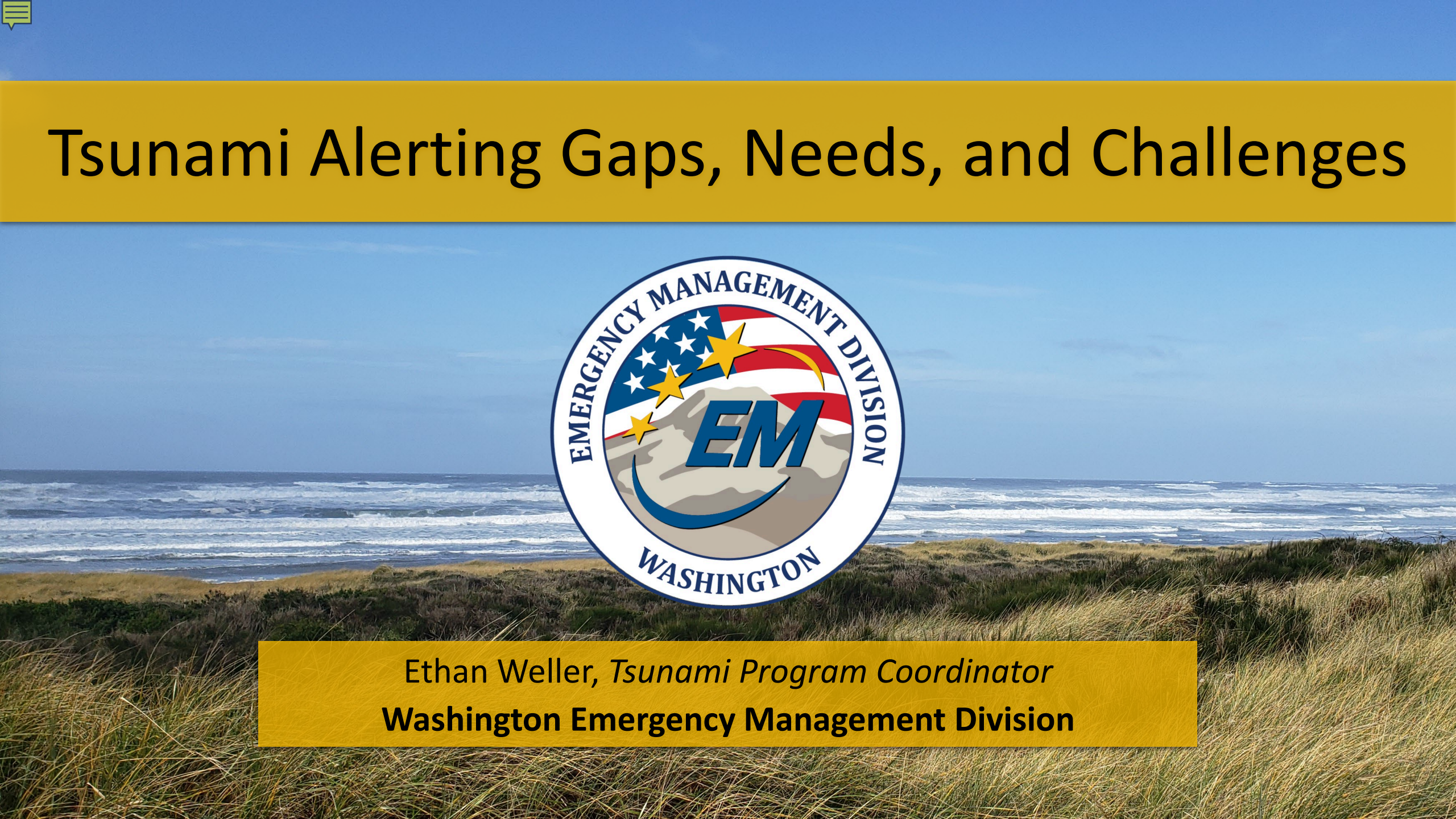
Tsunami Alerting Gaps, Needs, and Challenges



Ethan Weller, *Tsunami Program Coordinator*

Washington Emergency Management Division

Washington is Earthquake Country

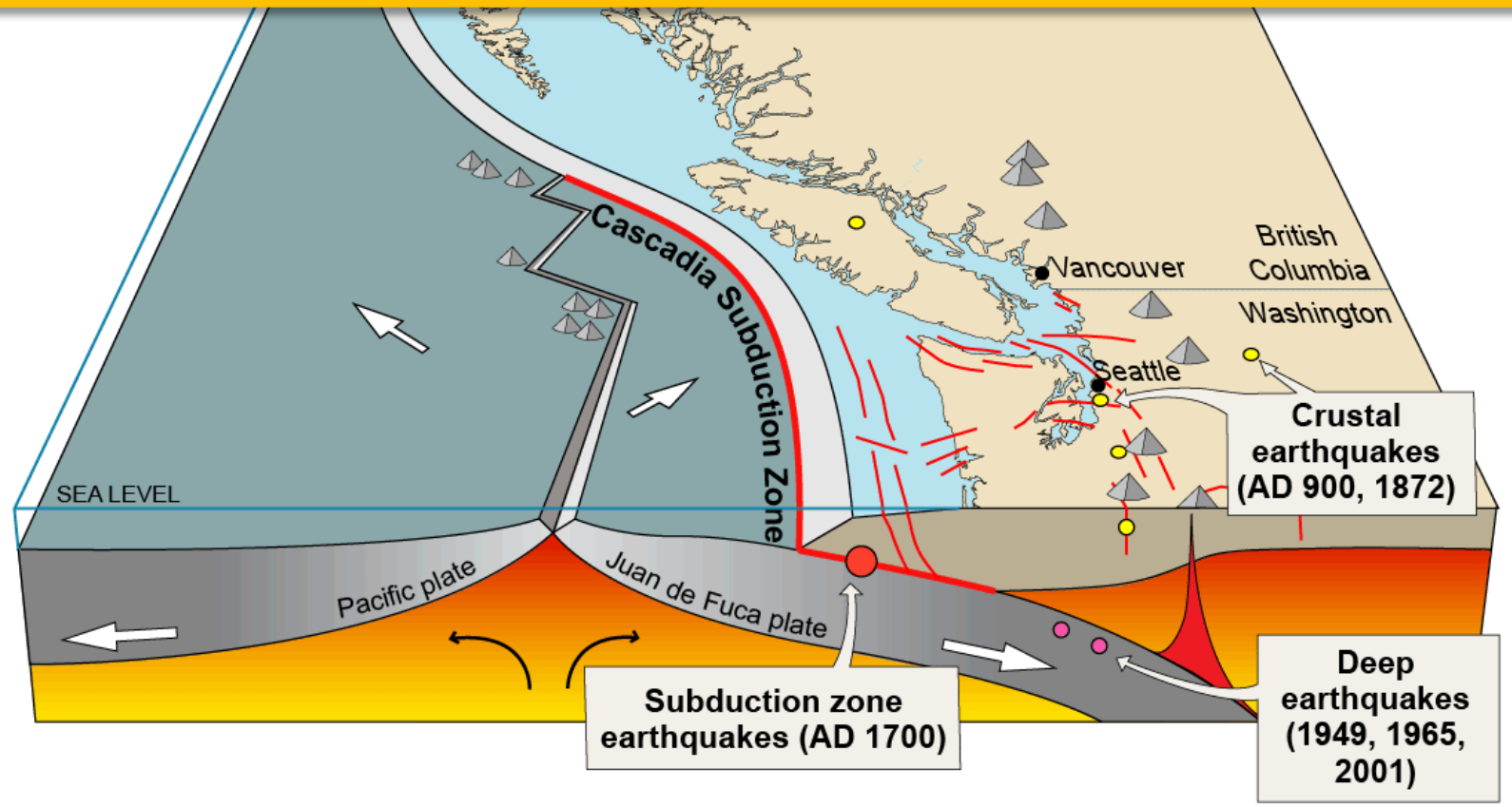
Washington has the
2nd highest earthquake risk
in the United States

It's not a matter of IF…
but WHEN.

