HAZARDS

Since October 1956 Washington has had 47 Disaster Declarations and 65 Fire Management Assistance Declarations

HEAT WAVES

FLOODS

MUD FLOWS

WIND STORMS

VOLCANOES

WILDFIRES

EARTHQUAKES

WINTER STORMS

TORNADOS

TSUNAMIS

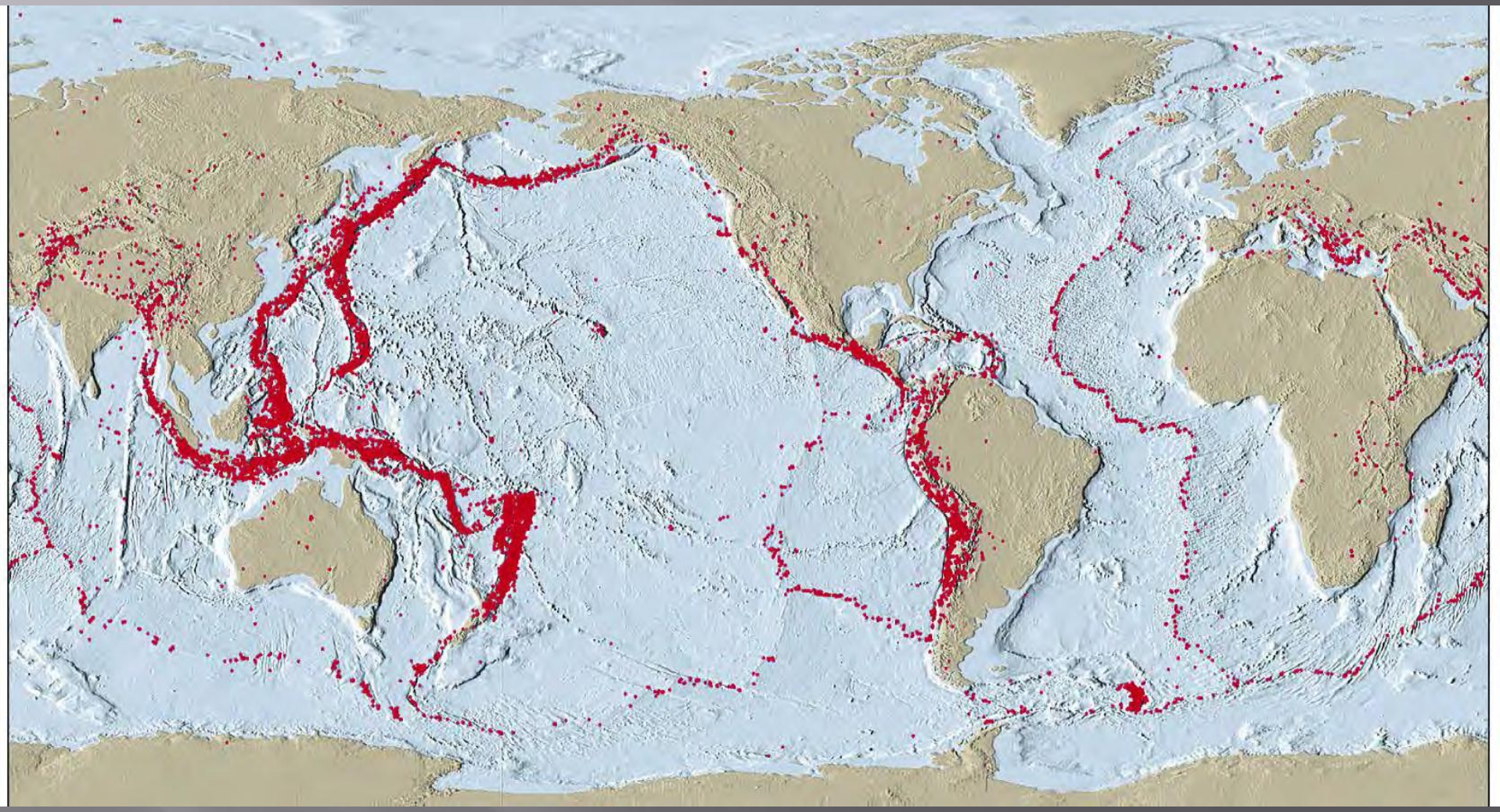
LANDSLIDES

SPACE WEATHER

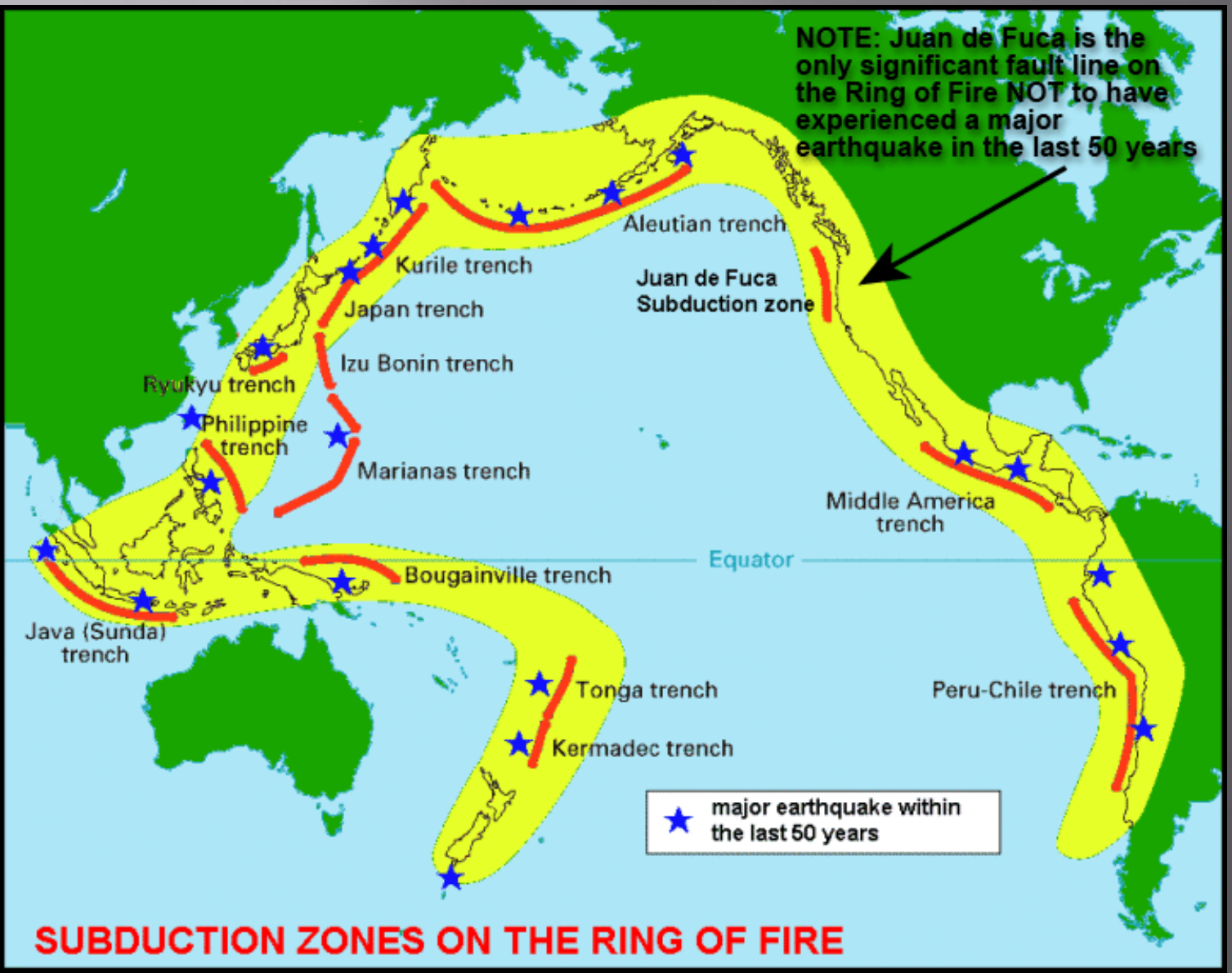
Thurston County has three types of Earthquakes:

