Tillamook County Natural Hazard Mitigation Plan

Planning Document Created for the Tillamook County Planning Department
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Project Partners

Tillamook County
Oregon Department of Land Conservation and Development
Federal Emergency Management Agency
Oregon Department of Geologic and Mineral Industries
University of Oregon

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Section 1: Introduction

Purpose and Scope

"The most common planning pitfall is the development of lengthy, overly detailed plans that those responsible for their execution do not read. A plan that tries to cover every conceivable condition or that attempts to address every detail will only frustrate, constrain, and confuse those charged with its implementation. Successful plans are simple and flexible." – FEMA Comprehensive Preparedness Guide 101, version 2.0.

This document was developed to identify actions to prepare for and mitigate potential natural hazards within Tillamook County. Technical guidance was provided by the Oregon Department of Land Conservation and Development (DLCD). Data analysis and synthesis was completed by Tillamook County Planning Staff. GIS data was gathered from public sources and was analyzed using multiple methodologies.

Two committees were formed to inform the planning process: a steering committee consisting of elected officials, representatives from local jurisdictions, and citizen representatives from a variety of stakeholder groups was formed to prioritize the identified hazards and to adopt the plan; a technical advisory committee was formed to assist in the collection and analysis of data to inform the identification of hazards and hazard prone areas.

The primary goal of this project was to identify all natural hazards within the County, prioritize those hazards and risks, and identify what priority mitigation projects exist that address those hazards. This document is intended to provide accessible and accurate information regarding current baseline conditions within the County, a summary of how County partners are addressing hazards, and to provide a prioritized list of actions to maintain County infrastructure and reduce risk within the region. Secondary objectives include meeting the requirements of the FEMA Community Rating System (CRS); specifically, to prevent future development from increasing flood hazards to existing development.

Steering Committee			
Name	Stakeholder	Email	Phone
Mark Labhart	Tillamook County Commissioner		
Bryan Pohl	Tillamook County Community Development Director		
Liane Welch	Tillamook County Public Works Director		
Gordon McCraw	Tillamook County Emergency Management Director		
Michelle Bradley	Port of Tillamook Bay Director		
Barbara Trout	Tillamook People's Utility District Board Member		
Kurt Heckeroth	Tillamook County Planning Commission Chair		
…			
…			

Partners and Stakeholders

- Tillamook County
    - Department of Community Development
    - Emergency Management
    - Public Works
    - Parks and Recreation
    - Tillamook County Health Department
    - Sheriff
    - Paul Levesque
- Federal
    - FEMA
    - BLM
    - USFS
- State
    - DLCD
    - DOGAMI
    - ODF
    - SWCD
    - ODEQ
    - NRCS
    - ODFW
    - ODOT
- Local
    - Ports
        - Nehalem
            - Airport
            - Marine
        - Garibaldi
            - Marine
        - Tillamook
            - Rail
            - Airport
    - Utilities
        - Tillamook People's Utility District
        - Nehalem RTI
        - Drinking Water and Wastewater
            - Falcon Cove Water District

        - Neahkahnie Water District
        - Nehalem Water District
        - Rockaway Water (Water collected outside of City UGB, County Jurisdiction)
        - Kilchis Water District
        - Netarts-Oceanside Water District – Mike Slipsager
        - Pacific City-Woods Joint Water/Sanitary
    - Education
        - University of Oregon Partnership for Disaster Resilience – Josh Bruce and Michael Howard
        - Oregon State University Coastal Futures Project – Peter Ruggiero and Eva Lipiec
        - Tillamook Bay Community College – Connie Green
        - Tillamook School District
        - Neahkahnie School District
        - Nestucca Neskowin School District
    - Emergency Services
        - Fire
            - Nehalem Bay Fire and Rescue
            - Garibaldi Rural Fire Protection District
            - Nestucca Rural Fire Protection District
        - Police
        - TC4
        - Medical
            - Reinhart Clinic
            - Nehalem Urgent Care
            - Tillamook County General Hospital
            - Private Practices
                - Nourish Nehalem
                - Tillamook Medical Clinic (3rd street)
                - Dr. Thompson (Pacific City)
            - Stand-alone Pharmacy
                - Safeway
                - Fred Meyer
                - Tillamook Pharmacy (12th street)
                - Wheeler Pharmacy
    - North County Recreation District
- Citizen

- Pacific City-Woods Citizen Advisory Committee
- Netarts Citizen Advisory Committee
- Oceanside Citizen Advisory Committee
- Non-profits
    - TEP
    - TBWC
    - NNWC
    - LNWC
    - LNCT
    - Food Roots
    - CARE
    - Senior Center
    - Nehalem Bay Emergency Volunteer Corps
    - Jerry Jefferies/John Sandusky (St. Peters Joint Church Group 3 churches)
    - Habitat for Humanity

Communities

- Urban
    - Manzanita
    - Nehalem
    - Wheeler
    - Rockaway
    - Bay City
    - Garibaldi
    - Tillamook
- Unincorporated Community
    - Neahkahnie
    - Mohler
    - Idaville
    - Oceanside
    - Netarts
    - Hebo
    - Beaver

  - Cloverdale
  - Pacific City-Woods
  - Neskowin
- Rural
  - Nehalem River Valley
  - Miami-Foley
  - Twin-rocks
  - Barview-Watseco
  - Tillamook suburban areas
  - Kilchis River
  - Wilson River
  - Cape Meares
  - Sand Lake
  - Trask River
  - Tillamook River
  - Hemlock
  - Tierra Del Mar

Background information

Tillamook County is a coastal Oregon community encompassing 709,077 acres (over 1100 square miles) from the southern community of Neskowin to the northern community of Neahkahnie. The County is bordered by Clatsop County on the north; Washington, Yamhill, and Polk County on the east; Lincoln County on the south; and the Pacific Ocean on the west.

Precipitation in the form of rain ranges from most widely from west to east with annual rain averaging around 70 inches in the low elevation communities and 180 inches in the headwaters of the Wilson River. Rain can occur during all months of the year with the driest season being between July and September. Snow is most common above the 2000 foot elevation between November and March but snow occasionally occurs at sea level. Rain-on-snow events are not common but can occur in a spring following a cold winter. Average monthly temperatures range between 40 and 70 degrees Fahrenheit with summer highs in the upper 90's (F) and lows in the teens (F). Extreme temperatures rarely exceed these limits.

Geology of the region is diverse with the headwaters of most streams dominated by granite based rocks. The Tillamook River and the Nestucca River have large portions of more erosion prone geology. Elevations range from sea level to 3700 feet. Many hill slopes are prone to mass wasting, landslides, and debris torrents. Tillamook County lies within the Cascadia Subduction Zone and regional geography is largely dominated by the presence of the North American crustal plate colliding with the Juan de Fuca plate. The geology of the County is dominated by two primary classes: tertiary sedimentary/volcanic bedrock are common on the hillslopes and quaternary sediments composed of beach and dune sand, fluvial and estuarine mid, clay, silt, sand, and gravel, and landslide debris dominate the bays and river valleys.[1]

Soils are largely well drained or excessively drained except for in the lower elevation valley or the Tillamook River where poorly drained soils dominate. Soil k-factor along the lower elevation river valleys (within a range from 0 to .69 with

[1] Wang et. al. Seismic Hazard and Risk Assessments in Tillamook County, Oregon April 2001

higher values being more erosive) averages around .37. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water.