"The Big One"

Nisqually, 2001

Seattle Fault, Chelan Fault, etc.



Source	Max. Size	Recurrence
Subduction zone	M 9+	200–600 years
Deep Juan de Fuca plate	M 7+	30–50 years
Crustal faults	M 7+	Hundreds of years?

Volcano

Active crustal fault

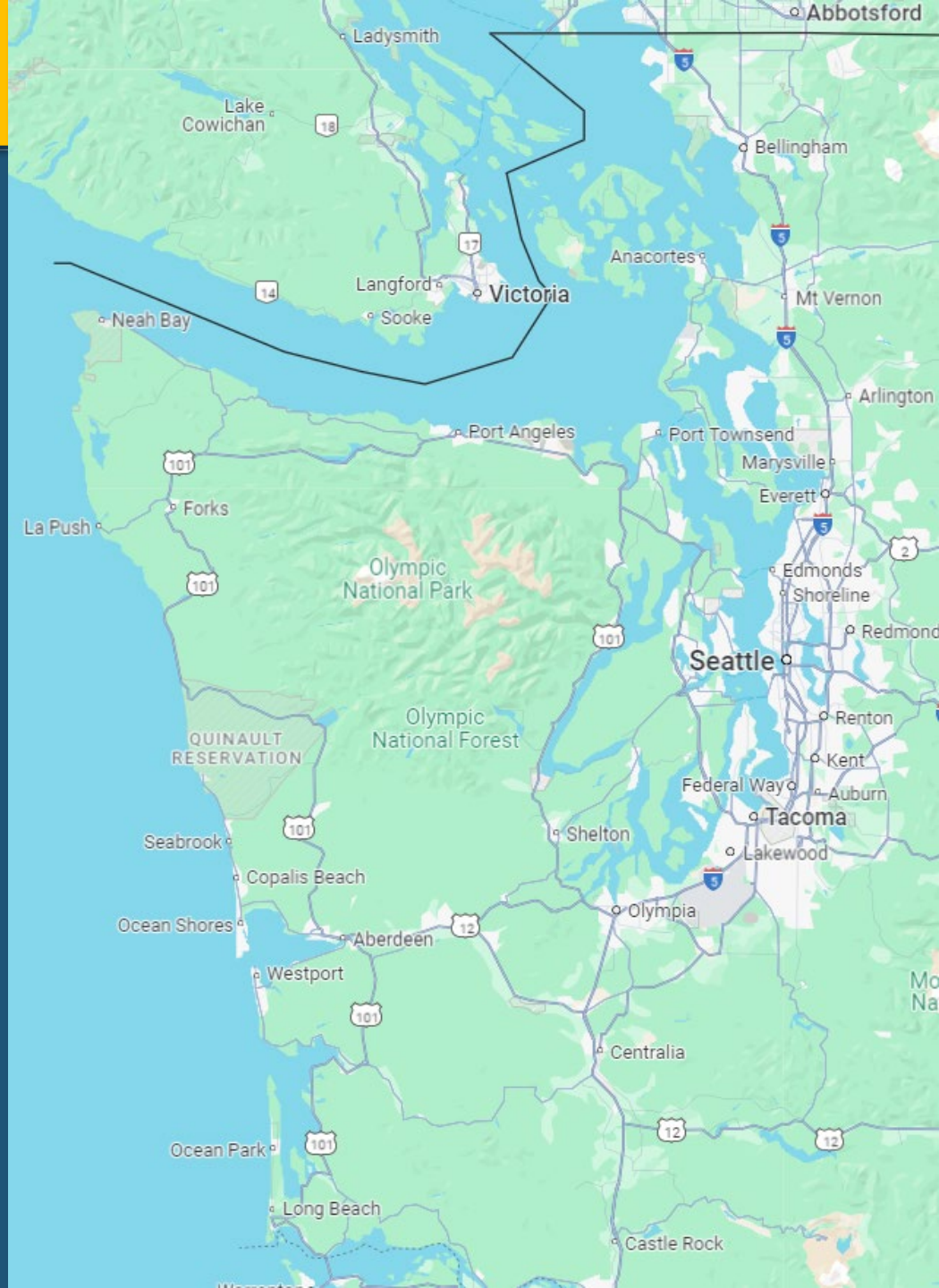
Active plate boundary fault

*figure modified from USGS Cascadia earthquake graphics at http://geomaps.wr.usgs.gov/pacnw/pacnweq/index.html