1. Subduction Zone - Cascadia
2. Deep Plate/Benioff – Nisqually
3. Crustal - Olympia

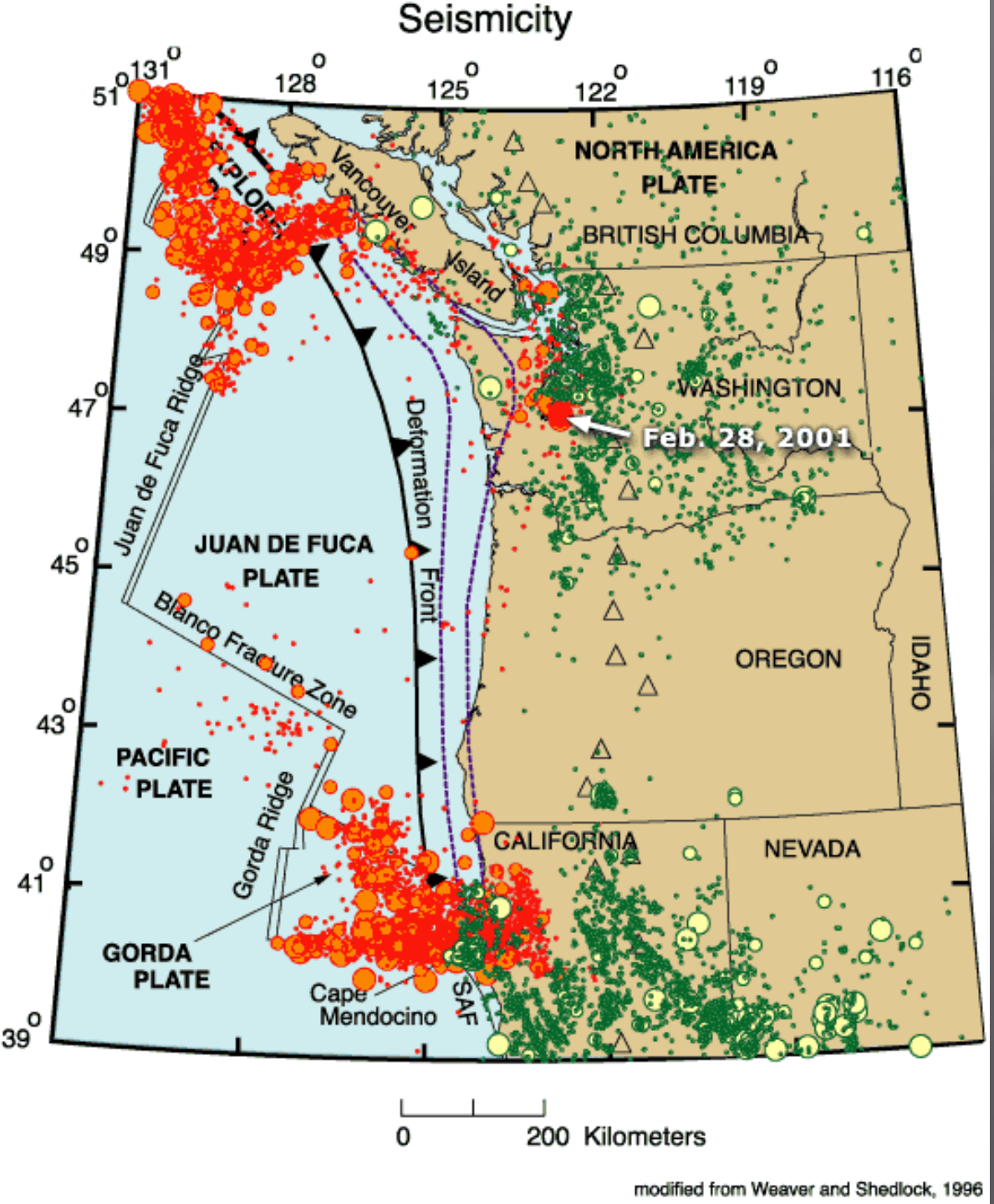
We keep hearing about Cascadia Earthquake



CASCADIA

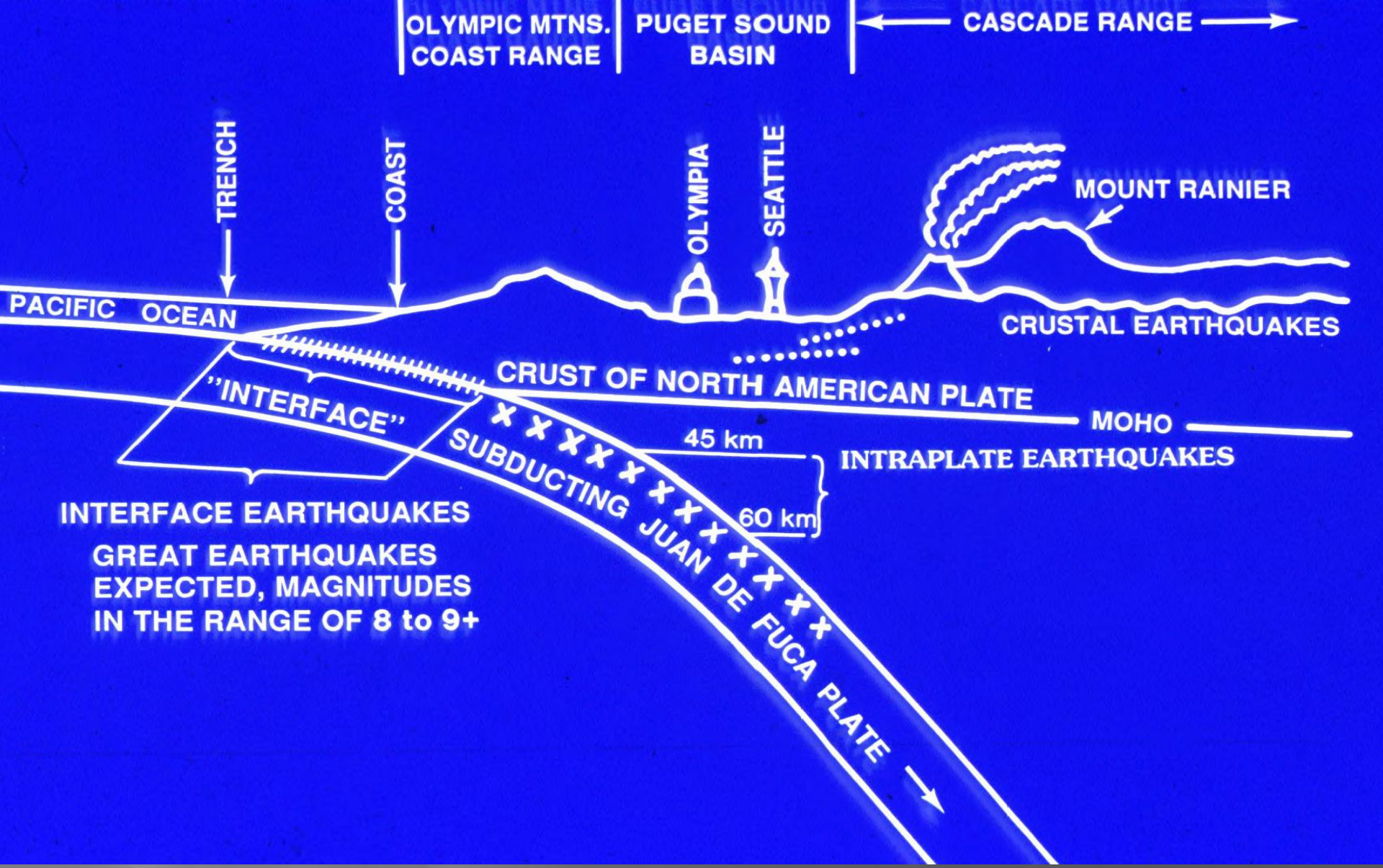


Geologic history shows that the Cascadia Subduction Zone shakes about every 200 to 500 years. Last time was January 26, 1700 at 9:00 PM, 314 years ago. When will it happen again?



CASCADIA

The Jan de Fuca plaate subducts under the North America plate along the Cascadia subduction zone, labeled “Deformation Front” in this diagram.



Intraplate Earthquakes or Deep Earthquakes 1949, 1965, and 2001 are examples for Thurston County

Nisqually type earthquake

Two Full Pages Quake Pictures | Quake News and Pict... On Nine Additional Pa...

EXTRA

Seattle Post-Intelligencer

CHARACTER · QUALITY · AMERICA FIRST · ACCURACY · ENTERPRISE

THE AMERICAN PAPER FOR THE AMERICAN PEOPLE · THE GREAT NEWSPAPER OF THE GREAT NORTHWEST

SUNRISE EDITION

Post-Intelligencer Telephone, MAin 2000 — Main Office — 6th Ave. and Wall St.

VOL. CXXXVI, NO. 44 — SEATTLE, THURSDAY, APRIL 14, 1949 — 40 PAGES — 5¢ PER COPY

SEVEN DEAD, 59 INJURED: EARTHQUAKE LOSS HEAVY

Temblor Lasts Two Minutes; Olympia Area Is Evacuated

Military Police Patrol Downtown Seattle

By Lloyd Stackhouse

Seven persons were killed ... were injured seriously in an earthquake ... rocked the Pacific Northwest ...