> "Tillamook soils are very unique, with high phosphate and nitrate retention capability. Much of the upper Tillamook watersheds have Andisol soils, a very rare and young soil type. It is expected that this is what gives some of the terrace and floodplain agricultural soils their unique characteristics. These soils are naturally high in Phosphorus (P), and will bind up much of added P, thus making it unavailable for plant growth. Andisols and Andisol type soils also have anion exchange capacity (i.e. they will adsorb negatively charged ions such as nitrate (NO3-). Thus, Tillamook soils are much more likely to take up nitrate, reducing the likelihood of nitrate leaching (C. Jasper, Soil Scientist, USDA NRCS, Tillamook, Oregon, pers. comm.)."[2]

Native vegetation is predominantly coniferous forest with Douglas fir, western hemlock, western red cedar, shore-pine, and Sitka spruce being most common. Deciduous trees are found primarily on unstable slopes and riparian areas and include red alder, Oregon maple, vine maple, and cascara. Native understory communities are comprised mostly of ferns and huckleberries. Refer to the Vegetation Table in Appendix XXX for a complete list of native plants found within the County.

Streams and wetlands: Streams are predominantly dendritic in nature with most streams and rivers draining to one of five estuaries: Nehalem Bay, Tillamook Bay, Netarts Bay, Sandlake, or the Nestucca estuary. There are several fresh water lakes as well as ocean draining streams. Please refer to the Waterways Table in Appendix XXX for a list of rivers and streams within the County. The Tillamook County Comprehensive Management Plan has identified several wetlands that are Goal 5 Inventoried Wetlands.

Demographics: The permanent full-time resident population of Tillamook County has remained relatively stable for the past 30 years. 1990 Census Bureau data estimated the population to be just under 22,000 people, the 2013 estimates put the County population at just over 25,000. The largest change in demographics has come from an increase in the population of people older than 65. In 2013 more than 20% of the population was older than 65. Compared to Clatsop and Washington County's, Tillamook County has a higher proportion of senior residents.[3]

Critical Infrastructure

2004 Transportation System Plan Summary

A transportation system plan (TSP) was developed in 2004 to serve as a 20 year plan for the County and is based on guidance from the Oregon Department of Transportation (ODOT) TSP 2001 guidelines. Key elements of the Tillamook TSP included the reduction of reliance on the automobile, to provide transportation for all people, to minimize conflicts between modes, to promote intermodal linkages for passengers and goods, to minimize impacts to the natural and built environment, and to make decisions about the community intentions and expectations for the future of its transportation system.

Several projects where access management components needed to be addressed included Blimp Boulevard, McCormick Loop, and Resort Drive. Potential access management measures near intersections and on state facilities also are

[2] North Coast Basin TMDL Appendix D Agricultural Water Quality Management Plan, Page 13

[3] http://www.census.gov/censusexplorer/censusexplorer-popest.html

identified in the TSP. The TSP indicated that roadway design standards were generated and should be incorporated into future maintenance projects. These improvements included increasing bicycle lanes and improving signage for pedestrian safety.

Public Transportation System Goals

- Expand service to Portland on Sundays
- Provide a park and ride at the TCTD headquarters, improve connects with other transit service providers
- Expand service to Oceanside, Pacific City, from Tillamook to the Port
- Provide pull-outs on state and county facilities
- Enlarge transit shelters
- Provide additional services in downtown Tillamook
- Advertise and promote services
- Construct a maintenance building
- Develop cohesive transit signage.

Major Roads: There are no state highways classified as expressways in Tillamook County, although Highway 18 (Valley Junction to U.S. 101) has been identified by ODOT as a potential future expressway. The TSP identified several roads that were designated as and ODOT lifeline route and several routes that should be designated as priority 1 lifeline routes (essential for emergency responses in the first 72 hours after an incident). Functional classifications of Tillamook County roads are *arterial roadways* (carries higher traffic volumes, 1000+ average daily traffic, and allow higher travel speeds while providing limited access to adjacent properties, 80 foot right of way width), *collector roadways* (collect traffic from local streets and provide connections to arterial roadways, 300-1000 average daily traffic, 60 foot right of way width), and *local roadways* (provide access to local traffic and route users to collector roadways, less than 300 average daily traffic, 50 foot right of way width).

Freight System

- The TSP identified the need and desire to minimize the impacts of local and through freight truck traffic and large recreational vehicles in the City of Tillamook downtown commercial area and in residential neighborhoods in the city. Potential solutions included improving the movement of trucks and large vehicles through the City of Tillamook, improve access to the Tillamook Lumber Company Mill, and to develop a detailed large vehicle alternate route study.
- ODOT has undertaken a reconfiguration of the Highway 101 and Highway 6 intersection to address the downtown Tillamook traffic concerns.

Rail Port

- Identify and prioritize improvements on railroad bridges throughout the county to ensure the system is able to function throughout the 20 year design horizon
- Expand tourist rail services
- Improve the railroad crossing at Latimer Road to accommodate increased truck traffic
- Upgrade the rubber crossing material at Highway 101 crossing near Hobsonville Point Road
- Improve pedestrian safety at Highway 101 near Three Graces
- Upgrade the railroad crossing to Blimp Boulevard

- Increase capacity and access to quarries and wood chips

Air Port

- Improve the entrance from Highway 101 to Tillamook Airport
- Evaluate existing land use constraints at the Pacific City Airport

Water Port

- Garibaldi boat basin – Water freight traffic at the Garibaldi port was inactive at the time the TSP was written, the reduction in freight traffic was attributed to changes in channel depth
- The need for additional boat launches on Resort Drive was identified
- The TSP and the Tillamook County Comprehensive Plan identified the need for Nehalem to establish a natural channel maintenance program for navigation, obtain COE authorization of a navigation channel in Nehalem Bay, and maintain the channel maker system.

Major roads and their classifications

- U.S. Highway 26: TSP potential lifeline route
- U.S. Highway 101: ODOT Designated Lifeline Route – Priority 1
- Oregon Highway 6: ODOT Designated Lifeline Route – Priority 1
- Oregon Highway 53: ODOT Designated Lifeline Route – Priority 1
- Oregon Highway 22: ODOT Designated Lifeline Route – Priority 1
- Oregon Highway 18: ODOT Designated Lifeline Route – Priority 1
- Little Nestucca Highway 130
- Netarts Highway 131: ODOT Designated Lifeline Route – Priority 1
- North Fork Road: ODOT Designated Lifeline Route – Priority 1
- Miami Foley Road: ODOT Designated Lifeline Route – Priority 1
- Latimer Road: ODOT Designated Lifeline Route – Priority 1
- Alderbrook Loop: ODOT Designated Lifeline Route – Priority 1
- Wilson River Loop: ODOT Designated Lifeline Route – Priority 1
- Bayocean Road/Cape Meares Loop
- Sand Lake Road
- Resort Drive: ODOT Designated Lifeline Route – Priority 1
- Beaver-Blain Road

Major Bridges		
Bridge	**Rating**	**Repair Schedule**
Highway 101 at Shortsands/Necarney		
Highway 101 at Nehalem		
Highway 53 at Nehalem		
Miami Foley at Nehalem		
Highway 101 at Miami		
Highway 101 north of Bay City		

Highway 101 at Kilchis		
Highway 101 at Wilson		
Highway 101 at Trask		
Long Prairie Road at Trask		
Highway 6 at Wilson		
Wilson River Loop on Wilson		
Highway 101 at Tillamook		
Highway 131/101 at Tillamook		
Highway 101 at Nestucca		
Highway 101 at Hebo		
Blain Road at Nestucca (multiple)		
…		
…		
…		

