle may be accelerated to less than 5 years based on the following triggers:

- A Presidential Disaster Declaration that impacts the planning area
- A hazard event that causes loss of life
- Completion of the Shoalwater Bay's comprehensive plan which would impact elements of the HMP.

It will not be the intent of future updates to develop a complete new hazard mitigation plan for the planning area. The update will, at a minimum, include the following elements:

- The update process will be convened through a steering committee.

- The hazard risk assessment will be reviewed and, if necessary, updated using best available information and technologies.
- The public will be given an opportunity to comment on the update prior to adoption.
- The action plan will be reviewed and revised to account for any initiatives completed, dropped, or changed and to account for changes in the risk assessment or new policies identified under other planning mechanisms (such as the comprehensive plan).
- The draft update will be sent to appropriate agencies and organizations for comment.
- Tribal Council will adopt the updated plan.

18.2.5 Continuing Public Involvement

The public will continue to be apprised of the plan's progress through the Tribe's website and by providing copies of annual progress reports at various public outreach meetings. The website will not only house the final plan, it will become the one-stop shop for information regarding the plan and plan implementation. Copies of the plan will be distributed to the various Shoalwater Bay Tribe departments and at annual public meetings. Upon initiation of future update processes, a new public involvement strategy will be initiated based on guidance from a new steering committee. This strategy will be based on the needs and capabilities of the Shoalwater Bay Tribe at the time of the update.

18.2.6 Incorporation into Other Planning Mechanisms

The information on hazard, risk, vulnerability, and mitigation contained in this plan is based on the best science and technology available at the time this plan was prepared. The Shoalwater Bay Tribe Comprehensive Plan, once completed, will be considered to be an integral part of this plan. The Shoalwater Bay Tribe, through adoption of a comprehensive plan, through its current development of a new zoning ordinance, and through its various transportation planning efforts has planned and will continue to plan for the impact of natural hazards. This plan development process provided the opportunity to review and provide input on policies in these planning mechanisms. The comprehensive plan and the hazard mitigation plan are complementary documents that work together to achieve the goal of reducing risk exposure. An update to a comprehensive plan may trigger an update to the hazard mitigation plan.

The Tribe will create a linkage between the hazard mitigation plan and the comprehensive plan by identifying a mitigation initiative as such and giving that initiative a high priority. Other planning processes and programs to be coordinated with the recommendations of the hazard mitigation plan include the following:

- Emergency response plans
- Capital improvement programs
- Tribal codes
- Community design guidelines
- Water-efficient design guidelines
- Stormwater management programs
- Water system vulnerability assessments
- Vegetation Studies
- Transportation Plans
- Master fire protection plans.

Some action items do not need to be implemented through regulation. Instead, these items can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation. As information becomes available from other planning mechanisms that can enhance this plan, that information will be incorporated via the update process.

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APPENDIX A.
ACRONYMS AND DEFINITIONS

APPENDIX A.
ACRONYMS AND DEFINITIONS

ACRONYMS

CFR—Code of Federal Regulations

cfs—cubic feet per second

CIP—Capital Improvement Plan

CRS—Community Rating System

DFIRM—Digital Flood Insurance Rate Maps

DHS—Department of Homeland Security

DMA —Disaster Mitigation Act

EAP—Emergency Action Plan

EPA—U.S. Environmental Protection Agency

ESA—Endangered Species Act

FEMA—Federal Emergency Management Agency

FERC—Federal Energy Regulatory Commission

FIRM—Flood Insurance Rate Map

FIS—Flood Insurance Study

GIS—Geographic Information System

HAZUS-MH—Hazards, United States-Multi Hazard

HMGP—Hazard Mitigation Grant Program

IBC—International Building Code

IRC—International Residential Code

MM—Modified Mercalli Scale

NEHRP—National Earthquake Hazards Reduction Program

NFIP—National Flood Insurance Program

NOAA—National Oceanic and Atmospheric Administration

NWS—National Weather Service

PDM—Pre-Disaster Mitigation Grant Program

PDI—Palmer Drought Index

PGA—Peak Ground Acceleration

PHDI—Palmer Hydrological Drought Index

SFHA—Special Flood Hazard Area

SHELDUS—Special Hazard Events and Losses Database for the US

SPI—Standardized Precipitation Index

USGS—U.S. Geological Survey

DEFINITIONS

100-Year Flood: The term "100-year flood" can be misleading. The 100-year flood does not necessarily occur once every 100 years. Rather, it is the flood that has a 1 percent chance of being equaled or exceeded in any given year. Thus, the 100-year flood could occur more than once in a relatively short period of time. The Federal Emergency Management Agency (FEMA) defines it as the 1 percent annual chance flood, which is now the standard definition used by most agencies and by the National Flood Insurance Program (NFIP).

Acre-Foot: An acre-foot is the amount of water it takes to cover 1 acre to a depth of 1 foot. This measure is used to describe the quantity of storage in a water reservoir. An acre-foot is a unit of volume. One acre foot equals 7,758 barrels; 325,829 gallons; or 43,560 cubic feet. An average household of four will use approximately 1 acre-foot of water per year.

Asset: An asset is any man-made or natural feature that has value, including, but not limited to, people; buildings; infrastructure, such as bridges, roads, sewers, and water systems; lifelines, such as electricity and communication resources; and environmental, cultural, or recreational features such as parks, wetlands, and landmarks.

Base Flood: The flood having a 1% chance of being equaled or exceeded in any given year, also known as the "100-year" or "1% chance" flood. The base flood is a statistical concept used to ensure that all properties subject to the National Flood Insurance Program (NFIP) are protected to the same degree against flooding.

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" and "drainage basins."

Benefit: A benefit is a net project outcome and is usually defined in monetary terms. Benefits may include direct and indirect effects. For the purposes of benefit-cost analysis of proposed mitigation measures, benefits are limited to specific, measurable, risk reduction factors, including reduction in expected property losses (buildings, contents, and functions) and protection of human life.

Benefit/Cost Analysis: A benefit/cost analysis is a systematic, quantitative method of comparing projected benefits to projected costs of a project or policy. It is used as a measure of cost effectiveness.

Building: A building is defined as a structure that is walled and roofed, principally aboveground, and permanently fixed to a site. The term includes manufactured homes on permanent foundations on which the wheels and axles carry no weight.

Capability Assessment: A capability assessment provides a description and analysis of a community's current capacity to address threats associated with hazards. The assessment includes two components: an inventory of an agency's mission, programs, and policies, and an analysis of its capacity to carry them out. A capability assessment is an integral part of the planning process in which a community's actions to reduce losses are identified, reviewed, and analyzed, and the framework for implementation is identified. The following capabilities were reviewed under this assessment:

- Legal and regulatory capability
- Administrative and technical capability

- Fiscal capability

Community Rating System (CRS): The CRS is a voluntary program under the NFIP that rewards participating communities (provides incentives) for exceeding the minimum requirements of the NFIP and completing activities that reduce flood hazard risk by providing flood insurance premium discounts.

Critical Area: An area defined by state or local regulations as deserving special protection because of unique natural features or its value as habitat for a wide range of species of flora and fauna. A sensitive/critical area is usually subject to more restrictive development regulations.