Washington is Tsunami Country

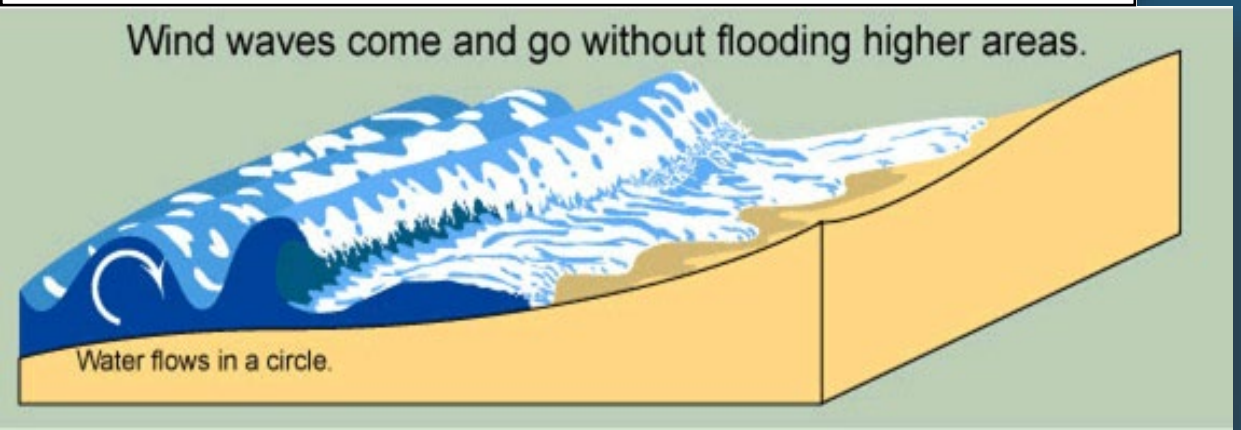
WA has 3,000 miles of shoreline with…

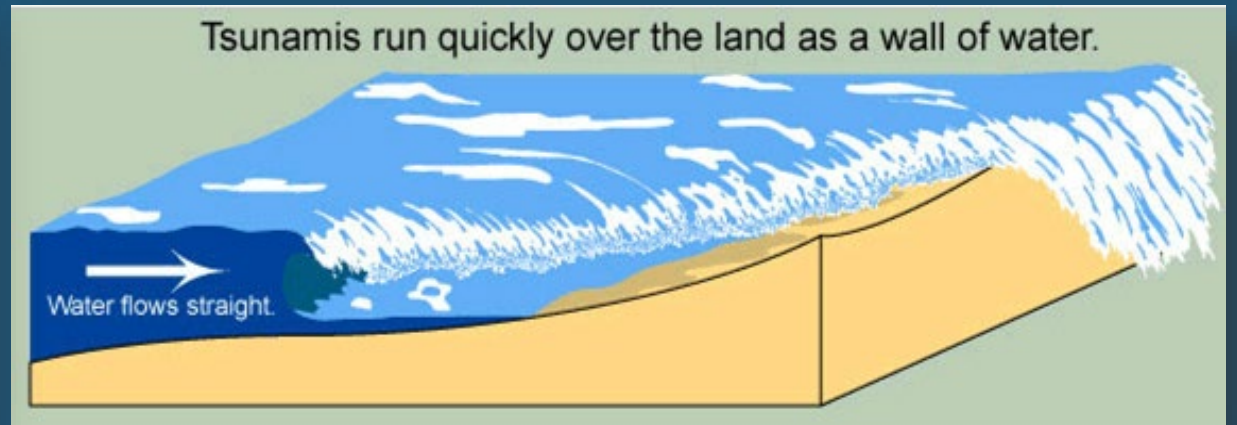
- 31 ports and over 90 individual port-run shipping terminals, marinas, and harbors
- Ports of Seattle and Tacoma, 4th largest container gateway in the US
- 7 Coast Guard stations and 4 Navy bases
- 700 fishing & seafood processing operations
- Largest ferry system in the US
- Millions of coastal tourists each year
- Highly vulnerable and aging coastal populations
- **175,000-300,000+ people living, working and recreating in tsunami hazard zones at any given time**



What is a tsunami?

- A series of long, multiple waves lasting 12-24+ hours
- Caused by earthquakes, landslides, volcanic eruptions, and some weather phenomena
- Can travel far distances across the water in minutes or hours
- The first wave is often neither the highest nor most destructive wave
- Very fast and powerful; entire column of water moves, not just the top like with wind waves





Local vs Distant Tsunamis

Local

- You **will feel the earthquake**
- **Shaking** is primary warning
- More inundation and severe currents
- Biggest local threat: CSZ
- **Threat to inner and outer coasts**

Distant

- You **will NOT feel the earthquake**
- **Tsunami alerts** are primary warning
- Less inundation and weaker currents
- Biggest distant threat: Alaska
- Smaller threat to inner coast

General Tsunami Impacts

- Damage to fuel piping systems and pumps; power loss can affect systems that are still intact or out of the tsunami inundation zone.
- Damage to bridges, overpasses, roadways, and other vulnerable transportation infrastructure.
- Damage to port/marina infrastructure and goods, impacting shipping and supply chains.
- Injuries and fatalities in coastal communities lacking adequate high ground nearby.
- Examples from Japan (2011):
  - 19,700+ deaths (majority from tsunami)
  - 400,000+ people displaced
  - 402,000+ buildings partially or totally collapsed
  - 28,000+ ships destroyed; 319 ports damaged


March 12, 2011

Natural Tsunami Warning Signs

Long or strong ground shaking at the coast

Ocean water bubbling, frothing, or otherwise acting abnormally

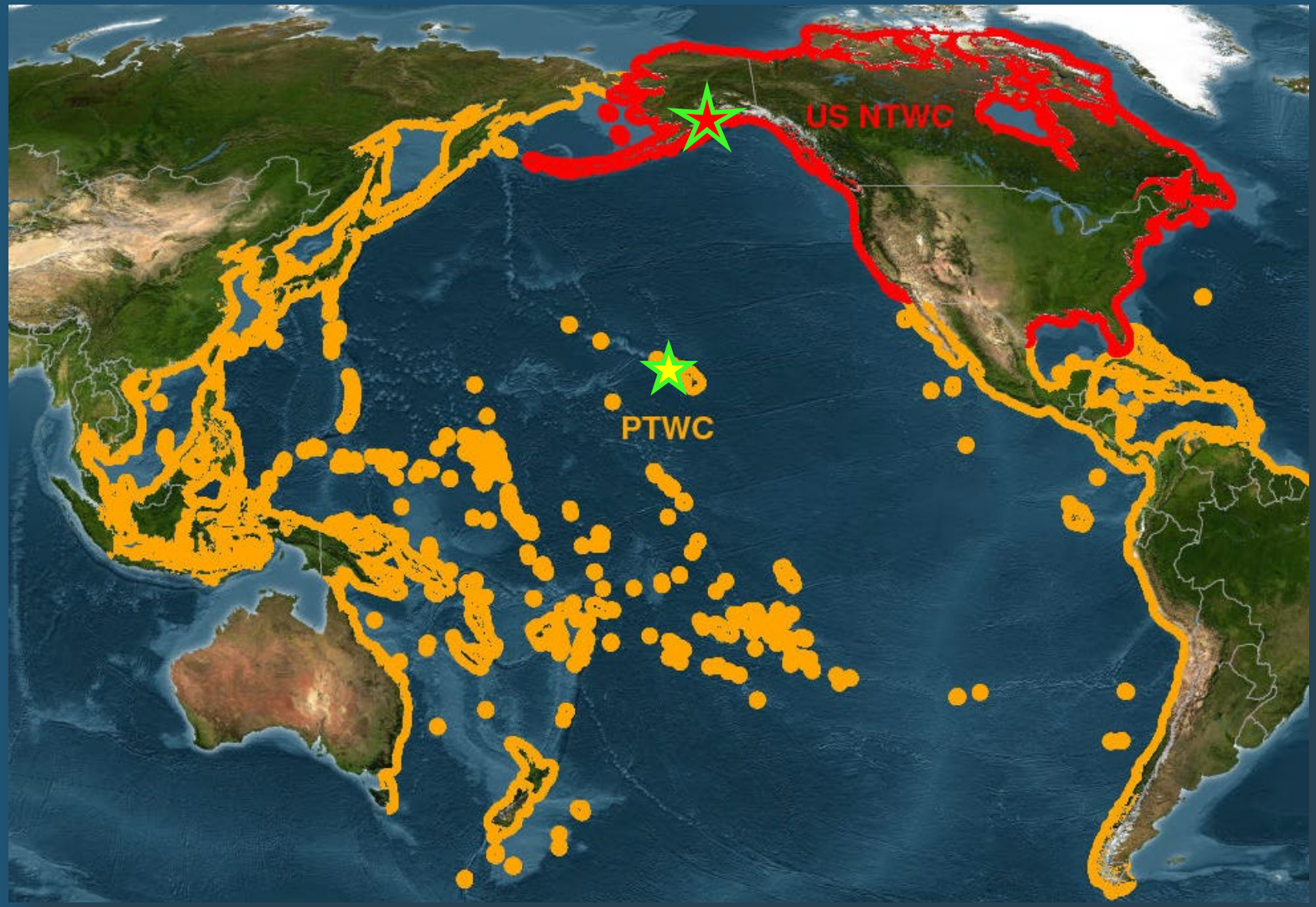
Loud roaring sound coming from the ocean

Sudden rise or fall of the ocean

Tsunami Warning Centers

Pacific Tsunami Warning Center (Honolulu, HI)

International warning center for 26 member countries, Hawaii and the US Territories



National Tsunami Warning Center (Palmer, AK)