Watershed Name (6th Field 12 Digit HUC)	Acres	Total Stream Length	Road Acres	Road Miles
171002031000-Pacific Ocean	111418	1.97	0.55	0.15
Anderson Creek-Nehalem River	10147	166.73	188.43	51.09
Arch Cape Creek-Frontal Pacific Ocean	21478	61.85	228.64	59.92
Beaver Creek	18673	217.33	351.18	95.49
Cook Creek	18859	369.87	311.97	84.95
Cronin Creek-Nehalem River	23021	18.59	80.50	22.04
Devils Lake Fork	17001	125.03	0.07	0.02
Devils Lake-Frontal Pacific Ocean	10717	0.05	245.99	67.00
East Fork South Fork Trask River	18619	173.49	315.88	85.83
Elk Creek-Nestucca River	11705	114.75	304.72	82.54
Farmer Creek-Nestucca River	18095	206.81	264.95	71.74
Foley Creek	10884	179.57	294.23	79.43
Headwaters Nestucca River	12597	43.89	79.56	21.72
Headwaters Tualatin River	15210	0.04	0.28	0.08
Jordan Creek	16179	173.15	260.56	71.14
Little North Fork Wilson River	12607	168.80	164.71	44.97
Little South Fork Kilchis River	24425	411.24	405.08	109.98
Lost Creek-Nehalem River	16662	302.16	209.16	57.02
Lousignont Creek-Nehalem River	18348	14.18	48.72	13.36
Lower Little Nestucca River	14524	119.88	286.37	77.69
Lower Miami River	11986	135.19	334.60	90.65
Lower North Fork Nehalem River	24968	218.65	253.28	68.65
Lower Salmon River	18100	33.92	56.24	15.28
Lower Salmonberry River	15008	45.61	213.27	58.18

Lower Tillamook River	17240	227.55	412.60	111.03
Lower Trask River	14018	89.38	483.27	127.53
Lower Wilson River	16945	182.28	347.84	93.73
Middle Fork of North Fork of Trask River	27625	67.72	168.67	46.03
Middle Little Nestucca River	10386	90.80	251.81	68.15
Middle North Fork Nehalem River	17356	59.99	77.58	21.12
Middle Wilson River	13506	183.96	246.27	66.91
Moon Creek	12486	138.08	291.99	78.95
Nehalem Bay	13503	172.58	424.19	112.30
Neskowin Creek-Frontal Pacific Ocean	16324	187.88	298.23	80.68
Nestucca Bay-Frontal Pacific Ocean	17547	168.57	394.14	105.71
Netarts Bay-Frontal Pacific Ocean	16349	224.30	374.08	99.87
Niagara Creek-Nestucca River	14942	100.55	207.54	56.05
North Fork Kilchis River	16851	267.16	203.95	55.67
North Fork of Trask River	23589	243.70	357.04	97.39
North Fork Salmonberry River	14749	30.83	164.76	45.07
North Fork Wilson River	17269	254.57	323.77	88.18
Powder Creek-Nestucca River	18093	191.24	237.37	64.15
Sain Creek-Scoggins Creek	28536	3.54	12.26	3.32
Sand Creek-Frontal Pacific Ocean	15943	215.14	266.26	71.93
Smuggler Cove-Pacific Ocean	114639	2.71	249.64	67.82
South Fork Trask River	14899	151.15	153.72	41.81
South Fork Wilson River	10217	106.02	282.22	73.64
Spring Creek-Frontal Pacific Ocean	5368	80.05	353.97	95.90
Testament Creek-Nestucca River	16382	146.02	216.09	58.27
Three Rivers	24299	172.46	445.38	116.98
Tillamook Bay-Frontal Pacific Ocean	21270	198.77	4.08	1.11
Upper Gales Creek	21226	0.50	177.86	48.13
Upper Little Nestucca River	14514	62.62	169.33	46.13
Upper Miami River	11067	120.33	6.24	1.71
Upper North Fork Nehalem River	19900	12.36	42.79	11.67
Upper Rock Creek	13904	6.14	64.06	17.49
Upper Salmon River	20396	33.50	124.59	34.06
Upper Salmonberry River	15827	27.65	463.12	125.65
Upper Tillamook River	22123	261.85	186.15	50.58
Upper Trask River	12831	145.81	114.79	31.19
Upper Willamina Creek	25113	68.21	303.63	82.39
Upper Wilson River	19332	262.33	48.81	13.34
Whale Cove-Pacific Ocean	75432	0.04	0	
Wolf Creek	10783	10.59	0	

Watershed Name	Crossings
Anderson Creek-Nehalem River	283

Arch Cape Creek-Frontal Pacific Ocean	101
Beaver Creek	379
Cook Creek	665
Cronin Creek-Nehalem River	11
Devils Lake Fork	189
East Fork South Fork Trask River	197
Elk Creek-Nestucca River	204
Farmer Creek-Nestucca River	227
Foley Creek	390
Headwaters Nestucca River	56
Jordan Creek	248
Little North Fork Wilson River	124
Little South Fork Kilchis River-Kilchis River	574
Lost Creek-Nehalem River	386
Lousignont Creek-Nehalem River	4
Lower Little Nestucca River	179
Lower Miami River	248
Lower North Fork Nehalem River	334
Lower Salmon River	32
Lower Salmonberry River	38
Lower Tillamook River	325
Lower Trask River	142
Lower Wilson River	269
Middle Fork of North Fork of Trask River	140
Middle Little Nestucca River	105
Middle North Fork Nehalem River	100
Middle Wilson River	289
Moon Creek	211
Nehalem Bay	405
Neskowin Creek-Frontal Pacific Ocean	304
Nestucca Bay-Frontal Pacific Ocean	280
Netarts Bay-Frontal Pacific Ocean	475
Niagara Creek-Nestucca River	158
North Fork Kilchis River	334
North Fork of Trask River	277
North Fork Salmonberry River	13
North Fork Wilson River	427
Powder Creek-Nestucca River	200
Sain Creek-Scoggins Creek	12
Sand Creek-Frontal Pacific Ocean	341
South Fork Trask River	190
South Fork Wilson River	142
Spring Creek-Frontal Pacific Ocean	229

Testament Creek-Nestucca River	270
Three Rivers	244
Tillamook Bay-Frontal Pacific Ocean	634
Upper Little Nestucca River	82
Upper Miami River	173
Upper North Fork Nehalem River	2
Upper Rock Creek	4
Upper Salmon River	45
Upper Salmonberry River	12
Upper Tillamook River	342
Upper Trask River	148
Upper Willamina Creek	129
Upper Wilson River	325
Wolf Creek	7

Farming Infrastructure

- Tillamook County Creamery Association
- Food Roots
- Lower Nehalem Farm Trust
- Tillamook County Farm Store
- Alder Creek Farm
- OSU Extension Demonstration Garden

Major Flood Control Infrastructure

- Jetty
    - Nehalem Bay
    - Tillamook Bay
    - Nestucca BaY
- Major Dikes and Drainage Districts

Active Drainage Districts

Big Nestucca Drainage District

Main ditches are maintained by the district, lateral ditches managed by farmers, problem site is where Clear Creek enters drainage and deposits 100 cy of sediments.
mstrent@embarqmail.com
Mike and Shelly Trent
(503)801-1456
(503)801-1446
3600 Jenck Rd.
Cloverdale, OR 97112

Little Nestucca Drainage District and Northside Big Nestucca Drainage District

Rob Seymour
(503)392-4185
7580 Redberg Rd.
Cloverdale, OR 97112

South Prairie Drainage District

Tim Jenck
(503)815-3744
3555 Gienger Rd.
Tillamook, OR 97141

Stillwell Diking and Drainage District – Drains ~431 acres, ACOE inspects annually, use levee money every year on maintenance. Not too many problem spots.
Joe Jenck
(503)842-6955
745 3rd. Street W.
Tillamook, OR 97141
lonnie@oregoncoast.com