Critical Facility: Facilities and infrastructure that are critical to the health and welfare of the population. These become especially important after any hazard event occurs. For the purposes of this plan, critical facilities include:

- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic and/or water reactive materials;
- Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a hazard event.
- Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for disaster response before, during, and after hazard events, and
- Public and private utilities, facilities and infrastructure that are vital to maintaining or restoring normal services to areas damaged by hazard events.
- Government facilities.

For the purposes of this planning effort, the steering committee elected to define all structures on the reservation, including culturally significant areas, as critical facilities due to the impact the loss of one structure would have on the Tribe.

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

Dam: Any artificial barrier or controlling mechanism that can or does impound 10 acre-feet or more of water.

Dam Failure: Dam failure refers to a partial or complete breach in a dam (or levee) that impacts its integrity. Dam failures occur for a number of reasons, such as flash flooding, inadequate spillway size, mechanical failure of valves or other equipment, freezing and thawing cycles, earthquakes, and intentional destruction.

Debris Avalanche: Volcanoes are prone to debris and mountain rock avalanches that can approach speeds of 100 mph.

Debris Flow: Dense mixtures of water-saturated debris that move down-valley; looking and behaving much like flowing concrete. They form when loose masses of unconsolidated material are saturated, become unstable, and move down slope. The source of water varies but includes rainfall, melting snow or ice, and glacial outburst floods.

Debris Slide: Debris slides consist of unconsolidated rock or soil that has moved rapidly down slope. They occur on slopes greater than 65 percent.

Disaster Mitigation Act of 2000 (DMA); The DMA is Public Law 106-390 and is the latest federal legislation enacted to encourage and promote proactive, pre-disaster planning as a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA emphasizes planning for disasters before they occur. Under the DMA, a pre-disaster hazard mitigation program and new requirements for the national post-disaster hazard mitigation grant program (HMGP) were established.

Drainage 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. Drainage basins are also referred to as **watersheds** or **basins**.

Drought: Drought is a period of time without substantial rainfall or snowfall from one year to the next. Drought can also be defined as the cumulative impacts of several dry years or a deficiency of precipitation over an extended period of time, which in turn results in water shortages for some activity, group, or environmental function. A hydrological drought is caused by deficiencies in surface and subsurface water supplies. A socioeconomic drought impacts the health, well-being, and quality of life or starts to have an adverse impact on a region. Drought is a normal, recurrent feature of climate and occurs almost everywhere.

Earthquake: An earthquake is defined as a sudden slip on a fault, volcanic or magmatic activity, and sudden stress changes in the earth that result in ground shaking and radiated seismic energy. Earthquakes can last from a few seconds to over 5 minutes, and have been known to occur as a series of tremors over a period of several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties may result from falling objects and debris as shocks shake, damage, or demolish buildings and other structures.

Exposure: Exposure is defined as the number and dollar value of assets considered to be at risk during the occurrence of a specific hazard.

Extent: The extent is the size of an area affected by a hazard.

Fire Behavior: Fire behavior refers to the physical characteristics of a fire and is a function of the interaction between the fuel characteristics (such as type of vegetation and structures that could burn), topography, and weather. Variables that affect fire behavior include the rate of spread, intensity, fuel consumption, and fire type (such as underbrush versus crown fire).

Fire Frequency: Fire frequency is the broad measure of the rate of fire occurrence in a particular area. An estimate of the area's most likely to burn is based on past fire history or fire rotation in the area, fuel conditions, weather, ignition sources (such as human or lightning), fire suppression response, and other factors.

Flash Flood: A flash flood occurs with little or no warning when water levels rise at an extremely fast rate

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).

Flood Insurance Study: A report published by the Federal Insurance and Mitigation Administration for a community in conjunction with the community's Flood Insurance rate Map. The study contains such background data as the base flood discharges and water surface elevations that were used to prepare the FIRM. In most cases, a community FIRM with detailed mapping will have a corresponding flood insurance study.

Floodplain: Any land area susceptible to being inundated by flood waters from any source. A flood insurance rate map identifies most, but not necessarily all, of a community's floodplain as the Special Flood Hazard Area (SFHA).

Floodway: Floodways are areas within a floodplain that are reserved for the purpose of conveying flood discharge without increasing the base flood elevation more than 1 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 located in the floodplain but outside of the floodway. Some development is generally allowed in these areas, with a variety of restrictions. On maps that have identified and delineated a floodway, this would be the area beyond the floodway boundary that can be subject to different regulations.

Fog: Fog refers to a cloud (or condensed water droplets) near the ground. Fog forms when air close to the ground can no longer hold all the moisture it contains. Fog occurs either when air is cooled to its dew point or the amount of moisture in the air increases. Heavy fog is particularly hazardous because it can restrict surface visibility. Severe fog incidents can close roads, cause vehicle accidents, cause airport delays, and impair the effectiveness of emergency response. Financial losses associated with transportation delays caused by fog have not been calculated in the United States but are known to be substantial.

Freeboard: Freeboard is the margin of safety added to the base flood elevation.

Frequency: For the purposes of this plan, frequency refers to how often a hazard of specific magnitude, duration, and/or extent is expected to occur on average. Statistically, a hazard with a 100-year frequency is expected to occur about once every 100 years on average and has a 1 percent chance of occurring any given year. Frequency reliability varies depending on the type of hazard considered.

Fujita Scale of Tornado Intensity: Tornado wind speeds are sometimes estimated on the basis of wind speed and damage sustained using the Fujita Scale. The scale rates the intensity or severity of tornado events using numeric values from F0 to F5 based on tornado wind speed and damage. An F0 tornado (wind speed less than 73 miles per hour (mph)) indicates minimal damage (such as broken tree limbs), and an F5 tornado (wind speeds of 261 to 318 mph) indicates severe damage.

Goal: A goal is a general guideline that explains what is to be achieved. Goals are usually broad-based, long-term, policy-type statements and represent global visions. Goals help define the benefits that a plan is trying to achieve. The success of a hazard mitigation plan is measured by the degree to which its goals have been met (that is, by the actual benefits in terms of actual hazard mitigation).

Geographic Information System (GIS): GIS is a computer software application that relates data regarding physical and other features on the earth to a database for mapping and analysis.

Hazard: A hazard is a source of potential danger or adverse condition that could harm people and/or cause property damage.

Hazard Mitigation Grant Program (HMGP): Authorized under Section 202 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the HMGP is administered by FEMA and provides grants to states, tribes, and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to disasters and to enable mitigation activities to be implemented as a community recovers from a disaster

Hazards U.S. Multi-Hazard (HAZUS-MH) Loss Estimation Program: HAZUS-MH is a GIS-based program used to support the development of risk assessments as required under the DMA. The HAZUS-MH software program assesses risk in a quantitative manner to estimate damages and losses associated with natural hazards. HAZUS-MH is FEMA's nationally applicable, standardized methodology and software program and contains modules for estimating potential losses from earthquakes, floods, and wind hazards. HAZUS-MH has also been used to assess vulnerability (exposure) for other hazards.

Hydraulics: Hydraulics is the branch of science or engineering that addresses fluids (especially water) in motion in rivers or canals, works and machinery for conducting or raising water, the use of water as a prime mover, and other fluid-related areas.

Hydrology: Hydrology is the analysis of waters of the earth. For example, a flood discharge estimate is developed by conducting a hydrologic study.

Intensity: For the purposes of this plan, intensity refers to the measure of the effects of a hazard.