Issues all tsunami products for AK, BC, WA, OR, CA – all of North America

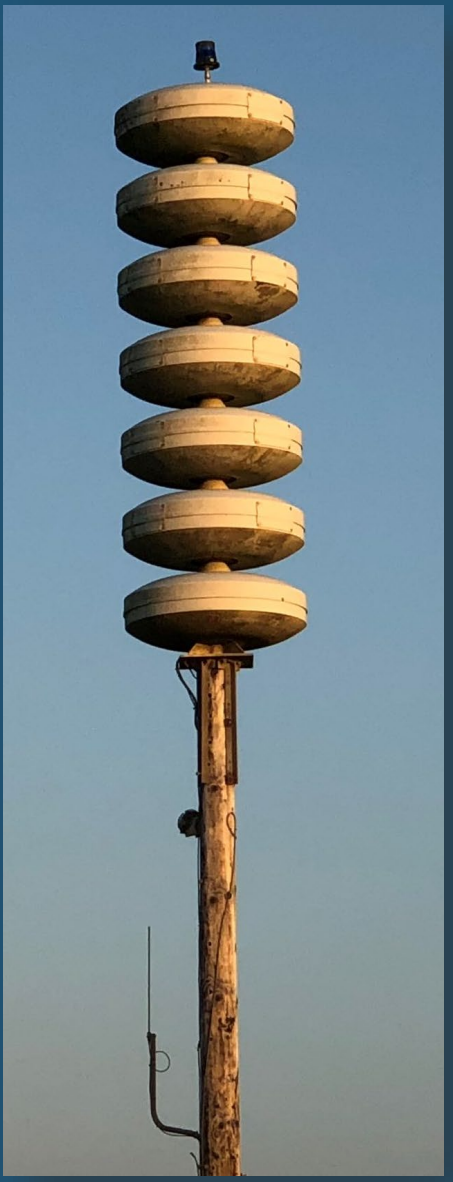
Tsunami Alert Levels

The National Tsunami Warning Center issues official tsunami alerts for Washington State. Check tsunami.gov for tsunami alert details.

⚠ ***WARNING***	Move inland to high ground!
⚠ ***ADVISORY***	Stay away from the shore.
⚠ ***WATCH***	Be prepared to take action.
ⓘ ***INFORMATION STATEMENT***	No action needed.

Alert Methods – AHAB Tsunami Sirens

- All Hazard Alert Broadcast (AHAB) sirens
- 120+ pole-mounted sirens along the outer and inner coasts of WA.
- For distant tsunami alerting; may not be functional or activated in time for a local tsunami.
- Approximate audio range of 1 mile depending on weather and physical barriers. For outdoor alerting purposes only.
- Programmed with voice messages in English and Spanish.
- Monitored and maintained by WA EMD in conjunction with local jurisdictions.
- WA EMD has the responsibility to activate the siren network when WA is under a tsunami warning. Local jurisdictions have the authority to activate their own sirens for lower tsunami alert levels or other hazards as desired.

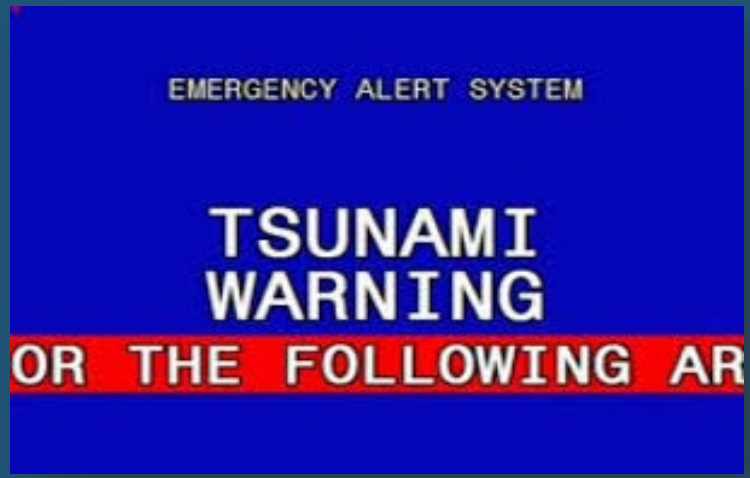


Alert Methods – WEA & EAS

Wireless Emergency Alerts (WEA):

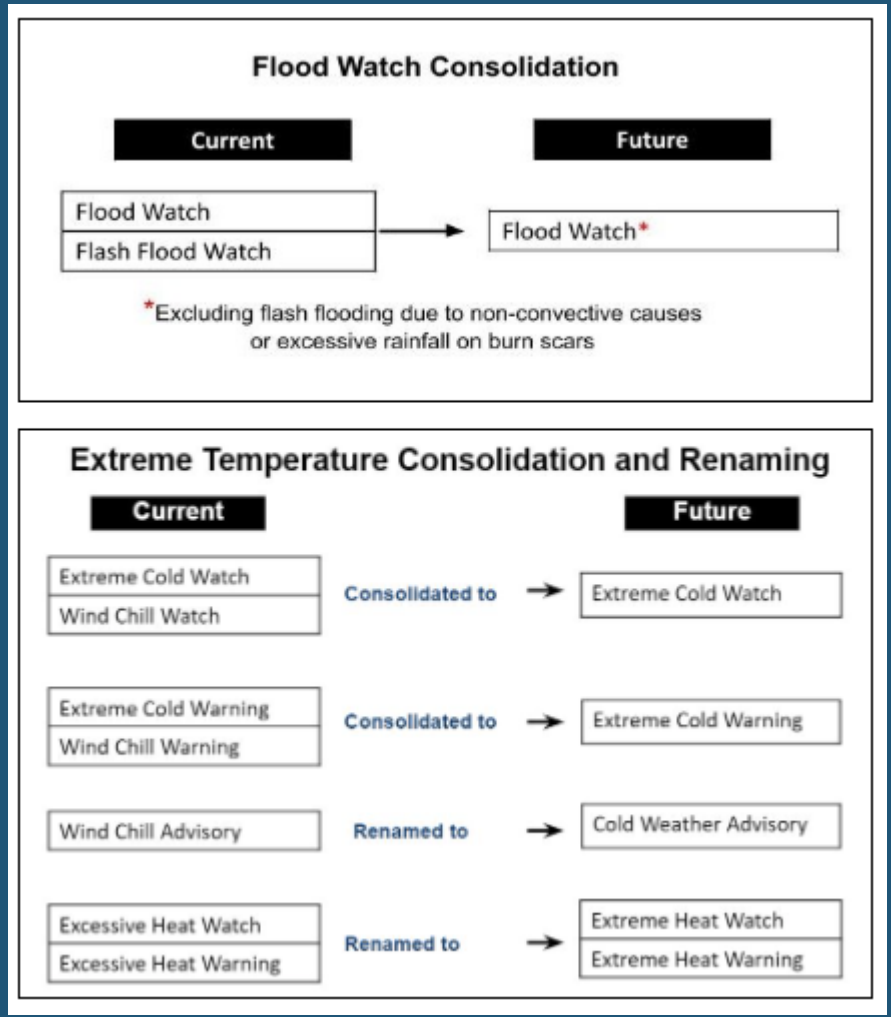
- Authorized authorities send alerts to participating wireless carriers, which then push the alerts to mobile devices in the affected area.
- NTWC will send WEA messages on first issuance of a tsunami warning, including an upgrade to a warning from watch or advisory.
- Only the first tsunami warning in a specific area will activate WEA and only one message will be sent. Tsunami warning continuation or cancellation messages will not activate WEA.

- Emergency Alert System (EAS):
  - Sends alerts via broadcast, cable, satellite, and wireline communication pathways; messages are transmitted primarily via terrestrial and satellite radio and television.