Sunset Drainage Diking District - Has a problem with Beaver, maintains 3-5 years, Nehalem Waste Water maintains it.
Jack Thayer
(503)368-6908
17855 Tideland Rd.
Nehalem, OR 97131

Tillamook Bay Habitat & Estuary Improvement District
Tilda Jones
(503)815-8164
PO Box 700
Tillamook, OR 97141
tbheid@tillamookoffice.com

Water, Sanitation, and Drainage Districts
Water Districts

District Name	Contact	Phone	Address	Water Source	Needs
Beaver Water District	Lisa	(503)392-4886 503-812-2478	PO Box 306 Cloverdale, OR 97112		
Cloverdale Water District	Faith Melendy	(503)392-3515 Cloverdalewater @earthlink.net	PO Box 166 Cloverdale, OR 97112	Ground Spring	
Fairview Water District	David Pace	(503)842-4333 fwd @oregoncoast.com	403 Marolf Dr Tillamook, OR 97141	Ground 2 wells	
Falcon-Cove Beach Water District	Charles Dice	(503)436-0146	79387 Ray Brown Rd. Arch Cape, OR 97102	Ground	
Hebo Joint Water & Sanitary Authority	Willard Anderson	(503)392-6100 co4capt @oregoncoast.com	PO Box 328 Hebo, OR 97122		
Hunt Water District	Carol M. Leuthold	(503) 801 0961 leutholddairy @oregoncoast.com	2425 McCormick Lp Tillamook, OR 97141		
Kilchis Water District	Beverly Prince	(503)842-6444	6105 Hathaway Rd Tillamook, OR 97141	Ground	
Long Prairie Water District	Janell Werner	(503)842-2158	PO Box 331Tillamook, OR 97141	Purchases from City of Tillamook	
Neahkahnie Water District	Richard Felley	(503)368-7309 Nwdmanager @nehalemtel.net	9155 Nehalem Rd Nehalem, OR 97131		
Neskowin Regional Water District	Guy Holsworth	(503)392-3966 guy_nrwd @embarqmail.com	PO Box 823 Neskowin, OR 97149	Surface	Increased riparian setbacks

					and sediment control
Netarts Water District	Mike Slipsaegar	(503)842-9405	PO Box 50 Netarts, OR 97143	Surface and ground	
Northwoods Water District	Norman Brennan	(503)842-6882	7645 Sollie Smith Rd Tillamook, OR 97141		
Oceanside Water District	Dell Tuckey Tami Walker	(503)842-6462 nosd-tami @embarqmail.com	1755 Cape Meares Loop Rd. W Tillamook, OR 97141	Surface	Increased sediment control measures from Quarry
Pacific City Joint Water Sanitary District	Tony Owen	(503)965-6636 towen@pcjwsa.com	PO Box 520 Pacific City, OR 97135	Ground and surface	
Tone Water District	Judith Robitsch	(503)842-2167	1455 Tone Road Tillamook, OR 97141		
Wilson River Water District	Teri Weber	(503)842-1976	4940 Sollie Smith Road N. Tillamook, OR 97141	Ground	

Neskowin Regional Water District – Hawk Creek (mostly Hancock). They would like to see further setbacks from the stream to improve water quality. $250,000, current bond $100,000 to replace plant ($470,000 annual budget) treated using micro membrane. Largest proportion cost to treat is sediments. Testing concluded that pesticides and herbicides don't make it to the filters (TEP did coast wide study and they didn't find anything either). They are looking to purchase the watershed for conservation.

Netarts Water District – Fall Creek, two springs, one of which is dammed. There is a 50 gallon back up tank to avoid turbidity and they can switch to groundwater. They pay $12k to treat, sediment is not large cost. Stimson maintains 100' setback and is 'a very good landowner'.

Oceanside Water District – Quarry, Stimson owns forest land, quarry started illegal dewatering into wetlands. Sediment costs exceed all other costs nearly $500,000.

Pacific City – Membranes need to be cleaned annually, $50k Horn Creek, not likely that upstream treatment will reduce treatment costs.

Nehalem Water

Manzanita Water

Wheeler Water – Wellheads up Foss Road, 53/101, treated in Manzanita, pumped up hill to tanks – Groundwater.

Tillamook Water -

Rockaway Water

Garibaldi Public Works
503-322-0217

Sanitary Districts
Cloverdale Sanitary District
Heidi Reid
(503)392-3117
PO Box 157
Cloverdale, OR 97112
cloverdalesd@embarqmail.com

Nehalem Bay Waste Water Agency
Bruce Halverson
(503)368-5125
PO Box 219
Nehalem, OR 97131

Neskowin Regional Sanitary Authority
Annis Leslie
(503)392-3404
PO Box 383
Neskowin, OR 97149
nrsa@oregoncoast.com

Netarts-Oceanside Sanitary District
Tami Walker
(503)842-8231
1755 Cape Meares Loop Rd. W
Tillamook, OR 97141
nosd-tami@embarqmail.com

Twin Rocks Sanitary District
Cyndy Arvin
(503)355-2732
PO Box 69
Rockaway Beach, OR 97136
cyndy@twinrocks.us

Solid Waste Facilities

- Pacific City Joint
- Hebo Joint
- Wheeler
- Garibaldi
- Rockaway
- Bay City
- Tillamook

Schools
Parks

Population

Section 2: Data Synthesis

Relevant Planning Documents

- 1996 Flood Hazard Mitigation Plan
- 2005 NHMP
- 2011 NHMP
- Tillamook County TSP
- Alternative Forest Management Plan
- Neskowin Coastal Adaptation Plan
- TMDL
- CCMP
- Watershed Plans (multiple)

1996 Flood Hazard Mitigation Plan

Primary Hazards Identified:

Floodwaters inundating buildings and landslides blocking roads and critical facilities were the primary hazards identified in the 1996 HMP. Landslides in the Kilchis, Wilson, and Trask river valleys were extensive as a result of the saturated soils prior to the storm and a rare rain-on-snow event from the 3 foot snow pack. Riparian roads were especially damaged from subsidence, slumping, and siltation. Some roads were buried in as much as 2 feet of mud. Bridges were jammed with logs and debris exacerbating and prolonging the impacts from flooding. The resources expended repairing the storm damage prevented the County from conducting regularly scheduled maintenance.

Regional hazards were also identified as follows:

North Tillamook County

- Prior to the flood the transportation network in the Nehalem area had suffered from repeated closures, isolating the towns of Nehalem, Manzanita, and Wheeler. A landslide at Neahkahnie north of Manzanita limited traffic on Highway 101 for 2 months between October and December of 1995. Landslides on Highway 101 at Fishers Point south of Wheeler closed the highway to two-way traffic for four months between November 1995 and March 1996.
- Siltation of the Nehalem River from the Highway 101 crossing to approximately 4000 feet downstream has resulted in an increase in water elevations at the City of Nehalem and regular nuisance flooding where there had previously been a 3.5’ + freeboard.
- A landslide broke the drinking water outlet line from the Reservoir to the City of Wheeler.
- Flooding up to five feet in depth in the downtown corridor of Nehalem caused significant losses to businesses.
- There was severe damage to the Sunset Drainage District levee system.
- The Nehalem Sewage Treatment Plant ponds and facility was flooded.
- The Falcon Cable TV facility was flooded.

Central Tillamook County

- Highway 6 was closed for 8 weeks, 19 events consisting of washouts, mudslides, and sunken grades destroyed the highway between milepost 29 and 38. The road repair took two months and cost $5.8 million dollars.
- Flood waters up to 58” reached businesses and left almost a foot of mud when they receded.