Inventory: The assets identified in a study region comprise an inventory. Inventories include assets that could be lost when a disaster occurs and community resources are at risk. Assets include people, buildings, transportation, and other valued community resources.

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.

Lightning: Lightning is an electrical discharge resulting from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a "bolt," usually within or between clouds and the ground. A bolt of lightning instantaneously reaches temperatures approaching 50,000ºF. The rapid heating and cooling of air near lightning causes thunder. Lightning is a major threat during thunderstorms. In the United States, 75 to 100 Americans are struck and killed by lightning each year (see http://www.fema.gov/hazard/thunderstorms/thunder.shtm).

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.

Local Government: Any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity.

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.

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

Mitigation: A preventive action that can be taken in advance of an event that will reduce or eliminate the risk to life or property.

Mitigation Actions: Mitigation actions are specific actions to achieve goals and objectives that minimize the effects from a disaster and reduce the loss of life and property.

Objective: For the purposes of this plan, an objective is defined as a short-term aim that, when combined with other objectives, forms a strategy or course of action to meet a goal. Unlike goals, objectives are specific and measurable.

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.

Preparedness: Preparedness refers to actions that strengthen the capability of government, citizens, and communities to respond to disasters.

Presidential Disaster Declaration: These declarations are typically made for events that cause more damage than state and local governments and resources can handle without federal government assistance. Generally, no specific dollar loss threshold has been established for such declarations. A

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

Probability of Occurrence: The probability of occurrence is a statistical measure or estimate of the likelihood that a hazard will occur. This probability is generally based on past hazard events in the area and a forecast of events that could occur in the future. A probability factor based on yearly values of occurrence is used to estimate probability of occurrence.

Repetitive Loss Property: Any NFIP-insured property that, since 1978 and regardless of any changes of ownership during that period, has experienced:

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

Return Period (or Mean Return Period): This term refers to the average period of time in years between occurrences of a particular hazard (equal to the inverse of the annual frequency of occurrence).

Riverine: Of or produced by a river. Riverine floodplains have readily identifiable channels. Floodway maps can only be prepared for riverine floodplains.

Risk: Risk is the estimated impact that a hazard would have on people, services, facilities, and structures in a community. Risk measures the likelihood of a hazard occurring and resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold due to occurrence of a specific type of hazard. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Risk Assessment: Risk assessment is the process of measuring potential loss of life, personal injury, economic injury, and property damage resulting from hazards. This process assesses the vulnerability of people, buildings, and infrastructure to hazards and focuses on (1) hazard identification; (2) impacts of hazards on physical, social, and economic assets; (3) vulnerability identification; and (4) estimates of the cost of damage or costs that could be avoided through mitigation.

Risk Ranking: This ranking serves two purposes, first to describe the probability that a hazard will occur, and second to describe the impact a hazard will have on people, property, and the economy. Risk estimates are based on the methodology used to prepare the risk assessment for this plan.

Robert T. Stafford Act: The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 100-107, was signed into law on November 23, 1988. This law amended the Disaster Relief Act of 1974, Public Law 93-288. The Stafford Act is the statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs.

Sinkhole: A collapse depression in the ground with no visible outlet. Its drainage is subterranean. It is commonly vertical-sided or funnel-shaped.

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

Stakeholder: Business leaders, civic groups, academia, non-profit organizations, major employers, managers of critical facilities, farmers, developers, special purpose districts, and others whose actions could impact hazard mitigation.

Stream Bank Erosion: Stream bank erosion is common along rivers, streams and drains where banks have been eroded, sloughed or undercut. However, it is important to remember that a stream is a dynamic and constantly changing system. It is natural for a stream to want to meander, so not all eroding banks are "bad" and in need of repair. Generally, stream bank erosion becomes a problem where development has limited the meandering nature of streams, where streams have been channelized, or where stream bank structures (like bridges, culverts, etc.) are located in places where they can actually cause damage to downstream areas. Stabilizing these areas can help protect watercourses from continued sedimentation, damage to adjacent land uses, control unwanted meander, and improvement of habitat for fish and wildlife.

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%. For this study, steep slope is defined as slopes greater than 33%.

Sustainable Hazard Mitigation: This concept includes the sound management of natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context.

Thunderstorm: A thunderstorm is a storm with lightning and thunder produced by cumulonimbus clouds. Thunderstorms usually produce gusty winds, heavy rains, and sometimes hail. Thunderstorms are usually short in duration (seldom more than 2 hours). Heavy rains associated with thunderstorms can lead to flash flooding during the wet or dry seasons.

Tornado: A tornado is a violently rotating column of air extending between and in contact with a cloud and the surface of the earth. Tornadoes are often (but not always) visible as funnel clouds. On a local scale, tornadoes are the most intense of all atmospheric circulations, and winds can reach destructive speeds of more than 300 mph. A tornado's vortex is typically a few hundred meters in diameter, and damage paths can be up to 1 mile wide and 50 miles long.

Vulnerability: Vulnerability describes how exposed or susceptible an asset is to damage. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power. Flooding of an electric substation would affect not only the substation itself but businesses as well. Often, indirect effects can be much more widespread and damaging than direct effects.

Watershed: A watershed is an area that drains down gradient from areas of higher land to areas of lower land to the lowest point, a common drainage basin.

Wildfire: These terms refer to any uncontrolled fire occurring on undeveloped land that requires fire suppression. The potential for wildfire is influenced by three factors: the presence of fuel, topography, and air mass. Fuel can include living and dead vegetation on the ground, along the surface as brush and small trees, and in the air such as tree canopies. Topography includes both slope and elevation. Air mass includes temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount, duration, and the stability of the atmosphere at the time of the fire. Wildfires can be ignited by lightning and, most frequently, by human activity including smoking, campfires, equipment use, and arson.

Windstorm: Windstorms are generally short-duration events involving straight-line winds or gusts exceeding 50 mph. These gusts can produce winds of sufficient strength to cause property damage. Windstorms are especially dangerous in areas with significant tree stands, exposed property, poorly constructed buildings, mobile homes (manufactured housing units), major infrastructure, and aboveground utility lines. A windstorm can topple trees and power lines; cause damage to residential, commercial, critical facilities; and leave tons of debris in its wake.

Zoning Ordinance: The zoning ordinance designates allowable land use and intensities for a local jurisdiction. Zoning ordinances consist of two components: a zoning text and a zoning map.

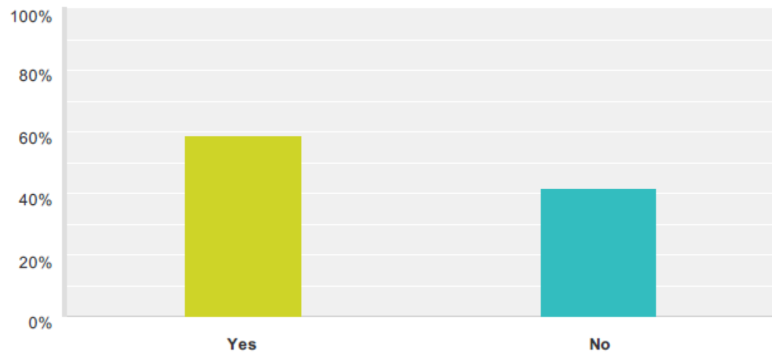
APPENDIX B. PUBLIC OUTREACH

APPENDIX B.
PUBLIC OUTREACH

Shoalwater Bay Tribe Hazard Mitigation Plan Survey

Q1 Do you live or work on the Reservation?