3 Full Pages Quake Pictures Inside

THE WEATHER

WESTERN WASHINGTON — Showers this morning, with more showers and partial clearing this afternoon. Highs in 50's. Lows, 38-45. Coastal winds variable 25-35 mph.

EASTERN WASHINGTON—Partly cloudy with increasing clouds today. Considerable cloudiness with chance of few showers tonight. Highs 65-75. Lows near 40.

Seattle Post-Intelligencer

THE QUALITY NEWSPAPER OF THE GREAT NORTHWEST

SUNRISE EDITION

102nd Year—No. 241 — 10c — SEATTLE, FRIDAY, APRIL 30, 1965 — 52 PAGES — MA. 2-2000

Quake Damage In Millions

Five Dead, Many Hurt In Quake

BY CHARLES DUNSIRE

Western Washington ... declared a ... aster area by Gov. Dan Evans, following ... day's earthquake which left five dead, ... injured and millions of dollars in property ... age in the Pacific Northwest.

The region writhed for nearly a full minute ...

The Olympian

SERVING WASHINGTON'S SOUTH PUGET SOUND

THURSDAY, MARCH 1, 2001 — www.theolympian.com — 50¢

GOOD MORNING! HIGH 51 LOW 38

Epicenter 11 miles northeast of Olympia

More than two dozen buildings damaged

Dozens of injuries; no South Sound deaths

6.8 QUAKE

WHAT YOU NEED TO KNOW NOW

BRIDGE DAMAGE

■ The Fourth Avenue bridge has been closed indefinitely because of visible bowing.

BUILDING DAMAGE

■ 19 Capitol Campus and other state buildings have been closed until they can be assessed.

■ 13 buildings in Olympia have been evacuated and will remain closed pending structural evaluations.

■ 14 buildings in Olympia have been yellow-tagged for a structural assessment. They can only be entered to secure offices or retrieve medicines.

ROAD CLOSURES

■ Washington Street from Fifth to Legion

■ Fifth Avenue from Capitol Way to Washington Street

■ Deschutes Parkway, Lakeridge Drive to Fifth

■ Martin Way limited to two lanes between Ensign and Lilly roads

■ Northbound lanes of U.S. Highway 101 north of state Route 8 were closed Wednesday night, but officials hope to have them open today. Call (800) 695-7623 or go to www.wsdot.wa.gov/traveler

SCHOOL CLOSURES

■ The Olympia, North Thurston and Tumwater schools will be closed today, as will The Evergreen State College, Saint Martin's College and South Puget Sound Community College will be open.

■ The Olympia Center will be closed today and Friday.

WORKERS

■ School district employees and state workers who work on the Capitol Campus have the day off, but Thurston County workers will work normal shifts today.

INDEX

OLYMPIA — South Sound today will begin to assess the long-term cost from a powerful earthquake that caused widespread damage and left thousands shaken — but, miraculously, few seriously injured.

Many residents will have an unexpected day off as schools and most state offices remain closed while buildings are inspected.

The magnitude 6.8 earthquake struck at 10:55 a.m., lasted about 45 seconds and was centered 30 miles beneath the Nisqually Delta, according to the National Earthquake Information Center in Golden, Colo.

The quake, the area's strongest since 1949, wreaked havoc across South Sound.

■ **The city of Olympia** evacuated 13 buildings and tagged 14 more as potentially dangerous because of quake damage.

■ **The Fourth Avenue bridge** in downtown Olympia was closed indefinitely because of damage.

■ **The stone exterior** of the Capitol dome cracked.

■ **Debris** from the facades of downtown Olympia buildings littered streets.

■ **Northbound lanes** of US Highway 101 were closed because of a landslide.

■ **Rail traffic** ground to a halt after six miles of track were damaged. Sea-Tac Airport also was closed for hours, with planes diverted to Portland, which also felt the quake.

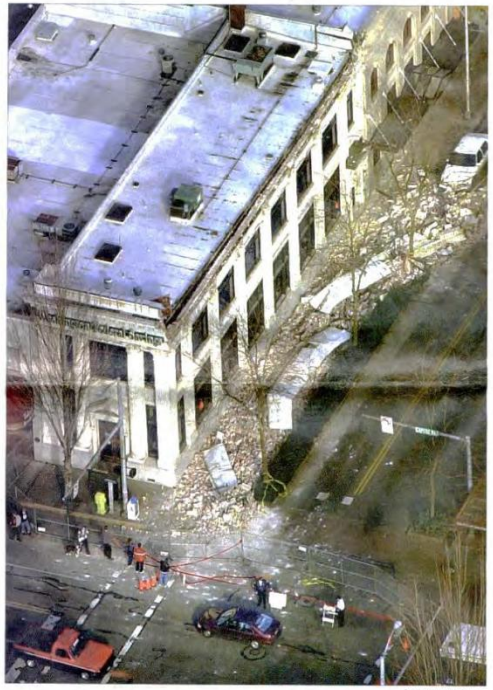
■ **More than 50 Olympia** residents were at least temporarily displaced from their homes.

In addition, to the damage, the quake left thousands of people unnerved.

"It felt like the end of the world," said Casey McKee, an employee of the Fifth Avenue Fabric and Clothing Gallery. "It felt very frightening."

At first McKee thought people upstairs were doing work on the floor, but then she realized it was a quake and ran for the nearest door.

See QUAKE, Page A2



Rubble from the downtown Washington Federal Savings building rests on the sidewalk off Fifth Avenue.

State buildings shut till Monday

BY PATRICK CONDON, BRAD SHANNON AND LAUREN WALSH

OLYMPIA — The earthquake that struck South Sound on Wednesday morning shook Washington government to the cracking ... the stone shell of the state Capitol dome and damaging more than 20 state office buildings.

State leaders quickly canceled the legislative session until at least Monday, and more than 10,000 state employees were left without phones or offices to work in when the 6.8 magnitude quake hit at 10:55 a.m.

"There was smoke, and then the sprinklers came on, and then there was water running down the marble steps," said Rep. Gigi Talcott, R-Tacoma, describing the chaos on the fourth floor of the John L. O'Brien office building, where many state representatives have their offices.

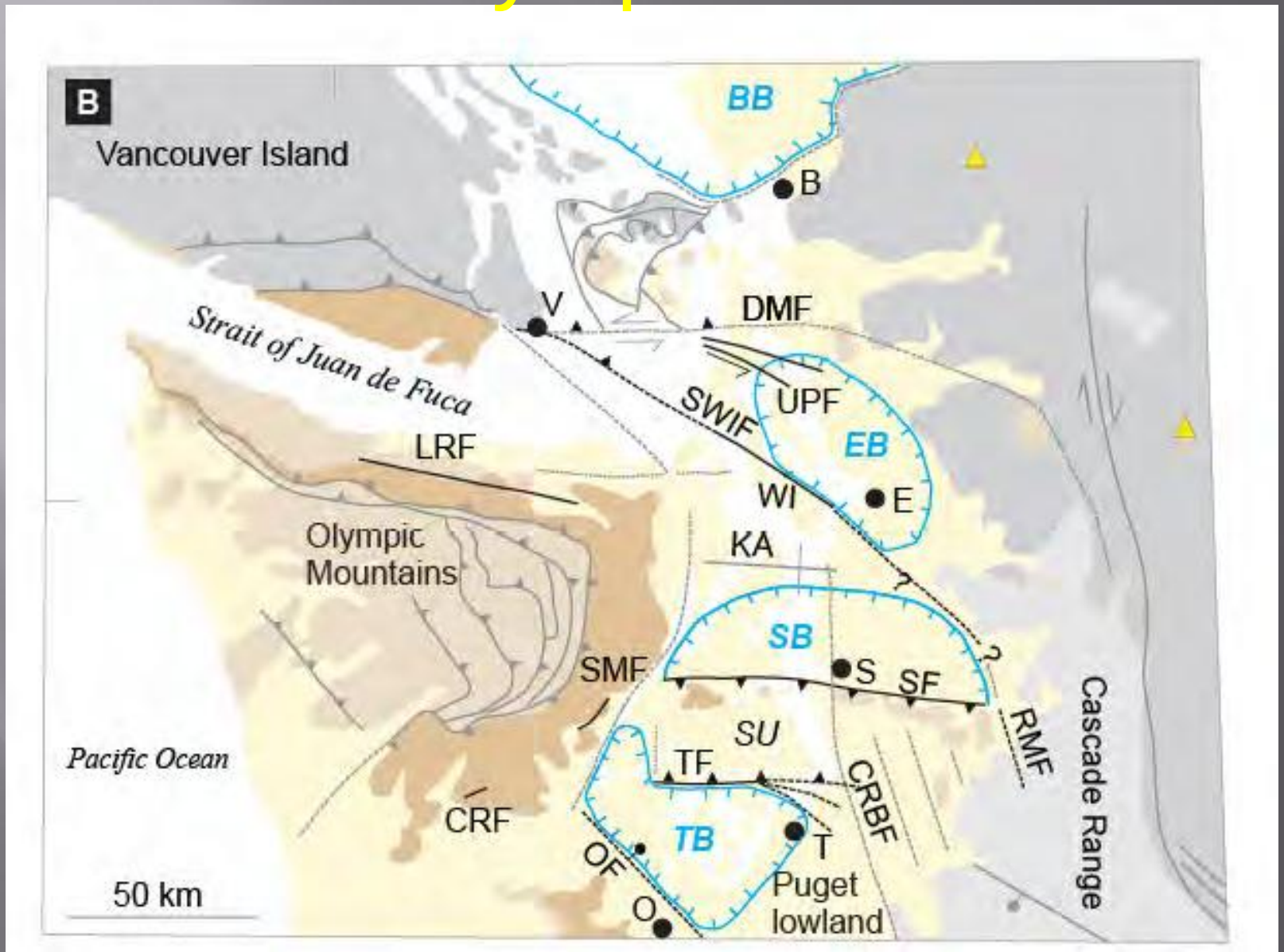
There were only minor injuries reported on the Capitol Campus, according to the Olympia Fire Department.