- The Safeway, which provided pharmacy services, was flooded and evacuated. This left residents without critical medications. A mobile pharmacy was provided through the Governor's office in response. The Safeway has since relocated to higher ground in the central area of downtown Tillamook.
- The Tillamook County Creamery had nearly a half million dollars in damage in lost production, overtime, and increased transportation costs due to road closures. Between 100,000 and 200,000 pounds of milk per day were lost due to decreased production from herd sickness and stress.

South Tillamook County

- Highway 22 traffic was detoured.
- The Tierra Del Mar Water System was out of operation for several days when a landslide damaged a reservoir.
- The Pacific City Sewer System was compromised when pumps and lift stations were subsided.
- Neskowin's sewage lagoon and water plant was damaged.

2005 Natural Hazard Mitigation Plan

- The purpose of the 2005 NHMP was to provide resources, information, and strategies for risk reduction while helping to guide and coordinated mitigation activities in the County.
- Flooding was a primary hazard identified in the 2005 NHMP. Other identified hazards included severe winter storms, earthquakes, tsunamis, windstorms, wildfires, landslides,
- 20 Oregonians lost their lives in the 1964 floods which caused over $157 million in damages.
- The 1996 floods caused a statewide loss of $400 million in damages as 26 major rivers rose to flood stage. 23,000 people were either evacuated or self-evacuated. 50 people were reported as injured and 1700 people lost their jobs. The Small Business Association loaned businesses over $40.5 million for recovery. The flooding was exacerbated by a larger than normal snowpack followed by 28 inches of rain in a 24 hour period. The railroad corridor along the Nehalem and Salmonberry rivers was especially damaged. There were 108 major wash-outs and over a mile of track was washed away, with 16 of the 30 miles of track sustaining damage.
- Landslides are often associated with flooding. The largest risk from landslides was identified as the disconnection of the transportation network.
- Ice storms occurred in the winter of 1978 and 1989. Prolonged freezing (sub-zero temperatures) and freezing rain caused power failures, tree fall, and road closures.
- Tillamook County and the Oregon coast are the most seismically active areas in Oregon. There have been more than 6000 recorded earthquakes in the state since 1841, most with a magnitude below 3.0. A Cascadia Subduction Zone Earthquake Model was developed for a magnitude 8.5 earthquake for the County. The model indicated that during an 8.5 Subduction Zone event there would be 151 injuries and 2 deaths. Economic loss for buildings was estimated at $275 million and estimated economic losses for highways was $43 million. Residential and Education buildings faced the highest risk and commercial buildings faced the lowest risk by percentage.
- A 1964 tsunami generated by an Alaskan earthquake in 1964 destroyed coastal bridges. There were 4 deaths in Oregon and $700 thousand in damages from this tsunami, largely from riverine flooding away from the coast.
- Windstorms in 1995 and 2002 damaged homes, utilities, businesses, and public facilities. Oregon received $2.8 million through the FEMA Public Assistance program to repair and restore damaged infrastructure. Windstorm events were recorded in 1951, 1962, 1967, 1972, 1981, and 1995. Gusts ranged from 60-120 miles per hour. Several people died during these storms and several hundred million dollars in damage occurred.
- The series of forest fires in the 1930's burned over a half million acres of forest with economic losses estimated at over a half billion dollars.
- Goals identified in the plan included:
    - Comprehensive public agency and local government participation in plan development
    - Protect life and property

- Calculate the amount of property in the floodplain as well as the type and value of structures on those properties to provide a working estimate for potential flood losses
- Identify the number and type of flood events with the potential to occur over time.

- Develop partnerships and implementation strategies
  - Provide Emergency Preparedness Meetings to discuss concerns
- Improve public awareness
  - Develop workshops and outreach materials with ONHW, Tillamook County Emergency Management, and Tillamook County Department of Community Development to incorporate communities in Tillamook County to assist in developing HMPs
  - Develop outreach programs to Tillamook County business organizations emphasizing the need to prepare for natural hazard events.
  - Develop adult and child public service announcements geared for the community to be used by local radio and cable stations
  - Coordinate with school programs and adult education on reducing risk and preventing loss from hazard through education
  - Conduct natural hazard awareness program outreach in schools and community centers
  - Include organizations and private businesses within the County that should be included in the development of the HMP
  - Educate private property owners of infrastructure limitations in an emergency
  - Encourage private property owners to upgrade private roadways to support weight of fire trucks and emergency vehicles and provide clearance for emergency vehicles
  - Develop a website to facilitate information sharing
- Improve emergency services
  - Encourage coordination of emergency transportation routes between the sheriff's office, emergency management, public works, cities, and ODOT
  - Teach residents to prepare for and respond effectively to an earthquake.
  - Retrofit an Emergency Operation Center within each community or neighborhood as needed to provide essential services for a self-sustaining community in the event that assistance is lengthy in arriving.
  - Develop an Emergency Response Plan consistent with IMS and NIMS technology to respond effectively to a disaster.
- Prepare the community for disaster response
- Develop a plan consistent with Statewide Planning, including Goal 7: Natural Hazards
  - Review the Hazard Mitigation Plan for opportunities to update the TCCMP

        - Consider how components of the HMP might be used in updating current and future capital improvement plans
    - Update the plan annually
    - Prioritize projects that can reduce risk if undertaken before a disaster occurs
        - Encourage seismic retrofitting to construction where effective
        - Train Community Emergency Response Teams within each city, neighborhood, local government, unincorporated community, public agency to handle
    - Create an emergency operations plan for the North, Central, and South regions of the County

2011 Natural Hazard Mitigation Plan

- The 2011 HMP identified flooding, winter storms, high wind, landslides, earthquakes, hazardous materials, tsunamis, wild fire, utility failure, El Nino/La Nina, dam and levee failures, resource shortage, biohazards, volcanic eruption, pest infestation, dust storm, civil disobedience, terrorism and war, and drought as potential hazards in the County. Other hazards identified but not evaluated include coastal erosion, wildland urban interface fire, and climate change.

Presidentially declared disasters for Tillamook County between 2006 and 2011		
Date	Disaster Type	Recovery Money Available
11/5/2006 - 11/8/2006	Severe Storms: Flooding and Mudslides	$5 million for DR 1683 & 1672
12/14/2006 - 12/15/2006	Severe Winter Storms: Flooding and Mudslide	
12/1/2007 – 12/17/2007	Severe Storms: Flooding, Landslides, and Mudslides	$56 million PA $6.5 IA DR 1733
12/13/2008 – 12/26/2008	Severe Winter Storm: Record Snow, Landslide, Mudslide	$10.9 million
1/13/2011 – 1/21/2011	Severe Winter Storm: Mudslide, Landslide, Debris Flow	$2.7 million

- Completed mitigation projects identified in the 2011 NHMP:
    - Lower Trask River drainage pump station and spillway improvements
    - Increased capacity for Tillamook County Department of Emergency Management
    - Flood and hazard maps for seismic, landslides, and coastal erosion provided by DOGAMI
    - Riparian improvement project completed by Tillamook Junior High School
    - Repair and replacement of broken tide-gates
    - Elevation of homes and businesses
    - Construction of (elevated islands for livestock refuge) on dairy farms
    - Drainage improvements, levee breaching and removal, and levee repair work in the Tillamook Bay basin
    - In 2011, the Tillamook High School worked with the City to remove garbage and invasive plants from Holden Creek to clear the creek bed for creek restoration
- Mitigation Goals:
    - Develop and implement mitigation initiatives to reduce hazards to life, businesses, property, and environmental systems.
        - Evaluate applicable city ordinances and capital improvement plans to ensure that they guide development that reduces potential for hazard
        - Promote insurance coverage to provide economic recovery after a disaster
        - Preserve environmental systems to serve natural hazard mitigation functions