Answered: 77 Skipped: 1

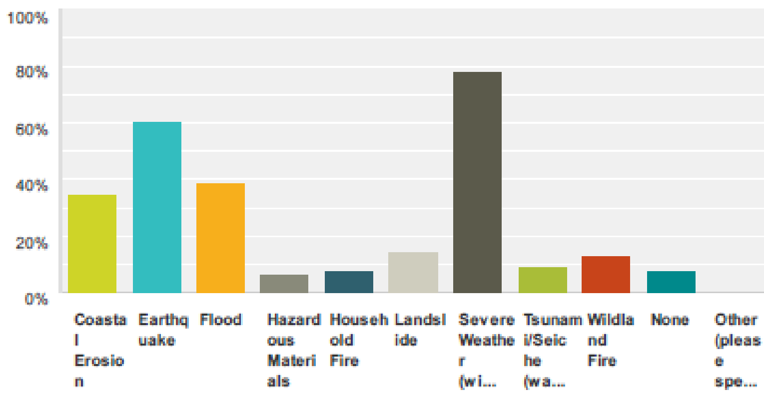


Answer Choices	Responses	
Yes	58.44%	45
No	41.56%	32
Total		77

Shoalwater Bay Tribe Hazard Mitigation Plan Survey

Q2 Which of the following natural hazard events have you or has anyone in your household experienced in the past 20 years? (Check all that apply)

Answered: 78 Skipped: 0



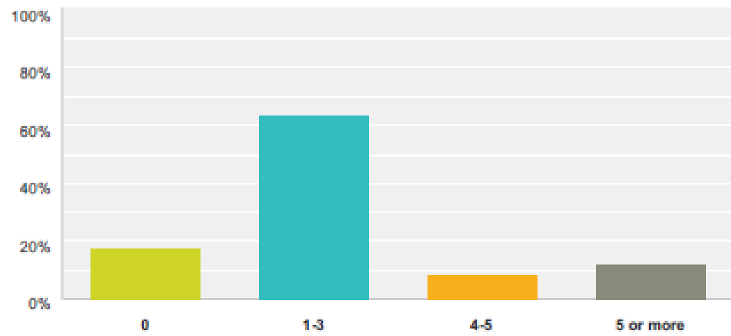
Answer Choices	Responses	
Coastal Erosion	34.62%	27
Earthquake	60.26%	47
Flood	38.46%	30
Hazardous Materials	6.41%	5
Household Fire	7.69%	6
Landslide	14.10%	11
Severe Weather (wind, lightning, winter storm, etc.)	78.21%	61
Tsunami/Seiche (waves generated by wind or seismic activity)	8.97%	7
Wildland Fire	12.82%	10
None	7.69%	6
Other (please specify)	0.00%	0
Total Respondents: 78		

#	Other (please specify)	Date
	There are no responses.	

Shoalwater Bay Tribe Hazard Mitigation Plan Survey

Q3 How many times have you been impacted by disaster events?

Answered: 76 Skipped: 2

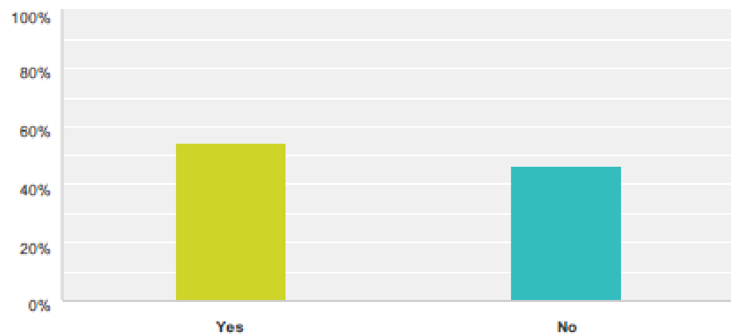


Answer Choices	Responses	
0	17.11%	13
1-3	63.16%	48
4-5	7.89%	6
5 or more	11.84%	9
Total		76

Shoalwater Bay Tribe Hazard Mitigation Plan Survey

Q4 Have these occurred while you have lived (or worked) on the Shoalwater Reservation?

Answered: 72 Skipped: 6

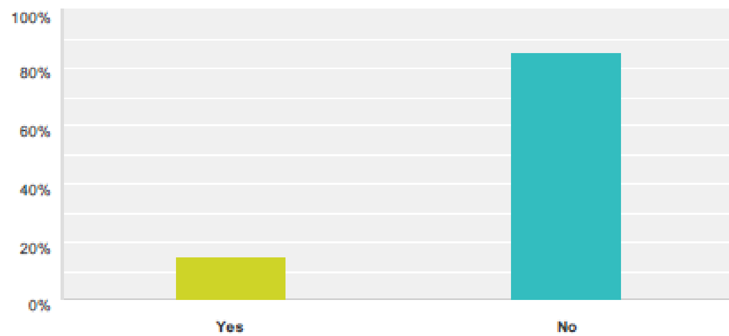


Answer Choices	Responses	
Yes	54.17%	39
No	45.83%	33
Total		72

Shoalwater Bay Tribe Hazard Mitigation Plan Survey

Q5 If the answer to the preceding question is in the affirmative, has the hazard event impacted your ability to use your residence because of damages?

Answered: 68 Skipped: 10

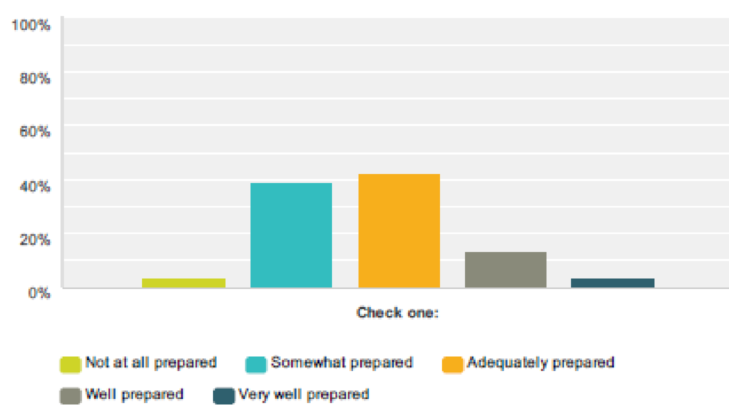


Answer Choices	Responses	
Yes	14.71%	10
No	85.29%	58
Total		68

Shoalwater Bay Tribe Hazard Mitigation Plan Survey

Q6 How prepared is your household to deal with a natural hazard event?