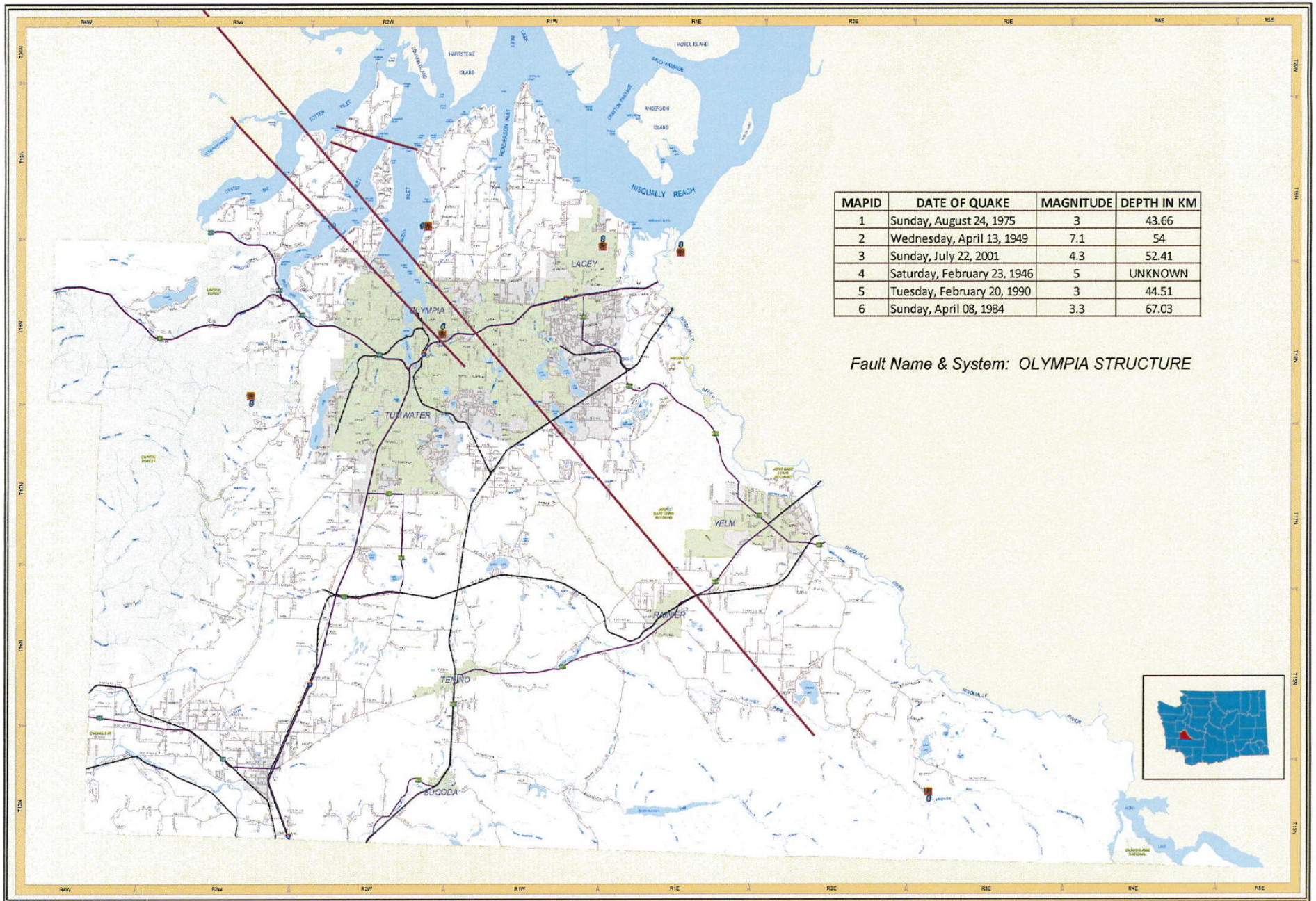
See CAPITOL, Page A2

4th Ave. bridge

Residents: 'Our building was dancing'

Crustal Earthquakes
The Olympia Structure





MAPID	DATE OF QUAKE	MAGNITUDE	DEPTH IN KM
1	Sunday, August 24, 1975	3	43.66
2	Wednesday, April 13, 1949	7.1	54
3	Sunday, July 22, 2001	4.3	52.41
4	Saturday, February 23, 1946	5	UNKNOWN
5	Tuesday, February 20, 1990	3	44.51
6	Sunday, April 08, 1984	3.3	67.03