        - Continuously develop and update natural hazard related data
    - Implement effective mitigation projects and activities
        - Evaluate mitigation projects and activities for benefit/cost analysis and cost effective analysis
        - Educate the public about hazard risks and mitigation project implementation
        - Consistently seek diverse funding and resource partnerships for mitigation project and activity implementation
    - Enhance Emergency Services and the capabilities of Local First Responders
        - Enhance community self-sustainability
        - Prepare first responders with training and equipment
        - Strengthen emergency operations through improvements to communication and coordination
        - Coordinate hazard mitigation with emergency operations plans and procedures
    - Improve regional coordination and communication
        - Participate in the Regional Hazard Mitigation Steering Committee
        - Maintain an active Emergency Preparedness Committee
        - Survey the community and develop response plans for each potential hazard

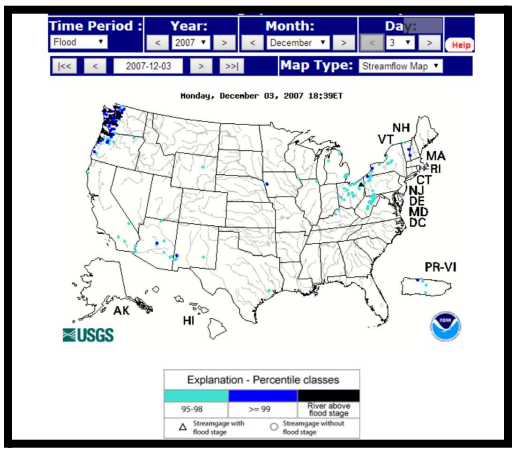
Section 3: Hazard Analysis

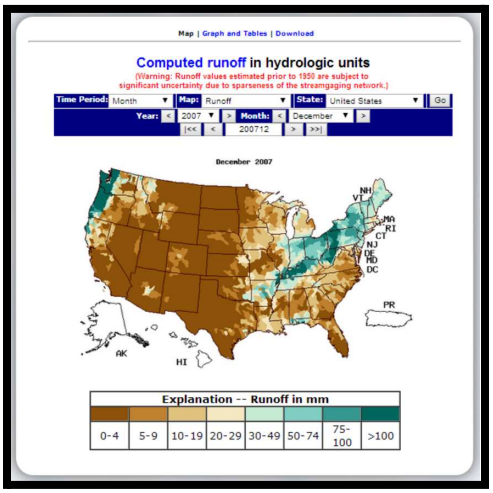
Riverine Flooding

Precipitation occurs predominantly between November and March, approximately 80% of annual precipitation falls within these months. The area receives roughly 8-12 feet of rain per year with most precipitation falls in the form of rain in December and January with the summer months experiencing little to no precipitation. Snow, sleet, and hail are rare for elevations below 2000' and, although annual snow is common for higher elevations, snow rarely accumulates and melts rapidly.

Riverine flooding is most common with early, wet autumns (rain that begins in September and persists through the winter) followed by intense rainstorms in December. When soils have been saturated for three weeks or more, a rain event of 1-2" in a 24 hour period will likely cause bank over-topping. Flooding will occur even when soils are not saturated when more intense rainfall events take place. Rainfall events of up to 14" in a 24 hour period have been recorded in the upper Wilson River watershed, although these events are rare.

The region is characterized by steep headwaters (100% slopes are common for most of the County) with most of the population concentrated in the wide, flat river valleys that make up the lower watershed. As a result of this characteristic, flooding occurs rapidly and rarely lasts for more than 2 days.[4]





Stream Gage Data for 8/20/2014

Gage ID	Site Name	Height	CFS
14301000	NEHALEM RIVER NEAR FOSS, OR	2.08	129
14301500	WILSON RIVER NEAR TILLAMOOK, OR	3.14	71
14302480	TRASK RIVER ABOVE CEDAR CREEK	6.47	79
14303200	TUCCA CREEK NEAR BLAINE, OR.	10.63	1.3
14303600	NESTUCCA RIVER NEAR BEAVER, OR	3.56	74

Nehalem - Flow at Foss Road

[4] Tillamook County 1996 Flood Hazard Mitigation Plan

- Maximum flows for 12/03/2007 peaked at 52,300 CFS
- Average winter high flows (December 2010) vary between 10,000 and 20,000 CFS
- Average winter low flows (January 2014) vary between 1,000 and 1,500 CFS
- Average summer low flows (August 2014) are ~150 CFS

Miami

- Average flows between 100-1000 CFS

Kilchis

- Average flows between 300-3000 CFS

Wilson - Flow near Tillamook

- Maximum flows for 12/03/2007 peaked at 33,100 CFS
- Average winter high flows (December 2010) vary between 3,000 and 8,000 CFS
- Average winter low flows (January 2014) vary between 400 and 800 CFS
- Average summer low flows (August 2014) are ~100 CFS

Wilson River Crests (Flood Stage: 11 feet) 1970-1996	
Date	Level
December 9, 1970	14.90

Trask - Flow at Cedar Creek

- Maximum flows for 12/03/2007 peaked at 20,300 CFS
- Average winter high flow (December 2010) vary between 2,000 and 7,000 CFS
- Average winter low flows (January 2014) are ~500 CFS
- Average summer low flows (August 2014) are ~100 CFS

Tillamook

- Average flows between 100-1000 CFS

Nestucca - Flow at Beaver

- Average winter high flow (December 2010) vary between 2,000 and 6,000 CFS
- Average winter low flows (January 2014) are ~500 CFS
- Average summer low flows (August 2014) are ~100 CFS

Major Riverine Flood Events

River	Damage Cost Estimate	Date	Source
		1916	T.C 1996 Flood Hazard Mitigation Plan
		1921	T.C 1996 Flood Hazard Mitigation Plan
		1931	T.C 1996 Flood Hazard Mitigation Plan
		1933	T.C 1996 Flood Hazard Mitigation Plan
		1949	T.C 1996 Flood Hazard Mitigation Plan

		1964	T.C 1996 Flood Hazard Mitigation Plan
		1965	T.C 1996 Flood Hazard Mitigation Plan
		1972	T.C 1996 Flood Hazard Mitigation Plan
		1974	T.C 1996 Flood Hazard Mitigation Plan
		1975	T.C 1996 Flood Hazard Mitigation Plan
		1977	T.C 1996 Flood Hazard Mitigation Plan
		1980	T.C 1996 Flood Hazard Mitigation Plan
		1981	T.C 1996 Flood Hazard Mitigation Plan
		1982	T.C 1996 Flood Hazard Mitigation Plan
		1986	T.C 1996 Flood Hazard Mitigation Plan
		1987	T.C 1996 Flood Hazard Mitigation Plan
		1990	T.C 1996 Flood Hazard Mitigation Plan
		1996	T.C 1996 Flood Hazard Mitigation Plan
		1998	
		2002	
		2004	
		2007	
		2010	
		2011	

Stormwater Overflow

Rain-on-Snow Flooding

Tidal Flooding and Sea Level Rise

High Wind

Drought

Freezing

Heatwave

Erosion

- Coastal

- Riverine
- Hillslope

Landslide

- Large scale slumping
- Debris torrent
- Mudslides

Invasive and Noxious Weeds

Fire

Populated Areas

Economic Downturn

Water Quality

Nestucca River Watershed
Bacterial contamination is cited within the Nestucca Bay Watershed TMDL as coming from the following sources:

"The vast majority of the basin is covered by forestlands, which generally do not discharge high concentrations of bacteria. Concentrations could not be reduced below current levels. Of the other land uses only pasture is of sufficient area to have an effect on bacterial concentrations in the rivers. Reductions in concentrations from urban, residential, and commercial uses had no effect on instream concentrations in modeled scenarios." – Nestucca TMDL, page 61

Forest Land Use: The forest land use concentration was based on samples collected from forest runoff in the Nestucca bay basin. The flow weighted average runoff concentration for a forested site was 10 MPN/100 mL. The forest land use concentration was also adjusted in the model to approximate the average instream concentration of 10 MPN/100 mL measured at the upstream forested site.