Answered: 67 Skipped: 11

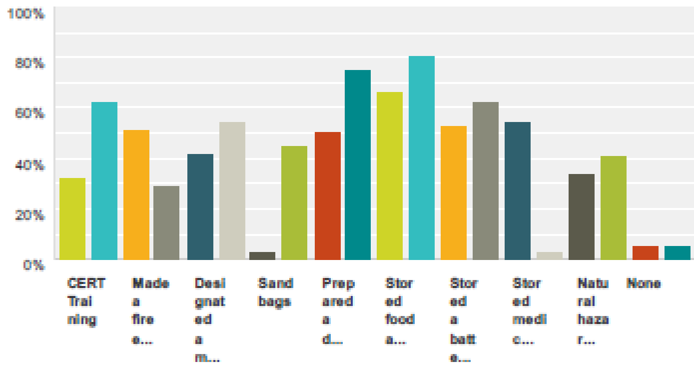


	Not at all prepared	Somewhat prepared	Adequately prepared	Well prepared	Very well prepared	Total	Average Rating
Check one:	2.99% 2	38.81% 26	41.79% 28	13.43% 9	2.99% 2	67	2.75

Shoalwater Bay Tribe Hazard Mitigation Plan Survey

Q7 Which of the following steps has your household taken to prepare for a hazard event? (Check all that apply)

Answered: 72 Skipped: 6



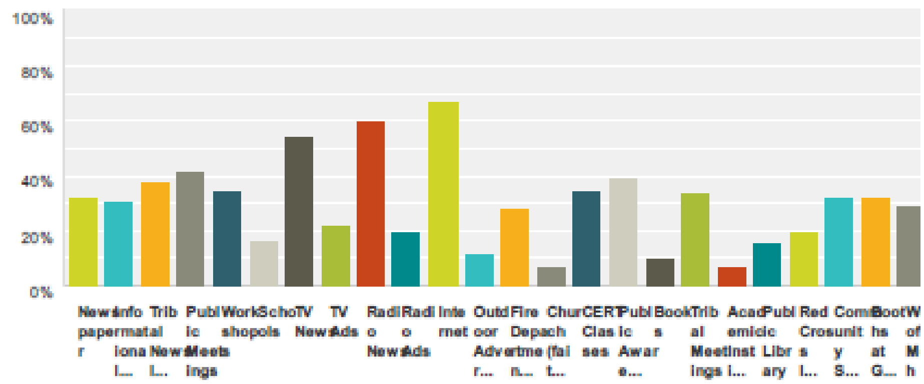
Answer Choices	Responses	
CERT Training	31.94%	23
Received first aid/CPR training	62.50%	45
Made a fire escape plan	51.39%	37
Removed/reduced vegetation 100 feet from immediate area of house	29.17%	21
Designated a meeting place	41.67%	30
Identified utility shutoffs	54.17%	39
Sand bags	2.78%	2
Cleared Roof/Gutters	44.44%	32
Prepared a disaster supply kit	50.00%	36
Installed smoke detectors on each level of the house	75.00%	54
Stored food and water	66.67%	48
Stored flashlights and batteries	80.56%	58
Stored a battery-powered radio	52.78%	38
Stored a fire extinguisher	62.50%	45
Stored medical supplies (first aid kit, medications)	54.17%	39
Planted fire resistant landscaping	2.78%	2
Natural hazard insurance (Flood, Earthquake, Wildfire)	33.33%	24
Stored NOAA Radio	40.28%	29
None	5.56%	4
Other (please specify)	5.56%	4
Total Respondents: 72		

#	Other (please specify)	Date
1	haz mat training	12/8/2013 2:04 PM
2	Generator	8/26/2013 9:52 PM
3	fire & co/2 alarms	8/22/2013 8:45 PM
4	all important papers in a small fire proof easily grabbed box.	8/22/2013 11:49 AM

Shoalwater Bay Tribe Hazard Mitigation Plan Survey

Q8 Which of the following methods do you think are most effective to provide hazard and disaster information to you? (Check all that apply)

Answered: 72 Skipped: 6



Answer Choices	Responses	
Newspaper	31.94%	23
Informational Brochures	30.56%	22
Tribal Newsletters	37.50%	27
Public Meetings	41.67%	30
Workshops	34.72%	25
Schools	16.67%	12
TV News	54.17%	39
TV Ads	22.22%	16
Radio News	59.72%	43
Radio Ads	19.44%	14
Internet	66.67%	48
Outdoor Advertisements	11.11%	8
Fire Department/Rescue	27.78%	20
Church (faith-based institutions)	6.94%	5
CERT Classes	34.72%	25
Public Awareness Campaign (e.g., Flood Awareness Week, Winter Storm Preparedness Month)	38.89%	28
Books	9.72%	7
Tribal Meetings	33.33%	24
Academic Institutions	6.94%	5
Public Library	15.28%	11
Red Cross Information	19.44%	14

Shoalwater Bay Tribe Hazard Mitigation Plan Survey

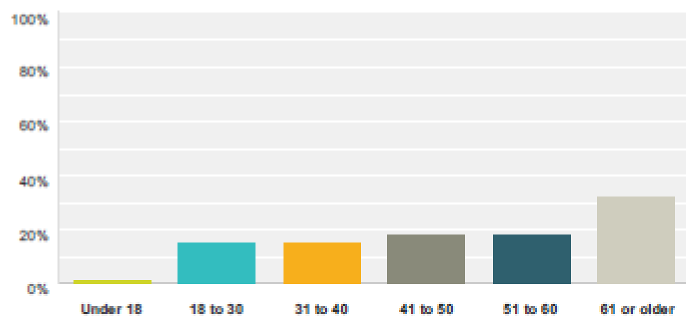
Community Safety Events	31.94%	23
Booths at Gatherings	31.94%	23
Word of Mouth	29.17%	21
Other (please specify)	2.78%	2
Total Respondents: 72		

#	Other (please specify)	Date
1	On line courses is best method for me + tribal meetings	9/2/2013 7:23 AM
2	More the better prepared	8/6/2013 2:43 PM

Shoalwater Bay Tribe Hazard Mitigation Plan Survey

Q9 Please indicate your age range:

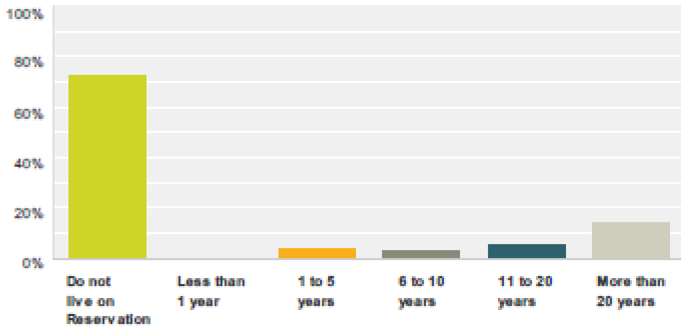
Answered: 72 Skipped: 6



Answer Choices	Responses	
Under 18	1.39%	1
18 to 30	15.28%	11
31 to 40	15.28%	11
41 to 50	18.06%	13
51 to 60	18.06%	13
61 or older	31.94%	23
Total		**72**

Q10 How long have you lived on the Reservation?

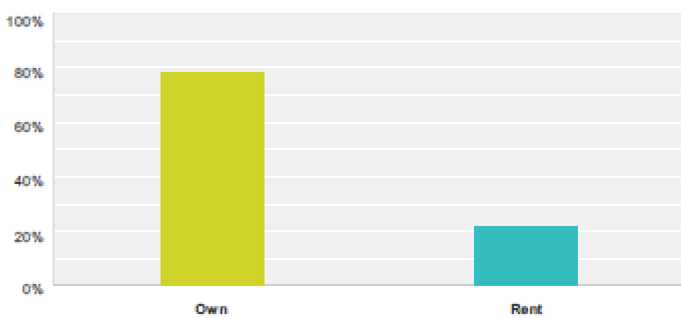
Answered: 71 Skipped: 7



Answer Choices	Responses	
Do not live on Reservation	73.24%	52
Less than 1 year	0.00%	0
1 to 5 years	4.23%	3
6 to 10 years	2.82%	2
11 to 20 years	5.63%	4
More than 20 years	14.08%	10
Total		71

Q11 Do you own or rent your place of residence?