NWS Hazard Simplification "Deep Dive"

- After a decade of social science research through their Hazard Simplification efforts, NWS came to a decision to remove the term "Advisory" from their products
- NTHMP members pushed back on the decision because
  1. the work did not directly reference tsunami hazards **and**
  2. significant work has gone into educating the public and drafting procedures around the current alert levels
- Washington was in the best position to lead the efforts for this project on behalf of NTHMP partners
  - Created Tsunami Alerting and Response Timeline
  - Available grant funding to hire another position to manage the project



Laying the Foundation

- M7.9 earthquake off the coast of AK - Jan 2018
- Put WA under a “Tsunami Watch” while BC was under a “Tsunami Warning”

Tsunami Warning in Effect for;

* **BRITISH COLUMBIA,** The Juan de Fuca Strait coast, the outer west coast of Vancouver Island, the central coast and northeast Vancouver Island, and the north coast and Haida Gwaii

* SOUTHEAST ALASKA, The inner and outer coast from The BC/Alaska Border to Cape Fairweather, Alaska (80 miles SE of Yakutat)

* SOUTH ALASKA AND THE ALASKA PENINSULA, Pacific coasts from Cape Fairweather, Alaska (80 miles SE of Yakutat) to Unimak Pass, Alaska (80 miles NE of Unalaska)

* ALEUTIAN ISLANDS, Unimak Pass, Alaska (80 miles NE of Unalaska) to Attu, Alaska including the Pribilof Islands

Tsunami Watch in Effect for;

* CALIFORNIA, The coast from The Cal./Mexico Border to The Oregon/Cal. Border including San Francisco Bay

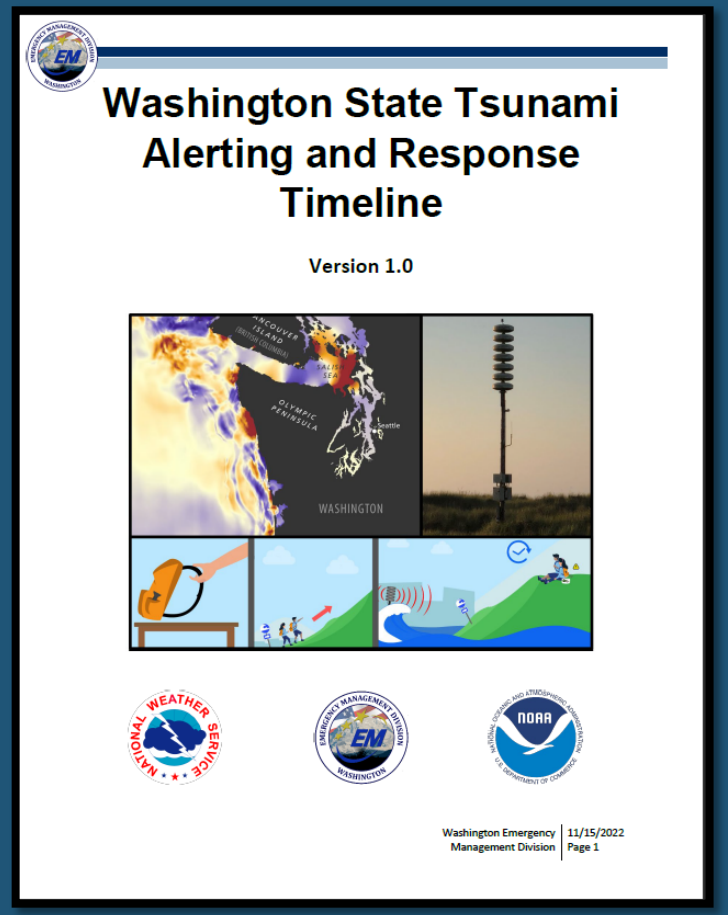
* OREGON, The coast from The Oregon/Cal. Border to The Oregon/Wash. Border including the Columbia River estuary coast

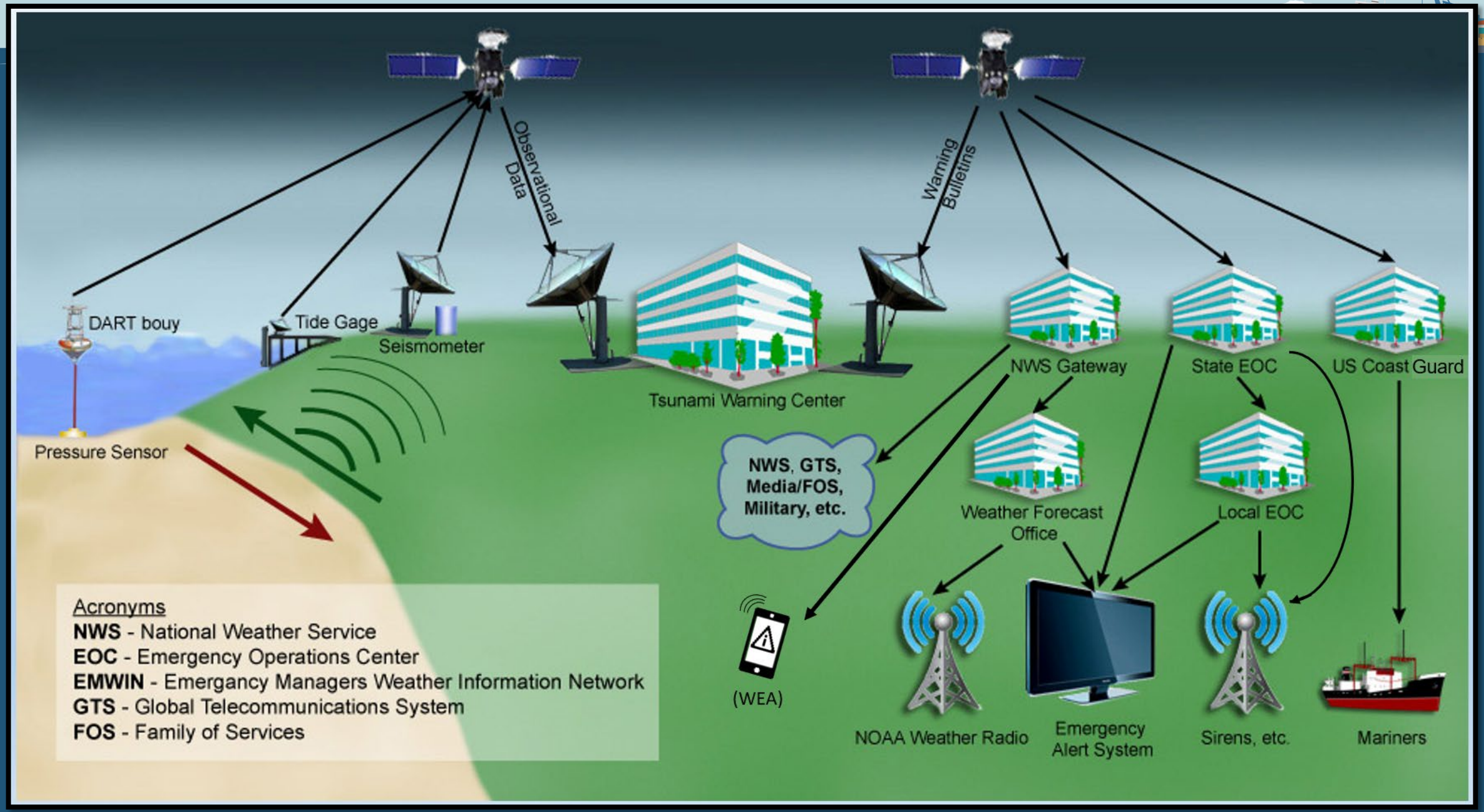
* **WASHINGTON,** Outer coast from the Oregon/Washington border to Slip Point, Columbia River estuary coast, and the Juan de Fuca Strait coast

What is going on here?