Residential Land Use: No residential outfalls were identified in the Nestucca Bay basin. The runoff concentration of 1400 MPN/100 mL was based on samples collected from an urban storm water outfall at Cloverdale Bridge collected during the February 2000 storm event.

Urban Land Use: The runoff concentration of 1400 MPN/100 mL was based on samples collected from an urban storm water outfall at Cloverdale bridge collected during the February 2000 storm event.

Pasture Land Use: Pasture land use was assumed to include animal grazing. The runoff concentration was based on the range of values from samples collected from agricultural operations in the Nestucca Bay basin during the February 2000 storm event. Flow weighted averages from 3 outfalls ranged from 3400 MPN/100 mL to 14000 MPN/100 mL.

CAFOs: CAFO locations and number of adult animals were provided by Oregon Department of Agriculture. Bacteria contributions from CAFOs were assumed to include manure application on fields. Manure was assumed to be spread on 1/2 acre per adult animal (Dean Moburg, NRCS, personal communication). Runoff concentrations were based on the range of runoff concentrations recorded in the Nestucca Bay basin. Although CAFOs are prohibited from discharging to surface waters, many are currently a source of contaminated runoff.

Point Sources: E coli concentrations and flow from the waste water treatment plants were taken from Discharge Monitoring Reports covering (approximately) the period of January 1999 to July 2000.
Septic Systems: No sanitary survey information was available for the Nestucca Bay basin. According to the county sanitarian, the area around the town of Beaver is most likely to have failing septic systems due to the age of the systems (Wes Greenwood, personal communication). Using data from "DEQ Final Report Oregon On site Experimental Systems Program, December 1982", the flow and concentration of septic tank effluent was estimated. It was assumed that 100% of the effluent flowed overland. The resulting load is calculated by the following equation: (200 gallons/day)(3.7854 L/gallon)(1000ml/1 L)(20000 counts/100 ml) = 1.51 x 108 counts/day

Facility Name	Discharge Point	Permit Limits
Hebo Joint Water and Sewer Authority STP	Three Rivers at RM 0.75 To Nestucca River at RM	Monthly geometric mean of 126 /100 ml No sample exceeding 406 /100 ml
Cloverdale Sanitary District STP	Nestucca River at RM 7	Monthly geometric mean of 126 /100 ml No sample exceeding 406 /100 ml
Pacific City Joint Water and Sewer Authority STP	Nestucca River at RM 1	Monthly geometric mean of 126 /100 ml No sample exceeding 406 /100 ml

Table taken from the Nestucca TMDL

Nehalem Bay

The Nehalem Bay has a TMDL for fecal coliform as well as a Water Quality Management Plan for Agricultural Lands from 2000 and 2002. Additional sources include the Waste Water Treatment Plant which has a load allocation. "Some of the nonagricultural sources of water pollution include municipal sewage treatment plants, leaking on-site septic systems in rural areas, forest roads and legacy issues, and residential homes located too close to streams. Localized high populations of geese have the potential to overgraze isolated areas and serve as sources of fecal coliform contributions. Growing deer and elk populations, in addition to recovering beaver populations, challenge efforts at riparian restoration in both agricultural and nonagricultural areas." – North Coast Basin Agricultural Management Plan Appendix D of the North Coast Basin TMDL, Page 16

Temperature

- Sources of temperature loading are cited within the Tillamook Bay TMDL as coming from
- Sources of bacterial contamination are cited within the Nestucca Bay Watershed TMDL as coming from
- The mainstem Nehalem and North Fork Nehalem are both listed for spawning and rearing temperatures.

Sediment

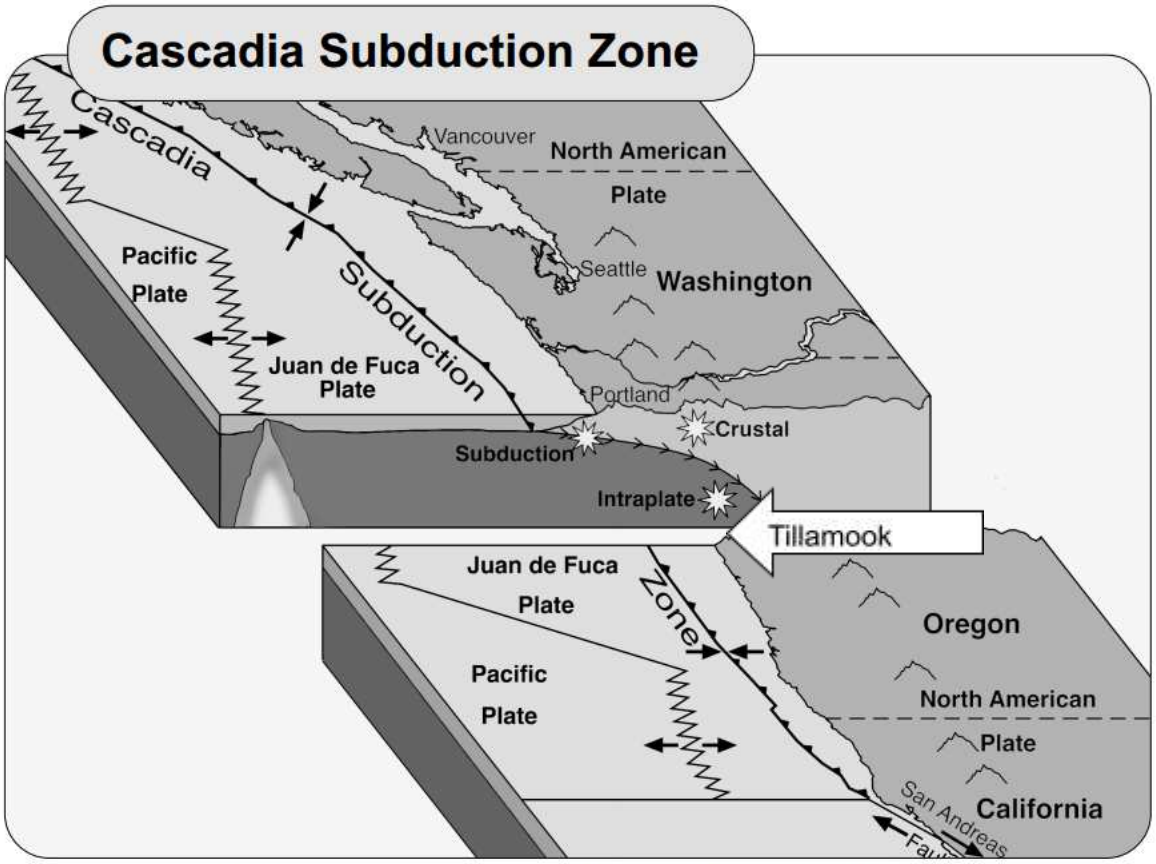
- Sources of sediment loading are cited within the Tillamook Bay TMDL as coming from:
    - Natural vs channelized runoff and industrial runoff falls under access road

- The EPA is developing BMP requirements to address sedimentation from forest roads as a result of appeal to Supreme Court to consider forest road exemption from the point-source program.

- Sources of sediment loading are cited within the Nestucca River TMDL as coming from, “Fine sediments in the watersheds are principally from non-point sources. Agricultural clearing and maintenance of riparian areas in the lower elevations of the watershed have resulted in unstable streambanks that fail and collapse into the river. Forestry operations that historically have developed roads and harvested on extreme slopes have resulted in an accelerated rate of mass failures throughout the upland forested areas of the Watershed. The practices that resulted in many of these failures have been revised with new laws.” Nestucca River TMDL, - Page 72.