Answered: 70 Skipped: 8



Answer Choices	Responses	
Own	78.57%	55
Rent	21.43%	15
Total		70

Shoalwater Bay Tribe Hazard Mitigation Plan Survey

Q12 If you have additional information you would like to share about your knowledge and experience regarding local natural hazards and disasters, we invite you to provide your information on the space provided below. Thank you for your time!

Answered: 6 Skipped: 72

#	Responses	Date
1	Love the site. I worked for SBT from 1993-1998. To understand a subduction zone tsunami google "Gold Beach Oregon,tsunami." I saw the damage a year later. The debris field included residential structures far up the Rouge River. I've studied the ground behind SBT. The rock/gravel quarries change color from a dark brown (basalt) to a gray color closer to the prison. Back in the mid 1990s, Rod Chenoweth and myself, Howard Scott, tried to negotiate an evacuation site in the coastal range. A problem exists called soil liquefaction. The hills behind SBT are ancient sand dunes. Another issue. When WDOT was building the jetty near North Cove, Joe Cushman showed me a WDOT map identifying a proposed highway bypassing North River to Markum. This map may still be in the Tribal Center. Perhaps you could request another map from WDOT.	3/10/2014 11:32 PM
2	I am independent health provider contractor working for the tribe. Their preparation has been 5 star. Thanks for providing support for the Shoalwater Bay Tribe to develop hazard mitigation strategies.	9/2/2013 7:24 AM
3	Thank you for thinking of us! We appreciate the tribal activities and info on disaster preparedness!	8/26/2013 7:59 PM
4	My parents both live in tokeland, and my step-mom has been part of the disaster team in the past. I have learned a lot from her about what she learned about the paperwork needed to be grabbed in case of a disaster.	8/22/2013 11:49 AM
5	I do not live on the Reservation but I work on the Resevation. I try to participate in prepardness activities if my work schedule permits.	8/22/2013 8:55 AM
6	Be prepared for anything, you never know what can happen or when. Knowledge is the key!	8/6/2013 2:45 PM

APPENDIX C.
MITIGATION ALTERNATIVE CATALOGS

APPENDIX C.
MITIGATION ALTERNATIVE CATALOGS

TABLE C.
CATALOG OF MITIGATION ALTERNATIVES—DAM FAILURE

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
• None	1. Remove dams 2. Remove levees 3. Harden dams	1. Remove dams 2. Remove levees 3. Harden dams
Reduce Exposure		
• Relocate out of dam failure inundation areas.	• Replace earthen dams with hardened structures	1. Replace earthen dams with hardened structures 2. Relocate critical facilities out of dam failure inundation areas. 3. Consider open space land use in designated dam failure inundation areas.
Reduce Vulnerability		
• Elevate home to appropriate levels.	• Flood-proof facilities within dam failure inundation areas	1. Adopt higher regulatory floodplain standards in mapped dam failure inundation areas. 2. Retrofit critical facilities within dam failure inundation areas.
Increase Preparation or Response Capability		
1. Learn about risk reduction for the dam failure hazard. 2. Learn the evacuation routes for a dam failure event. 3. Educate yourself on early warning systems and the dissemination of warnings.	1. Educate employees on the probable impacts of a dam failure. 2. Develop a continuity of operations plan.	1. Map dam failure inundation areas. 2. Enhance emergency operations plan to include a dam failure component. 3. Institute monthly communications checks with dam operators. 4. Inform the public on risk reduction techniques 5. Adopt real-estate disclosure requirements for the re-sale of property located within dam failure inundation areas. 6. Consider the probable impacts of climate in assessing the risk associated with the dam failure hazard. 7. Establish early warning capability downstream of listed high hazard dams. 8. Consider the residual risk associated with protection provided by dams in future land use decisions.

TABLE C.
CATALOG OF MITIGATION ALTERNATIVES—DROUGHT

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
None	None	Groundwater recharge through stormwater management
Reduce Exposure		
None	None	Identify and create groundwater backup sources
Reduce Vulnerability		
1. Drought-resistant landscapes 2. Reduce water system losses 3. Modify plumbing systems (through water saving kits)	1. Drought-resistant landscapes 2. Reduce private water system losses	1. Water use conflict regulations 2. Reduce water system losses 3. Distribute water saving kits
Increase Preparation or Response Capability		
• Practice active water conservation	• Practice active water conservation	1. Public education on drought resistance 2. Identify alternative water supplies for times of drought; mutual aid agreements with alternative suppliers 3. Develop drought contingency plan 4. Develop criteria "triggers" for drought-related actions 5. Improve accuracy of water supply forecasts 6. Modify rate structure to influence active water conservation techniques

TABLE C.
CATALOG OF MITIGATION ALTERNATIVES—EARTHQUAKE

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
None	None	None
Reduce Exposure		
• Locate outside of hazard area (off soft soils)	• Locate or relocate mission-critical functions outside hazard area where possible	• Locate critical facilities or functions outside hazard area where possible
Reduce Vulnerability		

1. Retrofit structure (anchor house structure to foundation) 2. Secure household items that can cause injury or damage (such as water heaters, bookcases, and other appliances) 3. Build to higher design	1. Build redundancy for critical functions and facilities 2. Retrofit critical buildings and areas housing mission-critical functions	1. Harden infrastructure 2. Provide redundancy for critical functions 3. Adopt higher regulatory standards
Increase Preparation or Response Capability		
1. Practice “drop, cover, and hold” 2. Develop household mitigation plan, such as creating a retrofit savings account, communication capability with outside, 72-hour self-sufficiency during an event 3. Keep cash reserves for reconstruction 4. Become informed on the hazard and risk reduction alternatives available. 5. Develop a post-disaster action plan for your household	1. Adopt higher standard for new construction; consider “performance-based design” when building new structures 2. Keep cash reserves for reconstruction 3. Inform your employees on the possible impacts of earthquake and how to deal with them at your work facility. 4. Develop a continuity of operations plan	1. Provide better hazard maps 2. Provide technical information and guidance 3. Enact tools to help manage development in hazard areas (e.g., tax incentives, information) 4. Include retrofitting and replacement of critical system elements in capital improvement plan 5. Develop strategy to take advantage of post-disaster opportunities 6. Warehouse critical infrastructure components such as pipe, power line, and road repair materials 7. Develop and adopt a continuity of operations plan 8. Initiate triggers guiding improvements (such as <50% substantial damage or improvements) 9. Further enhance seismic risk assessment to target high hazard buildings for mitigation opportunities. 10. Develop a post-disaster action plan that includes grant funding and debris removal components.