Fault Name & System: OLYMPIA STRUCTURE

Legend

Earthquake Sites
Active Fault Lines
City Limits
Urban Growth Limits

Thurston County

Emergency Management

EARTHQUAKE SITES & ACTIVE FAULT LINES

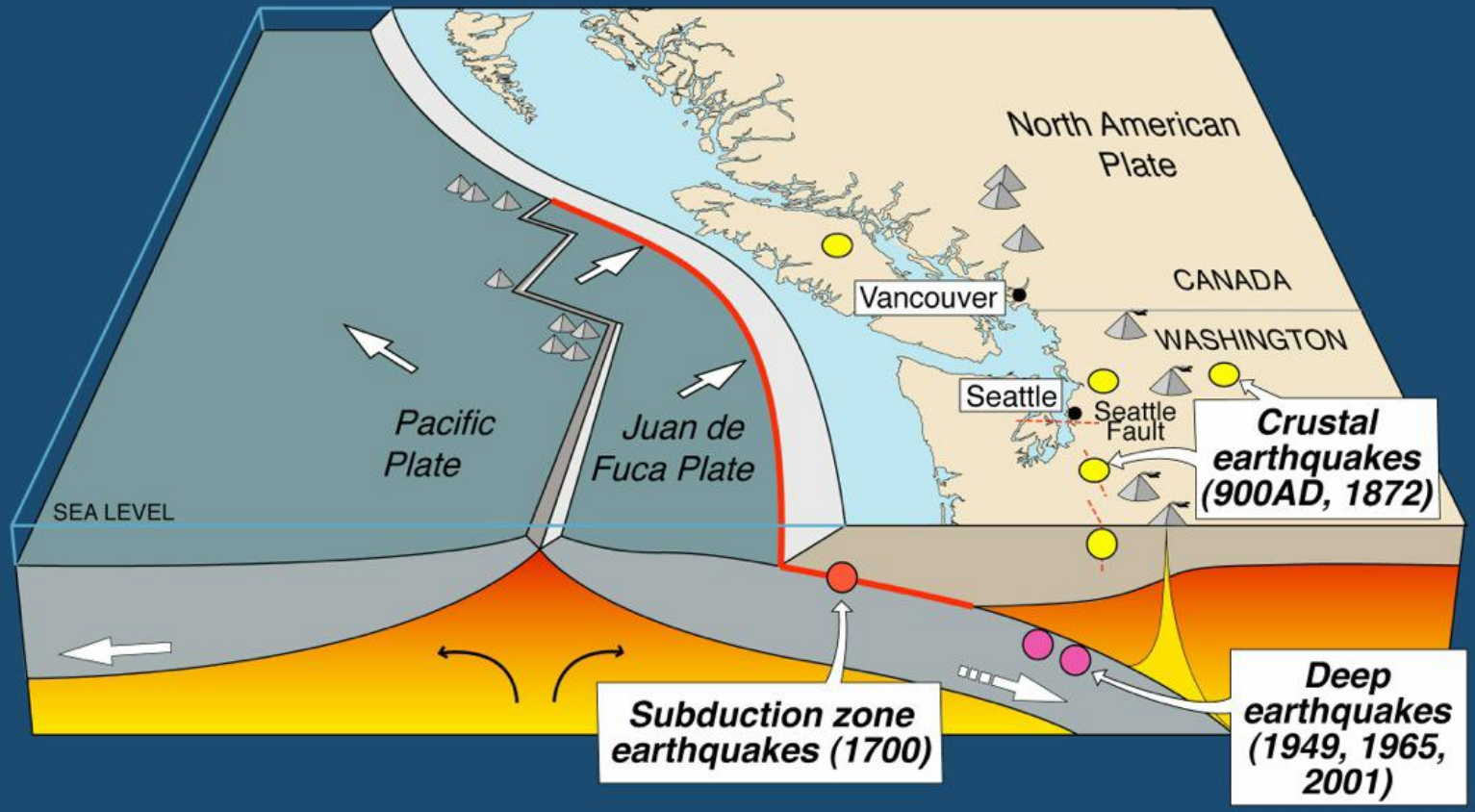
N

Miles

Date: 3/5/2014

Thurston GeoData Center

Cascadia earthquake sources



Source	Affected area	Max.Size	Recurrence
Subduction Zone	W. WA, OR, CA	M 9	500-600 yr
Deep JdF plate	W. WA, OR	M 7	30-50 yr
Crustal faults	WA, OR, CA	M 7?	?

HAZUS is a nationally applicable standardized methodology that contains models for estimating potential losses from earthquakes, floods, and hurricanes. HAZUS uses Geographic Information Systems (GIS) technology to estimate physical, economic, and social impacts of disasters.

REMEMBER - IT IS ONLY A MODEL!

http://www.fema.gov/hazus

Through HAZUS We Will Explore the 3 types of Earthquakes Potentially Impacting Thurston County

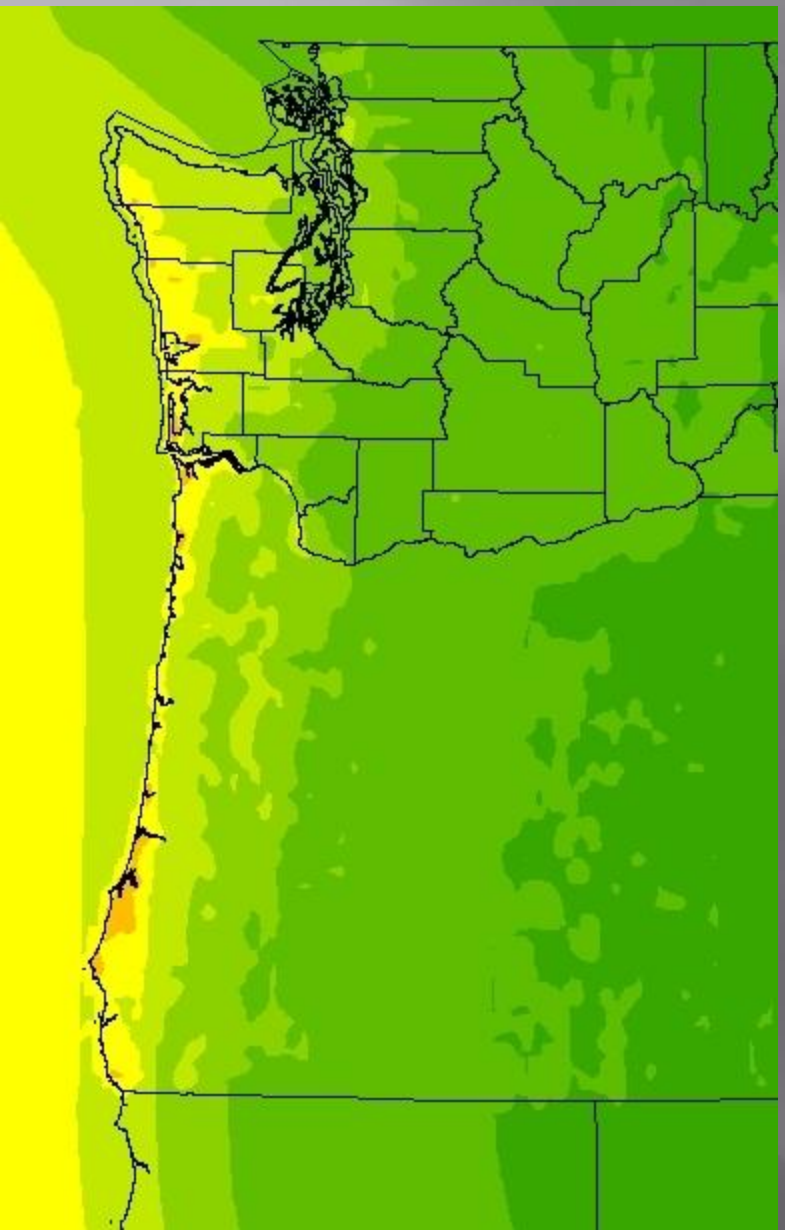
Cascadia 9.0

Nisqually 7.2

Olympia 6.8

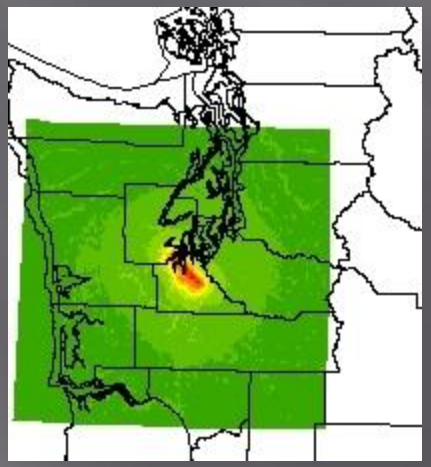
SCALE

Cascadia 9.0



Nisqually 7.2

Olympia 6.8



THURSTON COUNTY

Hydro-Enforced Digital Elevation Model
LiDAR Derived - 2011

Description

Light Detection and Ranging (LiDAR) data is remotely sensed high-resolution elevation data collected by an airborne collection platform. This LiDAR dataset is a survey of Thurston County and 20 square miles of Gray's Harbor county encompassing land within the jurisdiction of the Confederated Chehalis Tribe. The project area consists of approximately 825 square miles. The project design of the LiDAR data acquisition was developed to support a nominal post spacing of 1 meter. Fugro EarthData, Inc. acquired 283 flight lines in 15 lifts between June 2011 and July 2011. LiDAR data collection was performed with a Cessna 310 twin engine aircraft, utilizing a Leica ALS60 MPiA sensor; collecting multiple return x, y, and z as well as intensity data.

Elevation (feet)