WA State Tsunami Alerting & Response Timeline

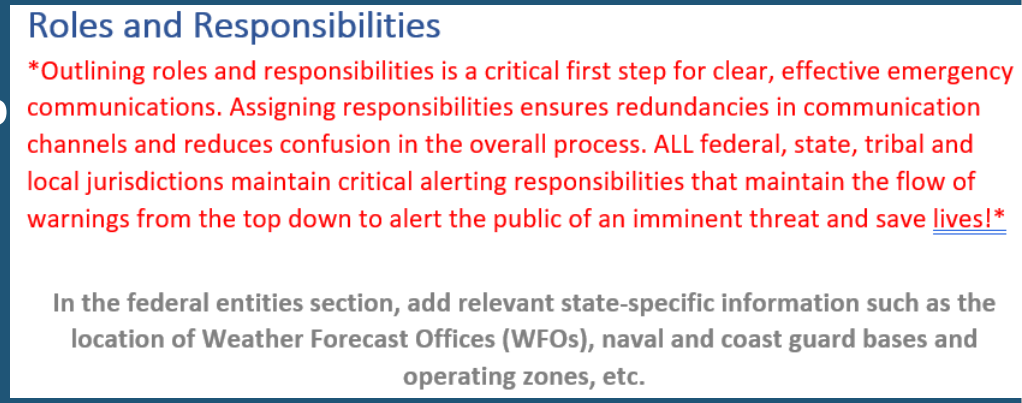
- *"The purpose of this document is to provide a basic understanding of the flow of information and actions taken during a tsunami on the federal, state, tribal, and local levels in Washington State"*
- Built over several years of partner engagement, workshops, exercising, and real-world incidents
- Timeline is a **living** document
- Comprehensive, **includes all key SOPs and alerting and communication steps/procedures at all levels** with all key stakeholders (as available)
- **Assists in aligning tsunami response and alerting across partner agencies** and highlighting existing gaps to address
- Intended to complement, not supersede or replace, partner-specific SOPs and other response documents
- **For key partners and stakeholders**, NOT the public




Observational Data
Warning Bulletins
DART bouy
Tide Gage
Seismometer
Pressure Sensor
Tsunami Warning Center
NWS Gateway
State EOC
US Coast Guard
NWS, GTS, Media/FOS, Military, etc.
Weather Forecast Office
Local EOC
(WEA)
NOAA Weather Radio
Emergency Alert System
Sirens, etc.
Mariners
Acronyms
NWS - National Weather Service
EOC - Emergency Operations Center
EMWIN - Emergancy Managers Weather Information Network
GTS - Global Telecommunications System
FOS - Family of Services

Alerting & Response Timeline Template

- **We have assembled a skeleton version of WA's Alerting and Response Timeline** to help guide efforts in documenting alert and warning procedures and processes
- **This template will help in many ways:**
  - Prompt users to **input specific state, territory, and local info**
  - Guide information gathering process
  - **Maintain relevant information and examples**
  - Provide **guidance on structure, style, and example graphics**
- **Template addresses all major sections** from WA example
  - **Roles and Responsibilities** (Federal, State/Territory, and Local and Tribal)
  - **Alerting** (Responsibilities, Methods, Graphics, Siren Networks)
  - Detailed **step-by-step processes**
  - Additional information and **graphics (SOPs, maps, canned messaging, etc.)**



Roles and Responsibilities

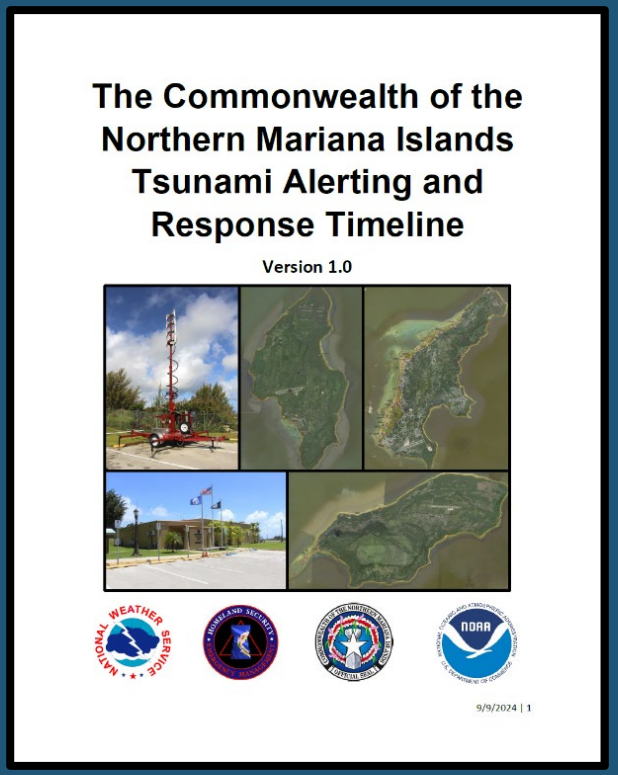
Outlining roles and responsibilities is a critical first step for clear, effective emergency communications. Assigning responsibilities ensures redundancies in communication channels and reduces confusion in the overall process. ALL federal, state, tribal and local jurisdictions maintain critical alerting responsibilities that maintain the flow of warnings from the top down to alert the public of an imminent threat and save lives!

In the federal entities section, add relevant state-specific information such as the location of Weather Forecast Offices (WFOs), naval and coast guard bases and operating zones, etc.

Tsunami Alerting Deep Dive Phase 1 - TARTs

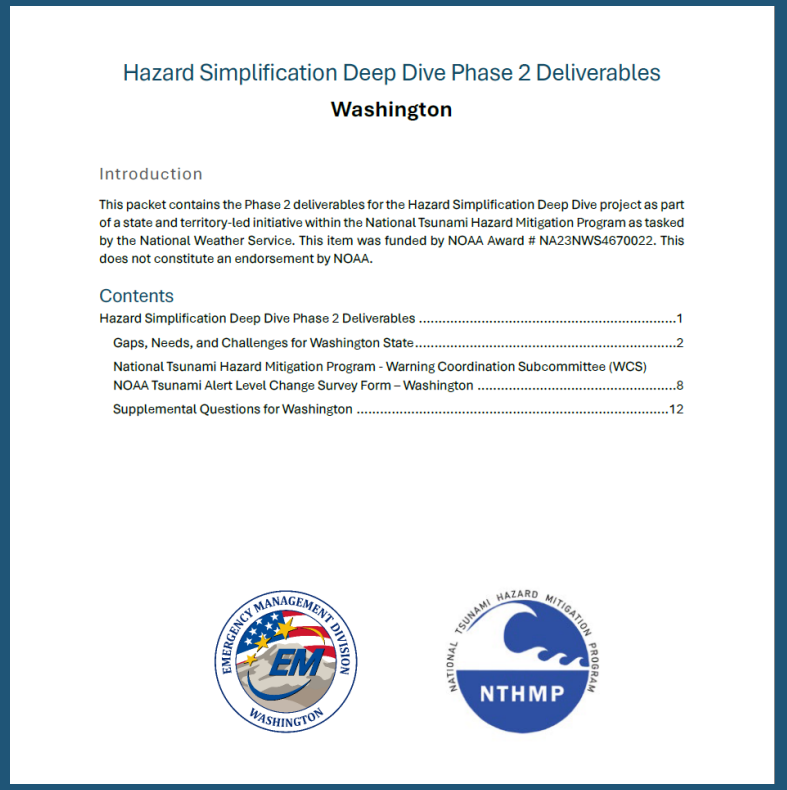
- **Goal of Phase 1** is to document a **detailed top-down step-by-step timeline** covering alert dissemination processes, procedures, and products within each state and territory with a tsunami risk

- **Results of Phase 1**
  - 6 states and territories have successfully created their own Tsunami Alerting and Response Timelines (60% of participating partners)
    - American Samoa, California, CNMI, Guam, Puerto Rico, and Washington (with USVI close to completion)
  - Others provided planning documents or other procedures



Deep Dive Phase 2 – Gaps, Needs, and Challenges

- Identify tsunami alerting and communication gaps, needs, and challenges using the timelines as a foundational reference
  - Gaps – what is currently missing from your products and services at the state/territory and local level?
  - Needs – what do you specifically need to help fill the gap?
  - Challenges – what barriers or obstacles interfere with obtaining the needs and completing projects?
- Document the impacts of an alert level change for the states and territories
- Results:
  - All state and territory partners participated and documented their respective tsunami alerting and communication Gaps, Needs, and Challenges for their tsunami programs



Hazard Simplification Deep Dive Phase 2 Deliverables

Washington

Introduction

This packet contains the Phase 2 deliverables for the Hazard Simplification Deep Dive project as part of a state and territory-led initiative within the National Tsunami Hazard Mitigation Program as tasked by the National Weather Service. This item was funded by NOAA Award # NA23NWS4670022. This does not constitute an endorsement by NOAA.