TABLE C.
CATALOG OF MITIGATION ALTERNATIVES—FLOOD

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
1. Clear stormwater drains and culverts 2. Institute low-impact development techniques on property	1. Clear stormwater drains and culverts 2. Institute low-impact development techniques on property	1. Maintain drainage system 2. Institute low-impact development techniques on property 3. Dredging, levee construction, and providing regional retention areas 4. Structural flood control, levees, channelization, or revetments. 5. Stormwater management regulations and master planning 6. Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff
Reduce Exposure		

1. Locate outside of hazard area 2. Elevate utilities above base flood elevation 3. Institute low impact development techniques on property	1. Locate business critical facilities or functions outside hazard area 2. Institute low impact development techniques on property	1. Locate or relocate critical facilities outside of hazard area 2. Acquire or relocate identified repetitive loss properties 3. Promote open space uses in identified high hazard areas via techniques such as: planned unit developments, easements, setbacks, greenways, sensitive area tracks. 4. Adopt land development criteria such as planned unit developments, density transfers, clustering 5. Institute low impact development techniques on property 6. Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff
Reduce Vulnerability		
1. Retrofit structures (elevate structures above base flood elevation) 2. Elevate items within house above base flood elevation 3. Build new homes above base flood elevation 4. Flood-proof existing structures	1. Build redundancy for critical functions or retrofit critical buildings 2. Provide flood-proofing measures when new critical infrastructure must be located in floodplains	1. Harden infrastructure, bridge replacement program 2. Provide redundancy for critical functions and infrastructure 3 Adopt appropriate regulatory standards, such as: increased freeboard standards, cumulative substantial improvement or damage, lower substantial damage threshold; compensatory storage, non-conversion deed restrictions. 4. Stormwater management regulations and master planning. 5. Adopt “no-adverse impact” floodplain management policies that strive to not increase the flood risk on downstream communities.

**TABLE C.
CATALOG OF MITIGATION ALTERNATIVES—FLOOD**

Personal Scale	Corporate Scale	Government Scale
Increase Preparation or Response Capability		
1. Buy flood insurance 2. Develop household mitigation plan, such as retrofit savings, communication capability with outside, 72-hour self-sufficiency during and after an event	1. Keep cash reserves for reconstruction 2. Support and implement hazard disclosure for the sale/re-sale of property in identified risk zones. 3. Solicit cost-sharing through partnerships with other stakeholders on projects with multiple benefits.	1. Produce better hazard maps 2. Provide technical information and guidance 3. Enact tools to help manage development in hazard areas (stronger controls, tax incentives, and information) 4. Incorporate retrofitting or replacement of critical system elements in capital improvement plan 5. Develop strategy to take advantage of post-disaster opportunities 6. Warehouse critical infrastructure components 7. Develop and adopt a continuity of operations plan 8. Consider participation in the Community Rating System 9. Maintain existing data and gather new data needed to define risks and vulnerability 10. Train emergency responders 11. Create a building and elevation inventory of structures in the floodplain 12. Develop and implement a public information strategy 13. Charge a hazard mitigation fee 14. Integrate floodplain management policies into other planning mechanisms within the planning area. 15. Consider the probable impacts of climate change on the risk associated with the flood hazard 16. Consider the residual risk associated with structural flood control in future land use decisions 17. Enforce National Flood Insurance Program 18. Adopt a Stormwater Management Master Plan

**TABLE C.
CATALOG OF MITIGATION ALTERNATIVES—LANDSLIDE**

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
1. Stabilize slope (dewater, armor toe) 2. Reduce weight on top of slope 3. Minimize vegetation removal and the addition of impervious surfaces.	1. Stabilize slope (dewater, armor toe) 2. Reduce weight on top of slope	1. Stabilize slope (dewater, armor toe) 2. Reduce weight on top of slope
Reduce Exposure		

• Locate structures outside of hazard area (off unstable land and away from slide-run out area)	• Locate structures outside of hazard area (off unstable land and away from slide-run out area)	1. Acquire properties in high-risk landslide areas. 2. Adopt land use policies that prohibit the placement of habitable structures in high-risk landslide areas.
Reduce Vulnerability		
• Retrofit home.	• Retrofit at-risk facilities.	1. Adopt higher regulatory standards for new development within unstable slope areas. 2. Armor/retrofit critical infrastructure against the impact of landslides.
Increase Preparation or Response Capability		
1. Institute warning system, and develop evacuation plan 2. Keep cash reserves for reconstruction 3. Educate yourself on risk reduction techniques for landslide hazards.	1. Institute warning system, and develop evacuation plan 2. Keep cash reserves for reconstruction 3. Develop a continuity of operations plan 4. Educate employees on the potential exposure to landslide hazards and emergency response protocol.	1. Produce better hazard maps 2. Provide technical information and guidance 3. Enact tools to help manage development in hazard areas: better land controls, tax incentives, information 4. Develop strategy to take advantage of post-disaster opportunities 5. Warehouse critical infrastructure components 6. Develop and adopt a continuity of operations plan 7. Educate the public on the landslide hazard and appropriate risk reduction alternatives.

TABLE C.
CATALOG OF MITIGATION ALTERNATIVES—SEVERE WEATHER

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
None	None	None
Reduce Exposure		
None	None	None
Reduce Vulnerability		
1. Insulate house 2. Provide redundant heat and power 3. Insulate structure 4. Plant appropriate trees near home and power lines (“Right tree, right place” National Arbor Day Foundation Program)	1. Relocate critical infrastructure (such as power lines) underground 2. Reinforce or relocate critical infrastructure such as power lines to meet performance expectations 3. Install tree wire	1. Harden infrastructure such as locating utilities underground 2. Trim trees back from power lines 3. Designate snow routes and strengthen critical road sections and bridges

Increase Preparation or Response Capability		
1. Trim or remove trees that could affect power lines 2. Promote 72-hour self-sufficiency 3. Obtain a NOAA weather radio. 4. Obtain an emergency generator.	1. Trim or remove trees that could affect power lines 2. Create redundancy 3. Equip facilities with a NOAA weather radio 4. Equip vital facilities with emergency power sources.	1. Support programs such as “Tree Watch” that proactively manage problem areas through use of selective removal of hazardous trees, tree replacement, etc. 2. Establish and enforce building codes that require all roofs to withstand snow loads 3. Increase communication alternatives 4. Modify land use and environmental regulations to support vegetation management activities that improve reliability in utility corridors. 5. Modify landscape and other ordinances to encourage appropriate planting near overhead power, cable, and phone lines 6. Provide NOAA weather radios to the public

TABLE C.
CATALOG OF MITIGATION ALTERNATIVES—TSUNAMI

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
• None	• None	• Build wave abatement structures (e.g. the “Jacks” looking structure designed by the Japanese)
Reduce Exposure		
• Locate outside of hazard area	• Locate structure or mission critical functions outside of hazard area whenever possible.	1. Locate structure or functions outside of hazard area whenever possible. 2. Harden infrastructure for tsunami impacts. 3. Relocate identified critical facilities located in tsunami high hazard areas.
Reduce Vulnerability		
• Apply personal property mitigation techniques to your home such as anchoring your foundation and foundation openings to allow flow though.	• Mitigate personal property for the impacts of tsunami	1. Adopt higher regulatory standards that will provide higher levels of protection to structures built in a tsunami inundation area. 2. Utilize tsunami mapping once available, to guide development away from high risk areas through land use planning.
Increase Preparation or Response Capability		

1. Develop and practice a household evacuation plan. 2. Support/participate in the Redwood Coast Tsunami Working Group. 3. Educate yourself on the risk exposure from the tsunami hazard and ways to minimize that risk.	1. Develop and practice a corporate evacuation plan. 2. Support/participate in the Redwood Coast Tsunami Working Group. 3. Educate employees on the risk exposure from the tsunami hazard and ways to minimize that risk.	1. Create a probabilistic tsunami map for the planning area. 2. Provide incentives to guide development away from hazard areas. 3. Develop a tsunami warning and response system. 4. Provide residents with tsunami inundation maps 5. Join NOAA's Tsunami Ready program 6. Develop and communicate evacuation routes 7. Enhance the public information program to include risk reduction options for the tsunami hazard