N
W E
S

0 1 2 3 4 5
Miles

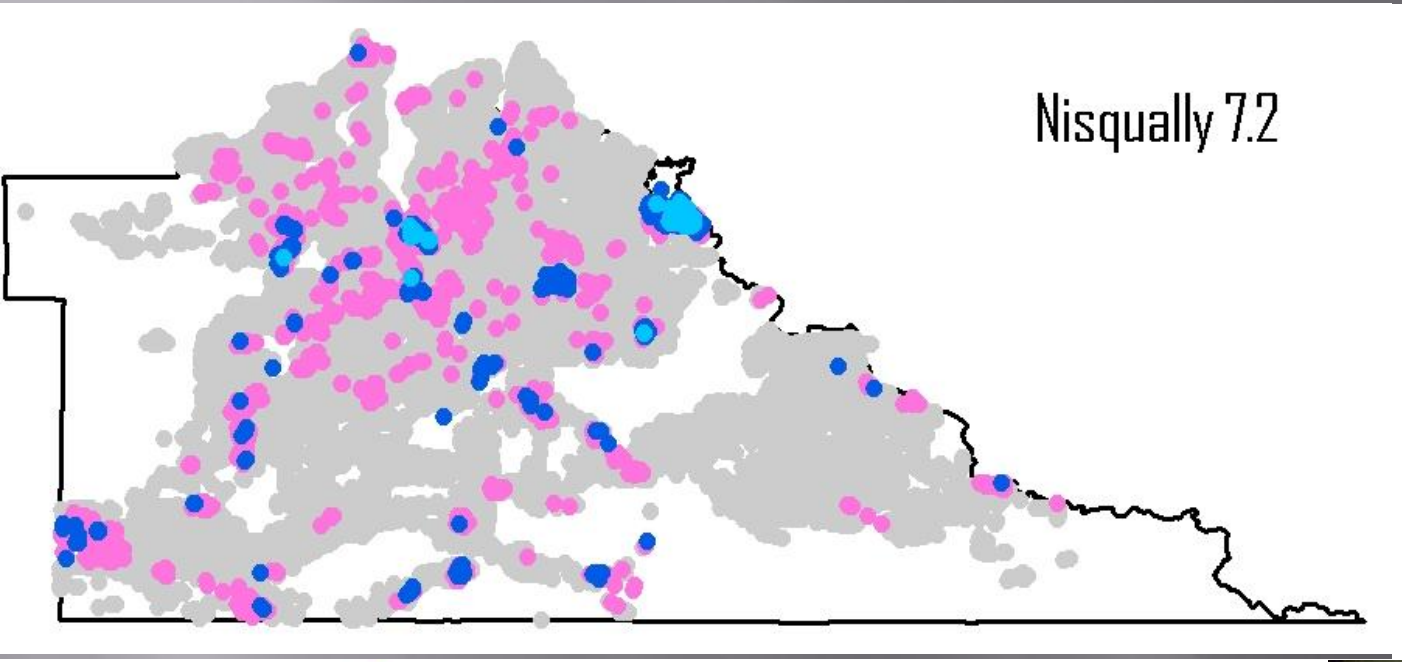
0 2 4 8 12
Kilometers

Thurston GeoData Center

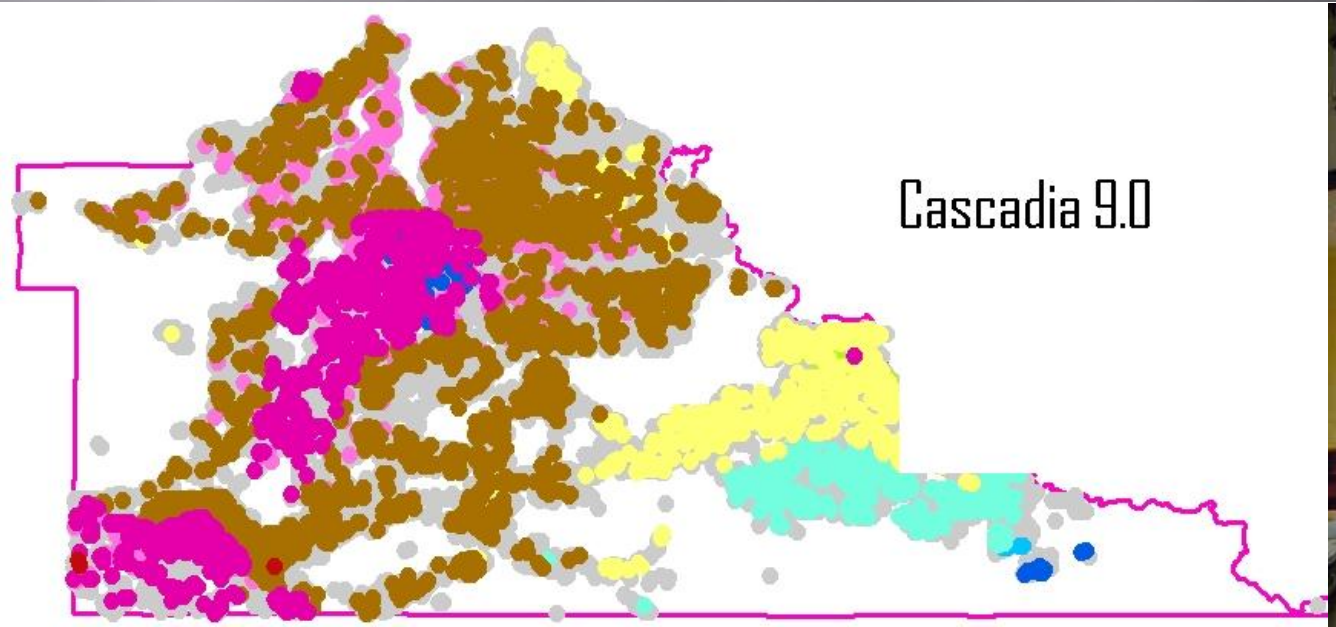
THURSTON COUNTY

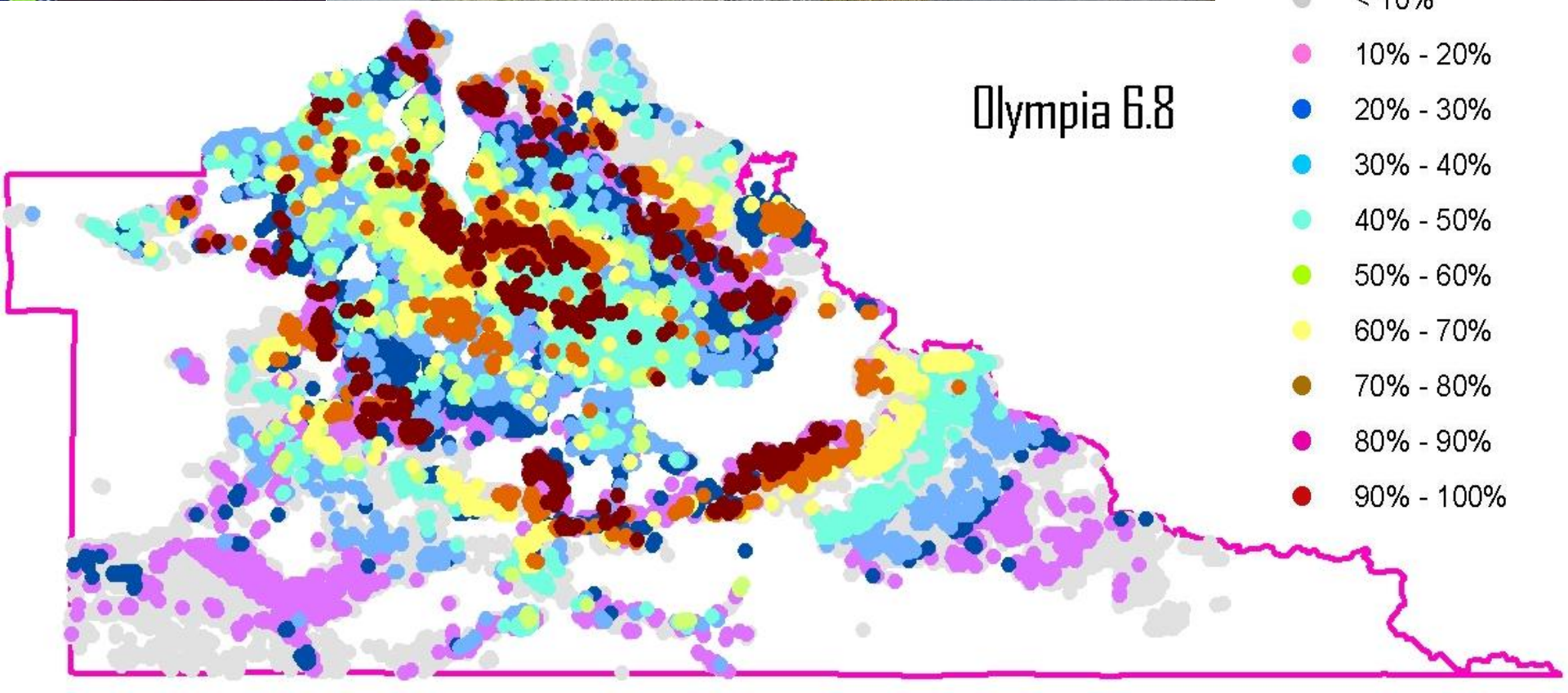
Again –
HAZUS is a model in progress, as is our effectiveness in its use.
In our presentation of impacts I'll focus on Building Stock.
We have updated the model with The Assessor database as of April 2013 – approx. 90,370 structures.

PATTERNS – The colors represent the probability that a structure will be completely damaged.



- < 10%
- 10% - 20%
- 20% - 30%
- 30% - 40%
- 40% - 50%
- 50% - 60%
- 60% - 70%
- 70% - 80%
- 80% - 90%
- 90% - 100%




Olympia 6.8
< 10%
10% - 20%
20% - 30%
30% - 40%
40% - 50%
50% - 60%
60% - 70%
70% - 80%
80% - 90%
90% - 100%

Expected Building Damage

HAZUS uses 5 damage categories – None, Slight, Moderate, Extensive and Complete.