Contents

Washington's Gaps, Needs, and Challenges

- Gap 1: Lack ability to accurately forecast and alert all at-risk communities
  - Need: Develop 2-pager bulletin summary document for EM partners
  - Need: Additional forecast points for Seattle, Everett, and possibly Bremerton

Long Beach	2030	PDT May 23	9 hrs	0.8- 1.6 ft
La Push	2040	PDT May 23		
Westport	2045	PDT May 23	9 hrs	0.8- 1.6 ft
Neah Bay	2045	PDT May 23		less than 1ft
Moclips	2050	PDT May 23	15 hrs	1.1- 2.0 ft
Port Angeles	2125	PDT May 23		less than 1ft
Port Townsend	2150	PDT May 23		less than 1ft
Bellingham	2220	PDT May 23		less than 1ft
Tacoma	2305	PDT May 23		

BULLETIN
Public Tsunami Message Number 1
NWS National Tsunami Warning Center Palmer AK
1235 AM AKST Tue Jan 23 2018

...A TSUNAMI WARNING IS NOW IN EFFECT...

...A TSUNAMI WATCH IS NOW IN EFFECT...

Tsunami Warning in Effect for;

* BRITISH COLUMBIA, The Juan de Fuca Strait coast, the outer west coast of Vancouver Island, the central coast and northeast Vancouver Island, and the north coast and Haida Gwaii

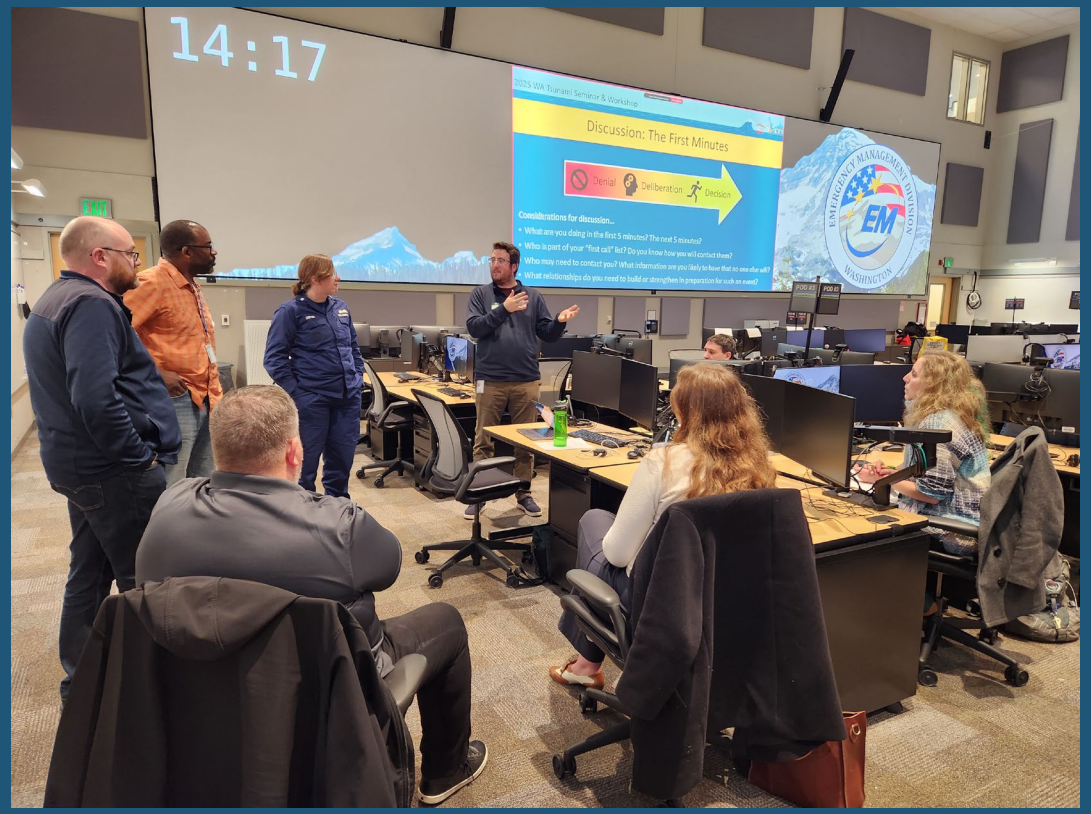
* SOUTHEAST ALASKA, The inner and outer coast from The BC/Alaska Border to Cape Fairweather, Alaska (80 miles SE of Yakutat)

* SOUTH ALASKA AND THE ALASKA PENINSULA, Pacific coasts from Cape Fairweather, Alaska (80 miles SE of Yakutat) to Unimak Pass, Alaska (80 miles NE of Unalaska)

* ALEUTIAN ISLANDS, Unimak Pass, Alaska (80 miles NE of Unalaska) to Attu, Alaska including the Pribilof Islands

Washington's Gaps, Needs, and Challenges

- Gap 2: Formally documented tsunami alerting and response procedures
  - Need: Federal, Tribal, State, and Local partners develop, exercise, and share formally documented tsunami SOPs and response plans