TABLE C.
CATALOG OF MITIGATION ALTERNATIVES—WILDFIRE

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
• Clear potential fuels on property such as dry overgrown underbrush and diseased trees	• Clear potential fuels on property such as dry underbrush and diseased trees	1. Clear potential fuels on property such as dry underbrush and diseased trees 2. Implement best management practices on public lands.
Reduce Exposure		
1. Create and maintain defensible space around structures 2. Locate outside of hazard area 3. Mow regularly	1. Create and maintain defensible space around structures and infrastructure 2. Locate outside of hazard area	1. Create and maintain defensible space around structures and infrastructure 2. Locate outside of hazard area 3. Enhance building code to include use of fire resistant materials in high hazard area.
Reduce Vulnerability		
1. Create and maintain defensible space around structures and provide water on site 2. Use fire-retardant building materials 3. Create defensible spaces around home	1. Create and maintain defensible space around structures and infrastructure and provide water on site 2. Use fire-retardant building materials 3. Use fire-resistant plantings in buffer areas of high wildfire threat.	1. Create and maintain defensible space around structures and infrastructure 2. Use fire-retardant building materials 3. Use fire-resistant plantings in buffer areas of high wildfire threat. 4. Consider higher regulatory standards (such as Class A roofing) 5. Establish biomass reclamation initiatives
Increase Preparation or Response Capability		

1. Employ techniques from the National Fire Protection Association's Firewise Communities program to safeguard home 2. Identify alternative water supplies for fire fighting 3. Install/replace roofing material with non-combustible roofing materials.	1. Support Firewise community initiatives. 2. Create /establish stored water supplies to be utilized for firefighting.	1. More public outreach and education efforts, including an active Firewise program 2. Possible weapons of mass destruction funds available to enhance fire capability in high-risk areas 3. Identify fire response and alternative evacuation routes 4. Seek alternative water supplies 5. Become a Firewise community 6. Use academia to study impacts/solutions to wildfire risk 7. Establish/maintain mutual aid agreements between fire service agencies. 8. Create/implement fire plans 9. Consider the probable impacts of climate change on the risk associated with the wildfire hazard in future land use decisions

APPENDIX D.
EXAMPLE PROGRESS REPORT

APPENDIX D.
EXAMPLE PROGRESS REPORT

Shoalwater Bay Indian Tribe
Hazard Mitigation Plan
Annual Progress Report

Reporting Period: *(Insert reporting period)*

Background: The Shoalwater Bay Indian Tribe developed a hazard mitigation plan to reduce risk from all hazards by identifying resources, information, and strategies for risk reduction. The federal Disaster Mitigation Act of 2000 requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. To prepare the plan, the Shoalwater Bay Indian Tribe organized resources, assessed risks from natural hazards, developed planning goals and objectives, reviewed mitigation alternatives, and developed an action plan to address probable impacts from natural hazards. By completing this process, the Shoalwater Bay Indian Tribe maintained compliance with the Disaster Mitigation Act, achieving eligibility for mitigation grant funding opportunities afforded under the Robert T. Stafford Act. The plan can be viewed on-line at:

INSERT LINK

Summary Overview of the Plan's Progress: The performance period for the Hazard Mitigation Plan became effective on ____, 2014, with the final approval of the plan by FEMA. The initial performance period for this plan will be 5 years, with an anticipated update to the plan to occur before ______, 2019. As of this reporting period, the performance period for this plan is considered to be __% complete. The Hazard Mitigation Plan has targeted __ hazard mitigation initiatives to be pursued during the 5-year performance period. As of the reporting period, the following overall progress can be reported:

- __ out of __ initiatives (__%) reported ongoing action toward completion.
- __ out of __ initiatives (__%) were reported as being complete.
- __ out of __ initiatives (___%) reported no action taken.

Purpose: The purpose of this report is to provide an annual update on the implementation of the action plan identified in the Shoalwater Bay Indian Tribe Hazard Mitigation Plan. The objective is to ensure that there is a continuing and responsive planning process that will keep the Hazard Mitigation Plan dynamic and responsive to the needs and capabilities of __[Client name]__. This report discusses the following:

- Natural hazard events that have occurred within the last year
- Changes in risk exposure within the planning area (all of the Shoalwater Bay Indian Tribe Reservation)
- Mitigation success stories
- Review of the action plan
- Changes in capabilities that could impact plan implementation
- Recommendations for changes/enhancement.

The Hazard Mitigation Planning Team: The Hazard Mitigation Planning Team, made up of stakeholders within the planning area, reviewed and approved this progress report at its annual meeting held on _____, 201_. It was determined through the plan's development process that a steering committee would remain in service to oversee maintenance of the plan. At a minimum, the Planning Team will provide technical review and oversight on the development of the annual progress report. It is anticipated that there will be turnover in the membership annually, which will be documented in the progress reports. For this reporting period, the Planning Team membership is as indicated in Table 1.

TABLE 1.
PLANNING TEAM MEMBERS

Name	Title	Jurisdiction/Agency

Natural Hazard Events within the Planning Area: During the reporting period, there were __ natural hazard events in the planning area that had a measurable impact on people or property. A summary of these events is as follows:

- ____________________________
- ____________________________

Changes in Risk Exposure in the Planning Area: *(Insert brief overview of any natural hazard event in the planning area that changed the probability of occurrence or ranking of risk for the hazards addressed in the hazard mitigation plan)*

Mitigation Success Stories: *(Insert brief overview of mitigation accomplishments during the reporting period)*

Review of the Action Plan: Table 2 reviews the action plan, reporting the status of each initiative. Reviewers of this report should refer to the Hazard Mitigation Plan for more detailed descriptions of each initiative and the prioritization process.

Address the following in the "status" column of the following table:

- *Was any element of the initiative carried out during the reporting period?*
- *If no action was completed, why?*
- *Is the timeline for implementation for the initiative still appropriate?*
- *If the initiative was completed, does it need to be changed or removed from the action plan?*

TABLE 2.
ACTION PLAN MATRIX

Action Taken? (Yes or No)	Time Line	Priority	Status	Status (X, O,✓)
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				
Initiative #__—______________________[description]				

Completion status legend:
✓= Project Completed
O = Action ongoing toward completion
X = No progress at this time

Changes That May Impact Implementation of the Plan: *(Insert brief overview of any significant changes in the planning area that would have a profound impact on the implementation of the plan.*

Specify any changes in technical, regulatory and financial capabilities identified during the plan's development)

Recommendations for Changes or Enhancements: Based on the review of this report by the Hazard Mitigation Plan Steering Committee, the following recommendations will be noted for future updates or revisions to the plan:

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

Public review notice: *The contents of this report are considered to be public knowledge and have been prepared for total public disclosure. Copies of the report have been provided to the* Shoalwater Bay Indian *Tribe governing board and to local media outlets and the report is posted on the* Shoalwater Bay Indian *Tribe Hazard Mitigation Plan website. Any questions or comments regarding the contents of this report should be directed to:*

Insert Contact Info Here