Epidemic

Earthquake



Source: *Shoreland Solutions. Chronic Coastal Natural Hazards Model Overlay Zone. Salem, Ore.: Oregon Department of Land Conservation and Development (1998) Technical Guide-3.*

1**) PLANNING FOR NATURAL HAZARDS: Seismic TRG July 2000**

2001 Seismic Hazard and Risk Assessments in Tillamook County, Oregon[5] – Summary

The study utilized the HAZUS99 platform to identify earthquake hazards in Tillamook County. The seismic hazard plan rated earthquake hazard as high in Tillamook County as a result of the proximity to the Cascadia subduction zone. Other hazard risks include the potential for ground motion amplification, liquefaction, and earthquake-induced landslides. A model for a magnitude 8.5 Cascadia subduction scenario was developed for the County. The model predicted that an 8.5 earthquake would result in:

- Damage to 47% of all the buildings (~7,225) in the County
- Extensive or greater damage to 21% of all buildings (~2,488)
- $350 million in economic losses due to direct building damage and related effects
- 123 first aid injuries, 24 non-critical hospitalization injuries, 4 life-threatening injuries, and 3 deaths

The report noted that there were data limitations in the available building inventory data. Information on building composition of the nonresidential buildings in Tillamook County was limited and default building type information was used which effects the estimates of damage, building sizes in Tillamook County are smaller on average than what the model estimated, and some commercial and agricultural buildings were underrepresented while industry and warehouses were overrepresented.

Landslides

"Earthquake-induced landslides are secondary hazards that occur from ground shaking. These landslides can destroy roads, buildings, utilities and critical facilities necessary to recovery efforts after an earthquake. Many Oregon communities are built in environments with high potential for earthquake induced landslide hazards. The potential for these types of landslides is greatest in areas with steep slopes." The Seismic Hazard and Risk Assessment identified earthquake induced landslides as being a high risk within the County. The report classified risk by slope; areas with slopes between 0% and 18% were classed as low risk, areas with slopes greater than 18% and less than 47% were classed as moderate risk, and areas with slopes greater than 47% were classed as high risk. More than 90% of earthquake induced slope failures occurred on steep slopes.

[5] Wang et. al. Seismic Hazard and Risk Assessments in Tillamook County, Oregon April 2001

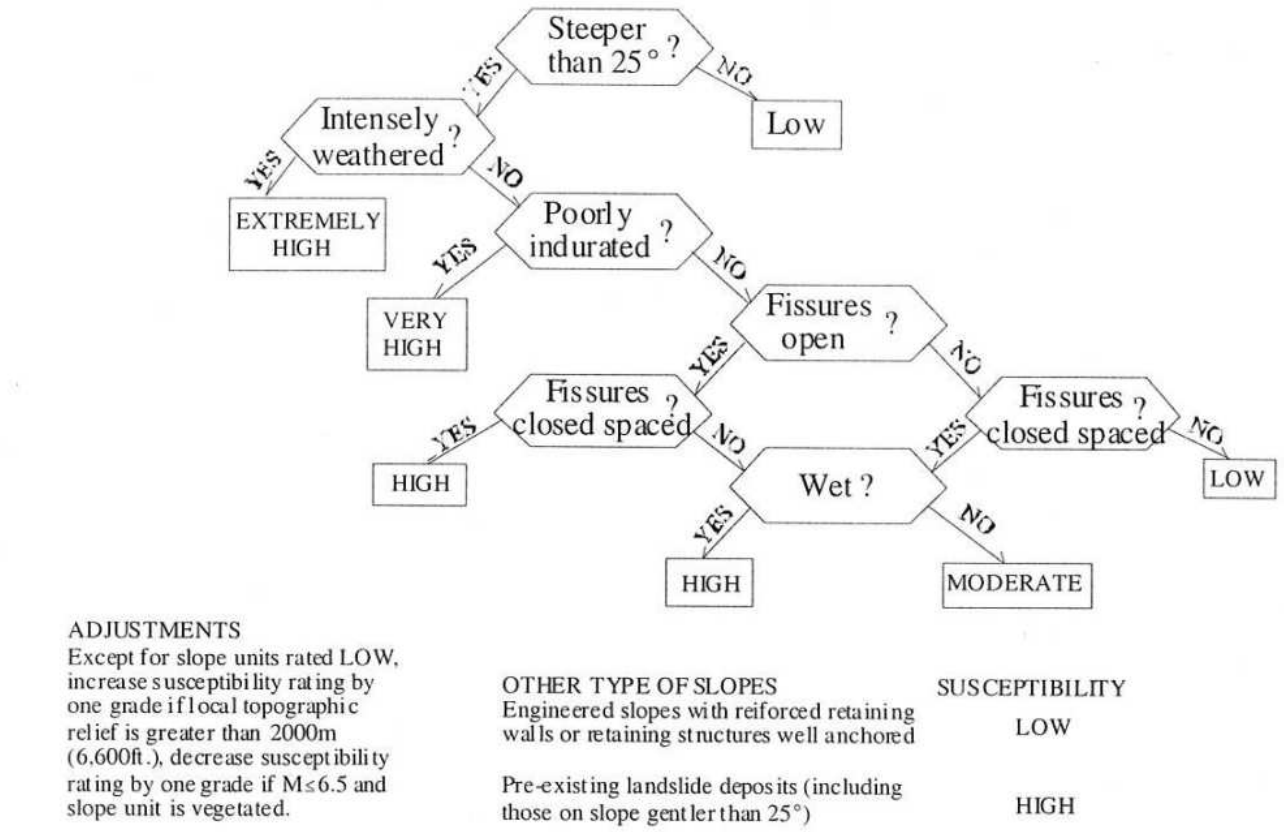


Figure 2 Wang et. al. Seismic Hazard and Risk Assessments in Tillamook County, Oregon April 2001

Liquefaction

"Liquefaction occurs when ground shaking causes granular soils to turn from a solid state into a liquid state. This causes soils to lose their strength and their ability to support weight. When the ground can no longer support buildings and structures, buildings and their occupants are at risk." There were three liquefaction hazard zones identified within the county; high, medium, and low risk zones. The County is largely within a low to moderate ground motion amplification hazard area except for the areas adjacent to the bay and river valleys which are high hazard areas.

Amplification

Amplification of ground shaking by a soft soil column – The 2000 Seismic TRG: Natural Hazard Resource Guide defines ground shaking amplification hazards as, "Soils and soft sedimentary rocks near the surface can modify ground shaking caused by an earthquake. This modification may be increased amplification or decreased strength of shaking and may change the frequency of the shaking. How much amplification occurs is determined by the thickness of the geologic materials and their physical properties. Ground motion amplification will exacerbate the risk for buildings and structures built on soft and unconsolidated soils. Information on the potential for ground motion amplification is critical for evaluating your community's seismic hazards."

Global Events

Next Steps:

- Collect landslide hazard data at drinking water reservoirs and access line points
- Verify historic landslide points
- Look at the hazards and determine which hazards are no longer relevant or which hazards need to be added
- Vulnerabilities identified: are these the right hazards? Are these the right goals? Based on the hazards, the findings, the goals, choose the priorities from these. Look at the mitigation actions, mark previous actions as either completed, in progress, not important, or needed actions based on goals and prioritize ie of 50 actions what are top 10.
- Highway 26 bottlenecks from the pass to the tunnel when traffic from Seaside to Portland is heavy. This might be exacerbated if a disaster occurred during a peak vacation period.
- Crosslink the ordinance with hazard type