Expected Building Damage by Building Type

		None/Slight			Moderate			Extensive			Complete			% > Extensive		
		N 7.2	C 9.0	O 6.8	N 7.2	C 9.0	O 6.8	N 7.2	C 9.0	O 6.8	N 7.2	C 9.0	O 6.8	N	C	O
Wood	76,646	76,491	74,049	62,305	85	2,568	13,889	56	28	407	14	1	44	0.09	0.04	0.59
Manufactured Housing	6,510	5,764	1,619	2,865	694	3,436	2,263	50	1,325	1,058	1	130	324	0.78	22.35	21.24
Reinforced Masonary	2,954	2,910	2,152	1,238	40	618	1,074	3	171	500	0	13	141	0.10	6.26	21.70
Steel	1,474	1,373	736	477	93	516	472	8	189	386	0	33	140	0.54	15.06	35.69
Precast	1,021	960	471	293	55	366	352	4	155	262	0	29	114	0.39	18.02	36.83
Concrete	1,257	1,199	650	342	45	416	434	3	161	313	0	20	158	0.24	14.40	38.27
Unreinforced Masonry	508	458	69	60	47	217	95	3	178	142	0	44	210	0.59	43.70	69.29
TOTAL	90,370	89,168	79,744	67,679	1,059	8,135	18,579	127	2,208	3,068	15	270	1,131	0.16	2.74	4.65

< Olympia 1949

Olympia, 2001 >

HAZUS Damage State Descriptions

Damage state		Description
	Slight	Small plaster cracks at corners of door and window openings and wall–ceiling intersections; small cracks in masonry chinmeys and masonry veneers. Small cracks are assumed to be visible with a maximum width of less than 1/8 inch (cracks wider than 1/8 inch are referred to as "large" cracks).
	Moderate	Large plaster or gypsum-board cracks at corners of door and window openings; small diagonal cracks across shear-wall panels exhibited by small cracks in stucco and gypsum wall panels; large cracks in brick chimneys; toppling of tall masonry chimneys.
	Extensive	Large diagonal cracks across shear-wall panels or large cracks at plywood joints; permanent lateral movement of floors and roof; toppling of most brick chimneys; cracks in foundations; splitting of wood sill plates and/or slippage of structure over foundations.
	Complete	Structure may have large permanent lateral displacement or be in imminent danger of collapse due to cripple-wall failure or failure of the lateral-load-resisting system; some structures may slip and fall off the foundation; large foundation cracks. Three percent of the total area of buildings with Complete damage is expected to be collapsed, on average.

Figure 7. Examples of damage states estimated by HAZUS-MH. The actual damage states vary slightly with building type, but this is representative.

Expected Building Damage by Building Type

		None/Slight			Moderate			Extensive			Complete			% ≥ Extensive		
		N 7.2	C 9.0	O 6.8	N 7.2	C 9.0	O 6.8	N 7.2	C 9.0	O 6.8	N 7.2	C 9.0	O 6.8	N	C	O
Wood	**76,646**	**76,491**	**74,049**	**62,305**	**85**	**2,568**	**13,889**	**56**	**28**	**407**	**14**	**1**	**44**	**0.09**	**0.04**	**0.59**
Manufactured Housing	6,510	5,764	1,619	2,865	694	3,436	2,263	50	1,325	1,058	1	130	324	0.78	22.35	21.24
Reinforced Masonary	2,954	2,910	2,152	1,238	40	618	1,074	3	171	500	0	13	141	0.10	6.26	21.70
Steel	1,474	1,373	736	477	93	516	472	8	189	386	0	33	140	0.54	15.06	35.69
Precast	1,021	960	471	293	55	366	352	4	155	262	0	29	114	0.39	18.02	36.83
Concrete	1,257	1,199	650	342	45	416	434	3	161	313	0	20	158	0.24	14.40	38.27
Unreinforced Masonry	**508**	**458**	**69**	**60**	**47**	**217**	**95**	**3**	**178**	**142**	**0**	**44**	**210**	**0.59**	**43.70**	**69.29**
TOTAL	**90,370**	**89,168**	**79,744**	**67,679**	**1,059**	**8,135**	**18,579**	**127**	**2,208**	**3,068**	**15**	**270**	**1,131**	**0.16**	**2.74**	**4.65**

Expected Building Damage by Building Type

		None/Slight			Moderate			Extensive			Complete			% ≥ Moderate		
		N 7.2	C 9.0	O 6.8	N 7.2	C 9.0	O 6.8	N 7.2	C 9.0	O 6.8	N 7.2	C 9.0	O 6.8	N	C	O
Wood	**76,646**	**76,491**	**74,049**	**62,305**	**85**	**2,568**	**13,889**	**56**	**28**	**407**	**14**	**1**	**44**	**0.20**	**3.39**	**18.70**
Manufactured Housing	6,510	5,764	1,619	2,865	694	3,436	2,263	50	1,325	1,058	1	130	324	11.44	75.13	55.99
Reinforced Masonary	2,954	2,910	2,152	1,238	40	618	1,074	3	171	500	0	13	141	1.46	27.18	58.06
Steel	1,474	1,373	736	477	93	516	472	8	189	386	0	33	140	6.85	50.07	67.71
Precast	1,021	960	471	293	55	366	352	4	155	262	0	29	114	5.78	53.87	71.33
Concrete	1,257	1,199	650	342	45	416	434	3	161	313	0	20	158	3.82	47.49	72.00
Unreinforced Masonry	**508**	**458**	**69**	**60**	**47**	**217**	**95**	**3**	**178**	**142**	**0**	**44**	**210**	**9.84**	**86.42**	**87.99**
TOTAL	**90,370**	**89,168**	**79,744**	**67,679**	**1,059**	**8,135**	**18,579**	**127**	**2,208**	**3,068**	**15**	**270**	**1,131**	**1.33**	**11.75**	**25.21**

Nisqually earthquake is estimated to generate 2,000 tons of debris requiring 840 truckloads each hauling 25 tons for removal.

Cascadia earthquake is estimated to generate 310,000 tons of debris requiring 12,360 truckloads each hauling 25 tons for removal.

Olympia earthquake is estimated to generate 720,000 tons of debris requiring 28,800 truckloads each hauling 25 tons for removal.

Expected Building Damage by Occupancy

		None/Slight			Moderate			Extensive			Complete			% ≥ Extensive		
		N 7.2	C 9.0	O 6.8	N 7.2	C 9.0	O 6.8	N 7.2	C 9.0	O 6.8	N 7.2	C 9.0	O 6.8	N	C	O
Commercial	4,565	4,367	2,449	1,285	186	1,444	1,626	11	574	1,090	0	97	564	0.24	14.72	36.23
Government	330	314	186	125	15	97	100	2	42	69	0	7	36	0.61	14.85	31.82
Religion	176	169	112	74	6	44	52	2	18	33	0	3	18	1.14	12.50	28.98
Education	101	97	62	45	4	25	28	0	12	18	0	2	10	0.00	13.86	27.72
Industrial	208	198	111	93	11	69	64	1	32	36	0	6	15	0.48	18.27	25.00
Other Residential	10,167	9,383	4,733	5,094	728	3,844	3,278	55	1,444	1,337	2	145	459	0.56	15.48	17.49
Agriculture	856	826	615	642	27	163	146	2	67	51	0	11	17	0.23	9.11	7.94
Single Family	73,952	73,806	71,486	60,221	82	2,450	13,285	54	20	434	13	0	12	0.09	0.03	0.60
TOTAL	**90,370**	**89,168**	**79,744**	**67,679**	**1,059**	**8,135**	**18,579**	**127**	**2,208**	**3,068**	**15**	**270**	**1,131**	**0.16**	**2.74**	**4.65**

Expected Building Damage by Occupancy

		None/Slight			Moderate			Extensive			Complete			% ≥ Moderate		
		N 7.2	C 9.0	O 6.8	N 7.2	C 9.0	O 6.8	N 7.2	C 9.0	O 6.8	N 7.2	C 9.0	O 6.8	N	C	O
Commercial	4,565	4,367	2,449	1,285	186	1,444	1,626	11	574	1,090	0	97	564	4.32	46.33	71.85
Government	330	314	186	125	15	97	100	2	42	69	0	7	36	5.15	44.24	62.12
Religion	176	169	112	74	6	44	52	2	18	33	0	3	18	4.55	36.93	58.52
Education	101	97	62	45	4	25	28	0	12	18	0	2	10	3.96	38.61	55.45
Industrial	208	197	111	93	11	69	64	1	32	36	0	6	15	5.77	51.44	55.29
Other Residential	10,167	9,383	4,733	5,094	728	3,844	3,278	55	1,444	1,337	2	145	459	7.72	53.44	49.91
Agriculture	856	826	615	642	27	163	146	2	67	51	0	11	17	3.39	28.15	25.00
Single Family	73,952	73,806	71,744	60,221	82	2,450	13,285	54	20	434	13	0	12	0.20	3.34	18.57
TOTAL	**90,370**	**89,168**	**47,919**	**67,679**	**1,059**	**8,135**	**18,579**	**127**	**2,208**	**3,068**	**15**	**270**	**1,131**	**1.33**	**11.75**	**25.21**

Nisqually earthquake total building-related losses are estimated at $235,630,000.
Cascadia earthquake total building-related losses are estimated at $1,670,260,000.
Olympia earthquake total building-related losses are estimated at $4,663,110,000.