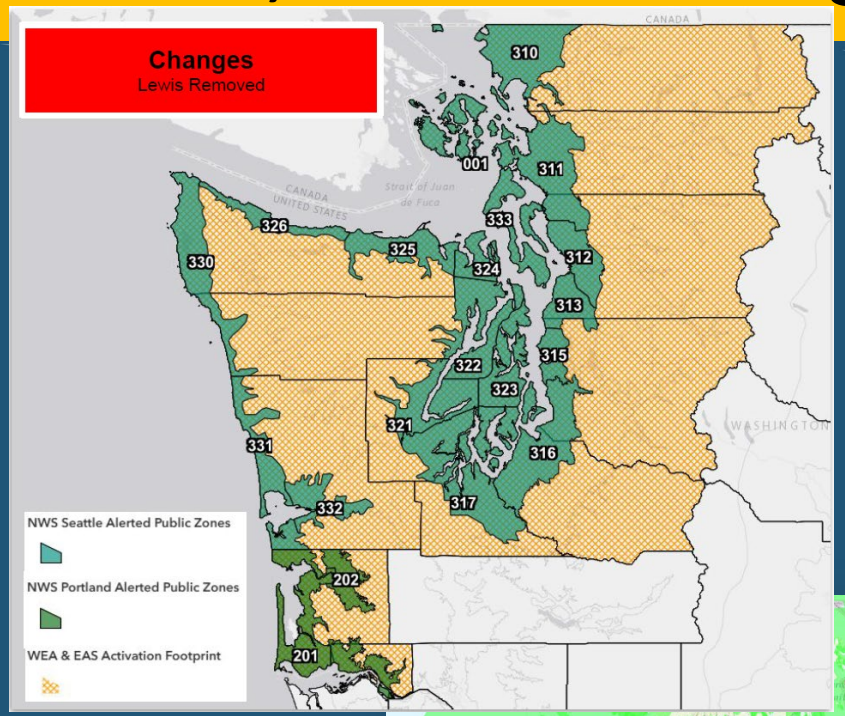


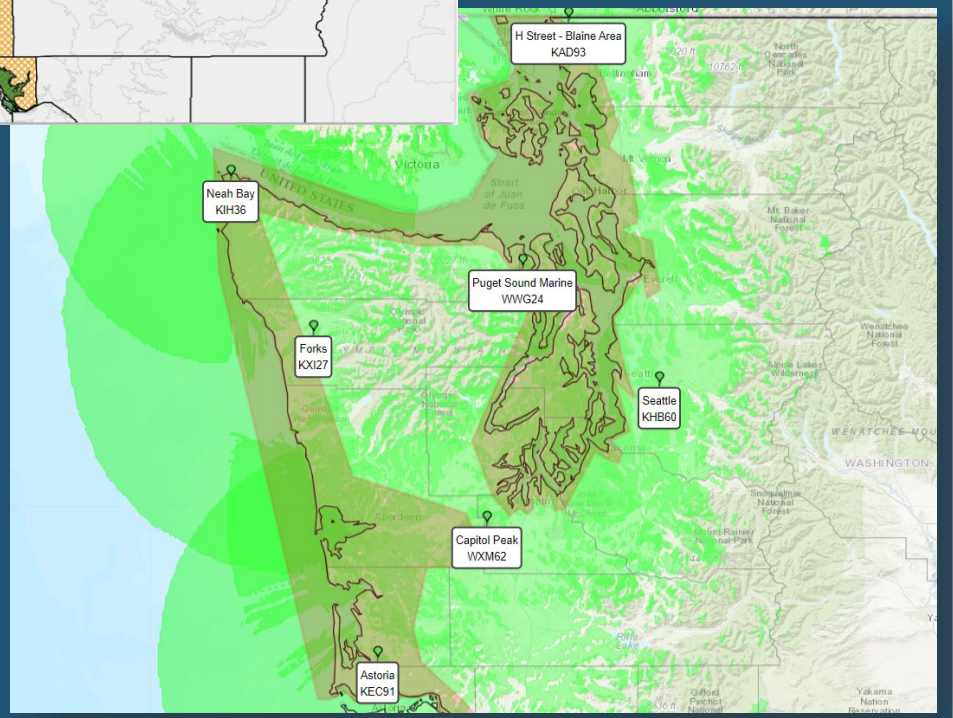
Washington's Gaps, Needs, and Challenges

- Gap 3: Single points of failure for tsunami siren maintenance with aging bucket truck and single FTE Emergency Alerting Systems Technician
  - Need: A new bucket truck for siren maintenance (We got one!)
  - Need: Complete installation of emergency lighting on all sirens for the deaf and hard of hearing, and cellular routers on all sirens as applicable

Washington's Gaps, Needs, and Challenges

- Gap 4: Effectively communicating and disseminating alerts to the intended audiences
  - Need: Implementation by NWS of tsunami alerting polygons for WEA/EAS submitted by WA EMD to fix the issue of over-alerting
    - Alternatively, shifting alerting footprint from FIPS codes to match NWS Coastal Public Alert Zones
  - Need: Additional NOAA weather radios and other tools to improve alerting at the local level





Impacts of an Alert Level Change for Washington

- What needs to be changed
  - Policies and procedures at the state and local level – Tsunami Alerting and Response Timeline, SOPs, siren procedures, other guidance documents, etc.
  - Educational outreach materials, such as our Boater's Guide, Tsunami Alert Level magnets, Tsunami 101 brochure
  - State website – mil.wa.gov/tsunami, mil.wa.gov/tsunami#resources
- Estimated Costs
  - $180,000 for implementation in addition to continued funding for FTEs for outreach to the public and stakeholder training
- Estimated Time
  - To ensure a successful transition (including funding), we've requested three years advance notice before the change goes into effect for implementation
  - Minimum two years once the change goes into effect for saturation among critical partners and the public

Deep Dive Phase 3 – What are we doing about it?

- Deliverable: Analysis of Gaps, Needs, and Challenges and Implementation Strategy.
- We are working directly with the other states and territories and representatives from the TWCs via the Warning Coordination Subcommittee of the NTHMP on Phase 3
- Sharing the impacts of an alert level change across all states and territories
  - What are the financial and time impacts associated with an alert level change?
- Analyzing cross-cutting gaps and needs for all states and territories
- Utilizing the information from Phase 1 and 2 – we are developing an implementation strategy
  - What resources are needed?
  - How will we prioritize the gaps, needs, and challenges?
  - Who has the responsibility for the change?
  - What is a realistic projected timeline for completion?
  - How can we utilize the NTHMP to support and complete these projects?

Why We're at a Critical Juncture

- This project is one of three critical tsunami alerting efforts right now
- Tsunami Warning Center alignment
  - Shift to a Common Analytics System for initial analysis and to align their alerting processes and procedures
  - Reduces confusion – December 5th, 2024 CA/OR tsunami warning example
  - Ensures that they can effectively back each other up
  - Ongoing effort with expected completion a few years out
- NWS Social Science for tsunami alerting
  - A second round of social science specifically for tsunamis!
  - Engaged with federal, tribal, state, territory, and local governments on tsunami response and education efforts
  - Results expected later this year barring any unforeseen changes
- These efforts combined with the results of the project create a tremendous opportunity to improve tsunami alerting services and products for the state of Washington and help align our alerting efforts with our state and territory partners

What it Boils Down to

- Improving the tsunami alerting process comes down to a few themes:
  - Improvements in existing tsunami alerting technologies – ensuring that we can disseminate alerts to the right people in the right area at the right time.
  - Expansion and use of templates, job aids, and other resources for utilization at the state, tribal, and local levels.
  - Continued collaboration over time with critical partners
    - NTHMP (via subcommittee work, Pacifex)
    - NWS
    - Other Tsunami Team projects - Maritime Response and Mitigation Strategies, updates to our TART, updating our A&WC SOPs and Everbridge process, etc.
    - Educating the public through presentations and outreach events
- Ensuring people receive tsunami alerts is the critical first step towards protecting our people, property, and environment across the state!

Connect to other hazards and next steps

- **How could this project relate to a hazard that impacts your jurisdiction?**
- Lahar
  - Do you know who is responsible for disseminating alerts and sharing information when a lahar is detected?
  - Do you know how you will receive those alerts and further disseminate the message?
- Wildfire
  - Do you have redundant systems in place to effectively alert at-risk populations?
  - What gaps in alert dissemination consistently arise for wildfire trainings and events?
- Severe storms
  - Could your jurisdiction establish a similar timeline for the lead-up of communications for a severe storm?
- Any other hazards I may have missed that have rapid-onset, rely on extensive alert dissemination processes or forecasting services from another agency?

The Barrier to Ensuring Improvements

- NOAA plans to terminate the Tsunami Program at the end of August
  - Listed on p. 27 of the FY25 Congressional Justification and on p. 58 of the FY25 Blue book
- The National Tsunami Hazard Mitigation Program funds all state and territory tsunami programs including myself and two other FTEs at EMD
  - Yet, the NTHMP costs about 4 cents per taxpayer per year
- A few of the services we've provided and continue to support:
  - Statewide Tsunami Hazus Runs
  - Tsunami Wayfinding Project
  - Tsunami Maritime Response and Mitigation Strats
  - Tsunami Vertical Evacuation Structure Manual
  - Managing state-level tsunami response
  - Community presentations and outreach events
  - Mapping and modeling tsunami hazards

Thank you!

mil.wa.gov/tsunami

mil.wa.gov/alerts

Questions?

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