Casualty Estimates													
		Medical Attention			Hospitalization			Life Threatening			Fatalities		
		N 7.2	C 9.0	O 6.8	N 7.2	C 9.0	O 6.8	N 7.2	C 9.0	O 6.8	N 7.2	C 9.0	O 6.8
2:00 AM	Commercial	0	5	19	0	1	6	0	0	1	0	0	2
	Educational	0	0	0	0	0	0	0	0	0	0	0	0
	Commuting	0	0	0	0	0	0	0	0	0	0	0	0
	Hotels	0	2	4	0	0	1	0	0	0	0	0	0
	Industrial	0	3	7	0	1	2	0	0	0	0	0	1
	Single Family	**9**	**50**	**148**	**1**	**2**	**40**	**0**	**0**	**1**	**0**	**0**	**9**
	Other-Residential	**7**	**76**	**168**	**1**	**12**	**16**	**0**	**1**	**5**	**0**	**1**	**2**
	TOTAL	**16**	**136**	**346**	**2**	**16**	**65**	**0**	**1**	**7**	**0**	**1**	**14**
2:00 PM	Commercial	**13**	**283**	**1,051**	**1**	**63**	**307**	**0**	**9**	**50**	**0**	**17**	**99**
	Educational	**15**	**274**	**928**	**2**	**57**	**266**	**0**	**7**	**44**	**0**	**14**	**86**
	Commuting	0	0	1	0	0	2	0	1	3	0	0	1
	Hotels	0	0	1	0	0	0	0	0	0	0	0	0
	Industrial	1	21	55	0	5	15	0	1	2	0	1	5
	Single Family	2	8	25	0	0	3	0	0	0	0	0	0
	Other-Residential	1	14	31	0	2	7	0	0	1	0	0	2
	TOTAL	**32**	**600**	**2,092**	**3**	**127**	**600**	**0**	**18**	**100**	**0**	**32**	**193**
5:00 PM	Commercial	**10**	**214**	**754**	**1**	**47**	**218**	**0**	**6**	**36**	**0**	**12**	**69**
	Educational	**2**	**45**	**172**	**0**	**9**	**50**	**0**	**1**	**8**	**0**	**2**	**16**
	Commuting	**2**	**8**	**37**	**3**	**9**	**47**	**5**	**17**	**82**	**1**	**3**	**16**
	Hotels	0	0	1	0	0	0	0	0	0	0	0	0
	Industrial	1	13	34	0	3	10	0	0	2	0	1	3
	Single Family	3	18	56	0	1	6	0	0	0	0	0	1
	Other-Residential	2	28	63	0	4	15	0	0	2	0	1	3
	TOTAL	**20**	**326**	**1,117**	**4**	**73**	**346**	**5**	**24**	**130**	**1**	**19**	**108**

Nisqually, the model estimates 53 households displaced with 28 people seeking public shelters.
Cascadia, the model estimates 907 households displaced with 498 people seeking public shelters.
Olympia, the model estimates 2,432 households displaced with 1,325 people seeking public shelters.

Ok. Computer Model!

Most likely Worst Case.

Can it be Less – Yes!

Can it be More – Yes!

The model considers liquefaction areas, but not soil saturation.

The model is only a single event model, it does not consider aftershocks.

Picture Cascadia 9.0 with Olympia 6.8

What is next with HAZUS?

1. Try to separate buildings by year built – Pre and Post 1997.
2. Sort data by jurisdictions.
3. Conduct individual structure analysis.
4. Shelter Planning – In an Olympia earthquake we may to shelter about 1,300 people. In a Cascadia earthquake about 500 from Thurston County, but about 11,000 from the coast.

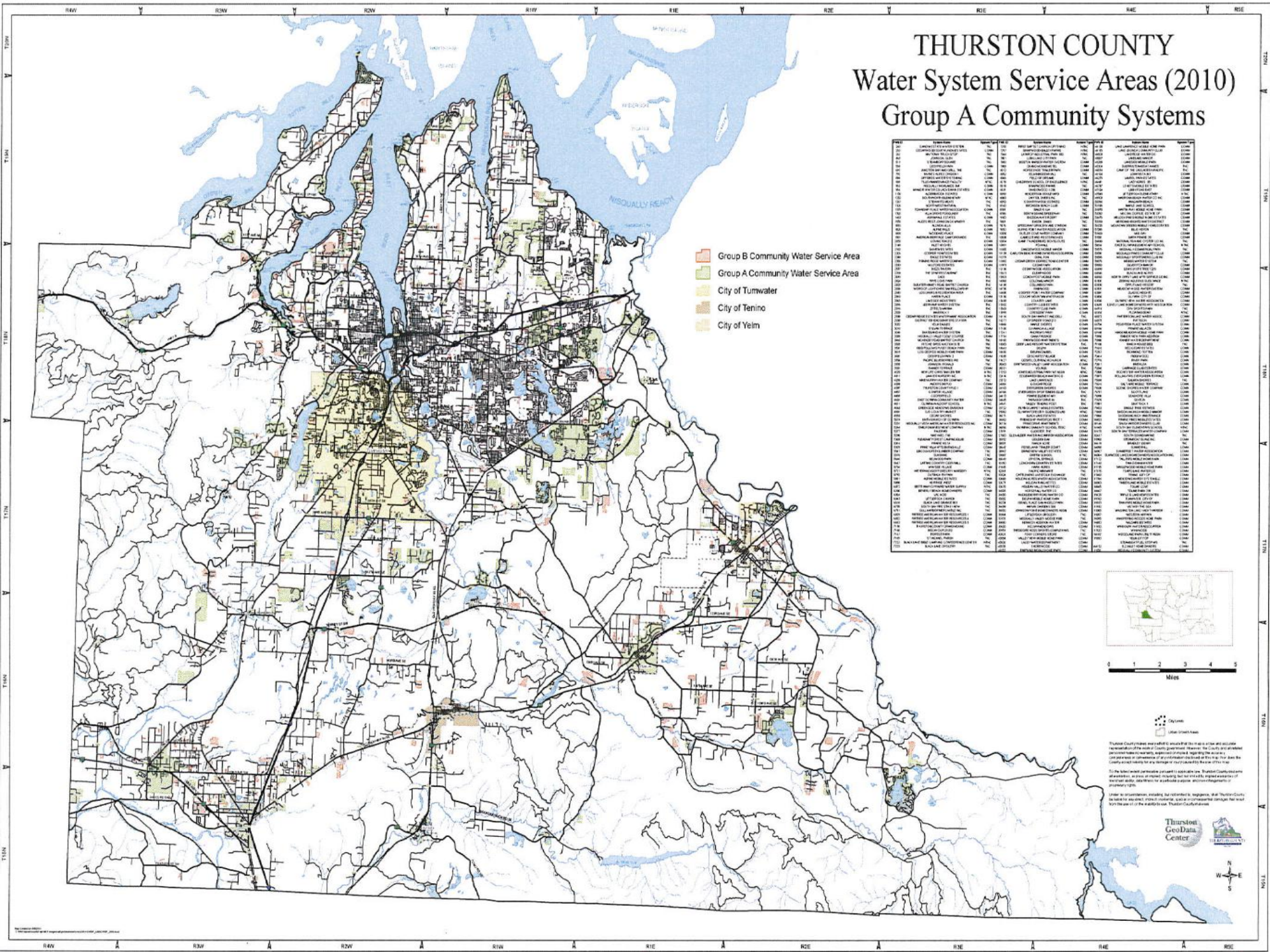
Good estimate for building stock, next we need to improve impact estimates for transportation, power, gas, pipelines, sewer, and water.

What HAZUS currently reports:

Nisqually – 1,373 Leaks, 343 Breaks, 11,091 at 7 days
Cascadia – 1,373 Leaks, 343 Breaks, 11,091 at 7 days
Olympia – 1,373 Leaks, 343 Breaks, 11,091 at 7 days

For waste water the patterns is the same: 690 Leaks, 172 Breaks.
HAZUS uses 2,963 miles of water and 1,778 miles of waste

THURSTON COUNTY
Water System Service Areas (2010)
Group A Community Systems



I Need help from you on acquiring data for water systems and wells.

Type of data that would help our analysis:
Well Locations
Pipe distribution – AutoCad, GIS file, Hand drawing
Pipe type (Hard or Flexible)
Or length of pipe in your Utility

QUESTIONS?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